



7TH INTERNATIONAL ANATOLIAN AGRICULTURE FOOD, ENVIRONMENT AND BIOLOGY CONGRESS

On behalf of Prof. Dr. Şaban KARATAŞ

26-29 SEPTEMBER 2024 KASTAMONU, TÜRKİYE

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PREFACE

Dear Colleagues...

The " 7th International Anatolian Agriculture, Food, Environment and Biology Congress (TARGID 2024) " has been held in Kastamonu/Turkey on 26-29 September 2024, with the participation of scientists working in agriculture and related sciences, with the aim of sharing scientific developments, proposing scientific solutions to international problems, increasing cooperation and creating scientific outputs that will benefit humanity by using international resources economically.

210 papers from 24 countries were presented to our congress. 109 of these papers came from foreign countries and 101 came from Türkiye. The countries of the participants who sent papers to the congress and the number of incoming articles are as follows; Afghanistan (1), Algeria (22), Bangladesh (9), Burundi (1), Chad (1), Ethiopia (1), Hungary (1), India (3), Indonesia (3), Iran (1), Libya (1), Nepal (2), Nigeria (21), Pakistan (27), Philippines (1), Rwanda (2), Serbia (1), Sri Lanka (2), Sudan (5), Uganda (1), Ukraine (1), United States (1), Vietnam (1) ve Türkiye (101). The rate of international papers is 53% (more than one paper by the same author was received as one; $(100*101/(101+90))= 53\%$).

At the congress; participants discussed such topics as animal production, crop production, aquaculture, food science and technologies, agricultural technologies, soil science, sustainable agricultural systems, agricultural economics, genetics, biology, agricultural ecology, landscape architecture and agricultural environment issues related to original, advanced technology on agriculture and natural life.

During the organization and congress phase of the congress; Dr. Burak Şen, Dr. Mustafa Duman, Dr. Kadir Erensoy, Dr. Brian Tainika, Dr. Myrzhiyeva Assem, Dr. Ahmet Uçar, Ahmet Akyol, Furkan Baş, Ali Kaan Yetik, Muhammet Talha İnce and Dilek Yaprak Uslu and Mehmet Yetişen took on important duties in the congress secretariat.

We would like to express our gratitude to all our stakeholders who supported the successful realization of our congress and all the scientists who participated and supported us with their papers.

Kind regards





ÖNSÖZ

Sayın Meslektaşlarımız...

Tarım ve ilgili bilim dallarında çalışan bilim insanlarının katılımıyla, bilimsel gelişmeleri paylaştıkları, uluslararası sorunlara bilimsel çözümler önermek, iş birliklerini artırarak uluslararası kaynakların ekonomik kullanılmasıyla insanlığın yararına olacak bilimsel çıktıların oluşturulması amacıyla, 26-29 Eylül 2024 tarihinde Kastamonu/Türkiye’de “7. Uluslararası Anadolu Tarım, Gıda, Çevre ve Biyoloji Kongresi (TARGID 2024)” gerçekleştirilmiştir.

Kongremize 24 ülkeden 210 bildiri sunulmuştur. Bu bildirilerin 109'u yurt dışından, 101'i ise Türkiye'den gelmiştir. Kongreye bildiri gönderen katılımcıların ülkeleri ve gelen makale sayıları şu şekildedir; Afganistan (1), Cezayir (22), Bangladeş (9), Burundi (1), Çad (1), Etiyopya (1), Macaristan (1), Hindistan (3), Endonezya (3), İran (1), Libya (1), Nepal (2), Nijerya (21), Pakistan (27), Filipinler (1), Ruanda (2), Sırbistan (1), Sri Lanka (2), Sudan (5), Uganda (1), Ukrayna (1), Amerika Birleşik Devletleri (1), Vietnam (1) ve Türkiye (101). Yurtdışı bildiri oranı %53 ‘dir (aynı yazara ait birden fazla bildiriler tek olarak alınmıştır; $(100 \times 101 / (101 + 90)) = 53$).

Kongrede; tarım ve doğal hayat ile ilgili özgün ve ileri teknoloji ile ilgili; hayvansal üretim, bitkisel üretim, su ürünleri, gıda bilimi ve teknolojileri, tarım teknolojileri, toprak bilimi, sürdürülebilir tarım sistemleri, tarım ekonomisi, genetik, biyoloji, tarımsal ekoloji, peyzaj mimarlığı ve tarımsal çevre konuları katılımcılar tarafından tartışılmıştır.

Kongremizin düzenlenmesi ve kongre aşamasında; kongre sekretaryasında önemli görevler üstlenen Dr. Burak Şen, Dr. Emre Aksoy, Dr. Mustafa Duman, Dr. Kadir Erensoy, Ahmet Akyol, Furkan Baş, Ali Kaan Yetik, Brian Tainika ve Muhammet Talha İnce, kongre organizasyonunu üstlenmişlerdir.

Kongremizin başarılı bir şekilde gerçekleştirilmesinde desteklerini esirgemeyen tüm paydaşlarımıza ve bildirileri ile katılarak destek veren tüm bilim insanlarına teşekkürü bir borç biliriz.

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Yayın Ve Düzenlemede Görevlendirilmiş Akademisyen Temsilci

26-29 Eylül 2024 tarihinde Kastamonu/Türkiye’de “7. Uluslararası Tarım, Gıda, Çevre ve Biyoloji Kongresi (TARGID 2024)” gerçekleştirilmesinde, Niğde Ömer Halisdemir Üniversitesi Rektörlüğü’nün 14/06/2024 Tarih E-87795264-903.07-519278 sayılı ve Sivas Cumhuriyet Üniversitesi Rektörlüğü’nün 06.09.2024 tarihli ve E-15097355-100-465628 sayılı olurları ile aşağıda isimleri verilen akademisyenlere *yayın ve düzenlemede akademik temsilci* olarak yer almalarına izin verilmiştir.

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Arş.Gör. Muhammet Talha İnce





ULUSLAR ARASI KONGRE ÖZELLİKLERİ

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2. Yurt dışından katılım sağlanan ülkeler ve bidiri sayıları

Ülke	Bidiri sayısı
Afganistan	1
Algeria	22
Bangladesh	9
Burundi	1
Chad	1
Ethiopia	1
Hungary	1
India	3
Indonesia	3
Iran	1
Libya	1
Nepal	2
Nigeria	21
Pakistan	27
Philippines	1
Rwanda	2
Serbia	1
Sri Lanka	2
Sudan	5
Uganda	1
Ukraine	1
United States	1
Vietnam	1
Türkiye	101

3. Yurt dışı katılım oranı

Ülke	Bidiri sayısı (birden fazla bildiriyle katılım)
Yurt dışı	101 (109)
Yurt içi	90 (101)
C %53 Yurt Dışı; %47 Türkiye	

Yukarıda verilen bilgiler çerçevesinde, 26-29 Eylül 2024 tarihinde Kastamonu/Türkiye’de “ 7. Uluslararası Tarım, Gıda, Çevre ve Biyoloji Kongresi (TARGID 2024) ”, uluslararası kongre niteliği taşımakta, akademik teşvik kriterleri ve UAK Doçentlik başvuru koşullarını sağlamıştır.





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ID: 300

Antidiabetic Activity of *Fraxinus xanthoxyloides* Bark Extract in Alloxan-induced Diabetic Rats

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Abstract

Fraxinus xanthoxyloides Wall. ex DC is a small tree of dry hills present in Northern parts of Pakistan. Leave, stem and bark of *F. xanthoxyloides* are used locally for the treatment of jaundice, malaria and pneumonia, internal injuries, rheumatism and bone fracture. *In vitro* and *in vivo* anti-diabetic activity of *F. xanthoxyloides* bark was explored for the first time, considering it a potential source of drug candidate. Powder of *F. xanthoxyloides* stem bark was extracted with methanol to obtain the crude extract and resultant was fractionated with solvents in escalating polarity. The evaporation of respective solvents was done and extract/fractions were dried and stored at 4°C for further investigation. Among all the extract/fractions, n-hexane fraction (FXBH) showed the powerful inhibition of α -amylase ($IC_{50} = 33.38 \mu\text{g/ml}$) comparable to the Acarbose ($35.8 \mu\text{g/ml}$) as well as powerful inhibition of α -glucosidase ($IC_{50} = 245.6 \mu\text{g/ml}$) comparable to Acarbose ($12.53 \mu\text{g/ml}$). HPLC-DAD analysis of FXBH showed the presence of Gallic acid, Catechin, Caffeic acid, Ferulic acid and Quercetin. *In vivo* antidiabetic potential of FXBH extract was evaluated through a trial of 15 days on Sprague Dawley rats. Biochemical parameters like serum Triglyceride, Low-density lipoprotein, Cholesterol, Lipase, Amylase, Alanine aminotransferase, Aspartate aminotransferase, Creatinine, Urea and C-reactive protein levels were decreased along with HBAIC while serum High-density lipoprotein was increased in rats treated with FXBH when compared to diabetic control. Histopathological analysis of pancreas of rats demonstrated the restoration of beta cells. In conclusion, *F. xanthoxyloides* bark has clinical potential for the treatment of diabetic diseases.

Key Words: *Fraxinus xanthoxyloides*, Alpha amylase, Alpha glucosidase, Alloxan Monohydrate, Histopathology





ID: 301

Growth Characteristic and Condition Factor Of Red Tilapia (*Oreochromis.sp*) Reared In Jijel Farms, Algeria

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Abstract

The present study describes characteristics of growth and condition factor of Red Tilapia reared in the Jijel fish farm, in Algeria. This study was carried out from September 2022 to Juin 2023, the Total lengths measured was ranged from 15cm to 23cm while total weight varying from 38 g to 120g , the relationship was calculated using the equation $P = a.LF^b$ and the condition factor using the equation $K = (100 P / LF)$. The value of the allometry coefficient was 1.6. These allometry coefficients was significantly different from the standard value of 3 ($p < 0.05$), reflecting a minor allometry in red tilapia species, this is mean that fish grows faster than it gets fatter. Also, the correlation coefficient of 0.70 indicates a strong correlation between the weight and the size of the fish. Additionally, The condition factor varies from 0.38 to 0.48 in males and from 0.42 to 0.72 in females. These results provide a database on the length-weight relationship and condition coefficient of the red tilapia species in Jijel fish farm.

Key Words: Length-weight, K-factor, Allometry growth, Red tilapia





ID: 302

Ethnobotanical Study And Inventory Of Medicinal Plants Used To Treat Children In Algeria

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Abstract

Medicinal plants have a long history of use in therapy, and are an important part of traditional medicine. As Algeria's flora is very rich and diverse, phytotherapy is considered to be particularly attractive in Algeria. Although the use of traditional herbal medicine in adults is very widespread, it has not been well documented in the paediatric population. Hence the importance of this study, that aims to identify the medicinal plants used in paediatric pathologies, and to assess the way in which they are used and their relative importance in the Algerian population. Ethnobotanical surveys were carried out using 2000 questionnaires. The results showed that 66.25% of users were women and only 33.75% were men. For 50% of informants, the use of medicinal plants was ancestral knowledge. In 30.25% of cases, the pathologies treated were gastric troubles, and (24.4%) respiratory ones. The survey identified 136 species belonging to 62 botanical families, the most represented being *Lamiaceae*, *Asteraceae*, *Apiaceae* and *Fabaceae*. The leaf was the most commonly used part of the plant (34%). The most common method of preparation was decoction (37%), which was mainly administered orally (79%). The dosage used was random (95%) and for a short period (77%). Allergies seemed to be the most common undesirable effect of using certain plants by children. 87% of the informants used herbal medicine exclusively, without any combination with other medicinal treatments. The PCA showed strong correlations between the different regions of the country, with regard to the use of certain medicinal plants. This work could serve as a basis for further pharmacological studies, aiming to assess the therapeutic efficacy and safety of plants used by children in Algeria.

Key Words: *Ethnobotany, Paediatric Population, Medicinal Plants, Pharmacology, Algeria*





ID: 304

Comparative Study between Two Wastewater Treatment Systems: a Wastewater Treatment Plant (WWTP) and a Lagoon Station

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Abstract

Water resource pollution is a major global issue primarily caused by human activities. To mitigate this pollution and preserve our water resources, purification systems have been developed. This study compares the efficiency of biological treatment of wastewater between a Wastewater treatment plant (WWTP) in Sidi Marouane and a lagoon station in Boughrara Saoudi. The aim is to analyze the performance of both systems for various physicochemical parameters (temperature, pH, BOD5, COD, nitrate, nitrite, phosphorus, etc.) and microbiological parameters (fecal coliforms, total coliforms, fecal streptococci, etc.). The results demonstrate that biological treatment at the outlet of the WWTP is more effective than that of the lagoon station in reducing pollutant levels. However, some parameters do not comply with reuse and environmental preservation standards. DBO5 and COD values exceed Algerian standards, as does the microbiological load. It is concluded that the natural lagoon system alone is insufficient to produce purified water suitable for agricultural reuse or environmental preservation. The addition of planted filter beds or sand and gravel beds downstream of the natural lagoon is recommended to improve water purification. Despite these challenges, both biological treatment systems remain effective solutions for pollution control, although the WWTP is generally more satisfactory and cost-effective than the lagoon station. In conclusion, this study emphasizes the importance of selecting appropriate purification technologies to ensure compliance with environmental standards and the reuse of wastewater.

Key Words: Biological treatment, wastewater, wastewater treatment plant (WWTP), Lagoon station, Algeria





ID: 306

Drug Resistance Patterns Of Some *Enterobacteriaceae* Isolated From Chicken In The West Of Algeria

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Abstract

Antibiotic-resistant bacteria may arise and proliferate as a result of the overuse of antibiotics in the chicken business. Antibiotics may be less effective in treating human illnesses if humans eat chicken products that include antibiotic-resistant bacteria or their genes. Determining the antimicrobial resistance (AMR) patterns of *E. coli* isolates obtained from poultry in different regions of the west of Algeria, is the goal of the current investigation. In order to isolate *E. coli*, samples from chicken (kidney, bones, and intestines) were gathered and prepared for culture using conventional microbiological techniques. While isolated *E. coli* was typed for O1, O2, and O78 antigens using slide agglutination with certain antisera, isolates were identified biochemically using API 20E. In accordance with CLSI guidelines, all isolates were identified and analyzed using the Kirby Bauer disk diffusion technique against 26 antibiotic disks. To find transferable resistance characteristics in 75 carefully chosen *E. coli* isolates, conjugative plasmid transfer, plasmid incompatibility, and colicin assays were employed. A total of 150 distinct species of *E. coli* were isolated. Fifty two agglutinable *E. coli* isolates with O78:K80 (n = 28), O1:K1 (n = 15), and O2:K1 (n = 9) were found using serotyping. *E. coli* resistance to nalidixic acid (95.6%), tetracycline (79.2%), streptomycin (73.5%), nitrofurantoin (71.4%), ampicillin (53.6%), ticarcillin (39.7%), piperacillin (37.9%), and chloramphenicol (21.3%) was highly prevalent when it came to antibiotic susceptibility. *Salmonella* present a resistance of 59.62% to nalidixic acid, ofloxacin and ciprofloxacin and 29.54% to streptomycin. The *Klebsiella* species shows no resistance for gentamicin, amikacin and kanamycin, but 73% ciprofloxacin 48% ofloxacin, and a total resistance to ampicillin and tetracycline. All the *Enterobacter* isolated were resistant to ampicillin, ceftiofur and cefazolin, however no resistance was observed for gentamicin, amikacin and kanamycin. Multidrug resistance, or resistance to more than four antibiotic classes, was present in 81.8% of the isolates. The predominant plasmid-mediated resistance markers in 75 *E. coli* isolates, as determined by conjugative transfer, are ASTeSuTnp (25.8%) and SSuTnp (13.6%). Regarding the clustering of plasmids only 9 plasmids were not grouped out of the 67 tested (Com1 and F1). The colicin test shows that 5 transconjugants were colicin positive, these results let us suppose that colicin production and antibiotic resistance are two characters carried by the same plasmid structures. This work demonstrates that these antibiotic resistance characteristics may be easily transferred by plasmids, which has important health consequences for humans. It also confirms that meat chicken in the western region of Algeria has multidrug resistance *E. coli*.

Key Words: Chicken, *Enterobacteriaceae*, multidrug resistance, plasmid, colicin





ID: 308

Anti-inflammatory and Gastroprotective Activity of Sigoise Olive Leaves Extracts from Algeria: *In vivo* and *In silico* Evidence

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Abstract

The number of inflammatory diseases and gastric pathologies is continuously increasing, secondary effects of synthetic drugs have led researchers to focus on compounds of vegetable origin, of which olive leaves are part. In this context our study aims to evaluate some biological activities (anti-inflammatory and gastroprotective) of Algerian Sigoise extracts of olive leaves *in vivo* and *in silico* using molecular docking modeling. The anti-inflammatory activity of olive leaves extracts was highly significant, with an inhibition percentage of inflammation of 79%, close to that of the reference drug ibuprofen (82%). The *in silico* study showed a high affinity between oleocanthal , hydroxytyrosol and tyrosol of sigoise olive leafs with COX-2 where the recorded interaction energies were of the order of -7.1 kcal/mol, -4.9 kcal/mol and -3.4 kcal/mol respectively. These values are relatively close to that of ibuprofen (G = -8.2 kcal/mol). The interaction energy of COX-2 with its reference ligand SC-588 is equal to -10.1 kcal/mol, the lowest RMSD values (1.02) was recorded with oleocanthal. At the same way, olive leaves extract have a gastroprotective activity wich was manifested by the protection of rats stomachs against ethanol alterations. This was clearly demonstrated by ANAPATH, which showed that the tissues of the stomachs treated with the extracts were not ulcerated and was similaire to those treated with drugs and even those of controls.

Key Words: anti-inflammatory activity- Algerian origin - gastroprotective activity – sigoise olive leaves





Antioxidant And Antihemolytic Activities Of *Scilla maritima* Leaf Extracts

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Abstract

There is a growing interest in finding new plant-derived antioxidants that are safer than synthetic products. These natural antioxidants are recognized for their health benefits and can be used in food, cosmetic and pharmaceutical industries. The present study reports the evaluation of antioxidant and antihemolytic activities of leaf extracts (CrEL: crude extract, EaEL: ethyl acetate fraction and AqEL: aqueous fraction) from *Scilla maritima*, a medicinal plant widely used in the treatment of many diseases. Total polyphenols and flavonoids of different extracts were determined by Folin-Ciocalteu and Aluminum chloride colorimetric assays, and ranged from 44.3 to 166.48±5.89 EAG/g and 7.27 to 10.28 µg EQ/mg, respectively. The antioxidant activity of these extracts was performed using DPPH free radical scavenging, β-carotene bleaching, reducing power and ferrous ion chelating methods. Potent DPPH scavenging activity was exhibited by EaEL and AqEL (IC₅₀ of 10.98±0.23 and 46.93±1.44 µg/ml), and these fractions were either the most active in inhibition of β-carotene oxidation (89.83 and 80.88%). While, EaEL and CrEL displayed the greater reducing power (EC₅₀= 43.4±0.58 and 55.4±0.59 µg/ml) and CrEL showed the strong chelating activity (IC₅₀= 93.8±2.83 µg/ml). Finally, all extracts have significant potential in protecting red blood cells against free radicals. These results support the use of this species in traditional medicine and could be a potential source of natural antioxidants.

Key Words: antioxidant, hemolysis, flavonoids, polyphenols, *Scilla maritima*



ID: 310

Enumeration and Identification of *Lactobacillus* and *Bifidobacterium* Species Isolated from Probiotic Food Supplements and Their Antibiotic Resistance

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Abstract

This study aimed to evaluate the content of *Lactobacillus* spp. and *Bifidobacterium* spp. in ten probiotic food supplements, along with assessing the antibiotic resistance of isolated probiotic cultures. Thirteen isolates were identified to the species level using both phenotypic and molecular methods. Antibiotic resistance was determined using the disk diffusion method. Results indicated discrepancies between the labeled and actual viable bacterial counts, with two out of the ten products containing fewer viable bacteria than stated. Interestingly, none of the products labeled to contain monocultures of *Bifidobacterium* spp. actually contained bifidobacteria. Moreover, two products were found to be incompatible with the bacterial species claimed on their labels. Furthermore, all *Lactobacillus* and *Bifidobacterium* strains exhibited resistance to methicillin and vancomycin. *Lactobacillus* spp. strains showed resistance to cefazolin (37.5%) and ciprofloxacin (50%), while *Bifidobacterium* spp. strains were resistant to cefazolin (80%), clindamycin (20%), and ciprofloxacin (20%). These findings underscore the need for stringent quality control measures in the probiotic food supplement industry, particularly regarding bacterial content accuracy and monitoring antibiotic resistance. Further research is necessary to explore the implications of antibiotic resistance in probiotic strains and its potential impact on human health.

Key Words: Identification, Antibiotic Resistance, Probiotics, *Bifidobacterium* spp., *Lactobacillus* spp.

Probiyotik Gıda Takviyelerinden İzole Edilen *Lactobacillus* ve *Bifidobacterium* Türlerinin Sayımı, Tanımlanması ve Antibiyotik Dirençliliği

Özet

Bu çalışmada, on probiyotik gıda takviyesindeki *Lactobacillus* spp. ve *Bifidobacterium* spp. içeriğinin değerlendirilmesi ve izole edilmiş probiyotik kültürlerin antibiyotik dirençlilik düzeyinin saptanması amaçlandı. On üç izolat, fenotipik ve moleküler yöntemler kullanılarak tür düzeyinde tanımlandı. Antibiyotik dirençliliği disk difüzyon yöntemi kullanılarak belirlendi. Etiket bilgisi ile canlı sayım sonuçları arasında farklılıklar bulunduğu, on üründen ikisinde ise belirtilen sayıdan daha az canlı bakteri bulunduğu saptandı. *Bifidobacterium* spp. monokültürlerini içerdiği iddia edilen hiçbir üründe bifidobakteri bulunamadı. Ayrıca, etiketlerinde belirtilen bakteri türleri ile uyumsuz olan iki ürün tespit edildi. Tüm *Lactobacillus* ve *Bifidobacterium* suşlarının metisilin ve vankomisine dirençli olduğu görüldü. *Lactobacillus* spp. suşları, sefazoline (%37.5) ve siprofloksasine (%50); *Bifidobacterium* spp. suşları ise sefazoline (%80), klindamisinine (%20) ve siprofloksasine (%20) dirençli bulundu. Bu bulgular, probiyotik gıda takviyesi endüstrisinde sıkı kalite kontrol önlemlerine ihtiyacın olduğunu vurgulamaktadır. Probiyotik suşlardaki antibiyotik dirençlilik sonuçları ve insan sağlığına olası etkilerinin araştırılması için daha fazla çalışma yapılmasına ihtiyaç duyulmaktadır.

Anahtar Kelimeler: Tanımlama, Antibiyotik Direnci, Probiyotikler, *Bifidobacterium* spp., *Lactobacillus* spp.





ID: 311

Leveraging Microalgae Biomass For Eco-Friendly Biofertilizers: A Path Towards Greener Practices

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Abstract

In an era where the urgency to address environmental challenges looms large, the intersection of technology and nature offers promising solutions. Among the myriad issues facing humanity, the depletion of natural resources, climate change, and the burgeoning global population stand as formidable obstacles. However, amidst these challenges lies a beacon of hope in the form of microalgae, particularly the resilient *Chlorella* species. With their rapid growth rate and adaptability to harsh environments, *Chlorella* presents itself as a versatile candidate for addressing pressing concerns, particularly in the realm of food security. Rich in proteins, essential and non-essential amino acids, lipids, sugars, and vitamins, *Chlorella* biomass holds immense potential for revolutionizing the agricultural landscape. The fabrication of biofertilizers from nutrient-rich microalgal biomass signifies a paradigm shift towards sustainable practices. By harnessing the inherent fertility-enhancing properties of *Chlorella* and other microalgae, biofertilizers offer an eco-friendly alternative to conventional chemical fertilizers, thereby mitigating environmental degradation and promoting soil health. Bloom collected from Bird Lake (lac des oiseaux) in October 2022. *Chlorella sp* were isolated then cultured using BG11 medium in a culture room at $25 \pm 2^\circ\text{C}$ then we monitored the growth rate by cell counting using Malassez counting cell. Exponential growth is allowed, and after 25 days, a concentration of 8.6×10^5 cells/ml and 9.8×10^5 cells/ml respectively is reached. The culture is then harvested by centrifugation, and the biomass is freeze dried then preserved at -80°C until further analysis. *Chlorella* biomass in addition to other microalgae strains will be used for the fabrication of the agriculture fertilizer.

Key Words: Agriculture sustainability, Microalgae, *Chlorella sp*, Soil health, Crop productivity





Aquatic macrophyte as a natural factor for reducing cyanotoxins

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Abstract

Cyanobacteria are found in a wide variety of environments environments, both aquatic and terrestrial. They can be found in freshwater reservoirs, oceans, hot and cold springs and lakes. and lakes. Over the years, periodic blooms of cyanobacteria have been observed. However, with the with the recent increase in municipal and industrial waste production freshwater reservoirs have undergone eutrophication, characterized by an excessive accumulation of nutrients. This eutrophication has contributed to an increase in the frequency and extent of cyanobacterial proliferation. Certain strains of cyanobacteria, such as *M. aeruginosa*, produce toxins to which humans can be exposed through recreation, drinking water and food. The elimination of cyanobacteria and their toxins is a crucial approach approach to controlling harmful algae. Recently, macrophytes have been as promising tools for biological control of harmful cyanobacterial proliferation. They release metabolites, called allelochemicals, into water, and allelopathy has been proposed as one of the main one of the main mechanisms by which macrophytes control phytoplankton biomass and taxonomic composition in aquatic ecosystems. In our study, we used bioactive compounds extracted from the roots of *Nymphaea alba* to study their effect on the growth of *Microcystis* spp. The results suggest that the cell density of *Microcystis* spp. decreased compared with the control group, indicating that these compounds could be recommended as a remedy against contamination of water bodies by harmful blooms.

Key Words: *Microcystis* sp, *Nymphaea alba*, cyanobacteria, macrophytes, blooms





Phytoremediation of phytoplankton and their toxins

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Abstract

Harmful cyanobacterial blooms are a serious environmental concern in aquatic ecosystems worldwide. Eutrophication and climate change stand out as the primary factors driving the escalation and expansion of harmful blue-green algae blooms. The *Microcystis* genus is widely recognized as the predominant cyanobacteria responsible for forming harmful blooms. These blooms lead to substantial degradation of water quality, primarily through scum formation, toxin release, hypoxia, and the generation of unpleasant tastes and odors. In recent times, macrophytes have garnered significant attention as a novel reservoir of bioactive compounds and an effective alternative to traditional methods for controlling the growth of cyanobacteria. *In our study, we used bioactive compounds extracted from the roots of *Nymphaea alba* to study their effect on the growth of *Microcystis* spp.* The findings indicate a decrease in the cell density of *Microcystis* spp. compared to the control group, suggesting that these compounds could serve as a potential remedy for mitigating contamination of water bodies caused by harmful blooms.

Key Words: Harmful cyanobacterial blooms, *Nymphaea alba*, *Microcystis* spp, contamination, aquatic ecosystems





ID: 314

Synergistic anti-inflammatory activity of combination of shrimp shells derived chitosan with *Cynara cardunculus* var. *scolymus* (L.) polyphenols

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Abstract

Inflammation is a symptom associated with many diseases. This symptom is treated with steroidal and non-steroidal anti-inflammatory drugs, which can cause severe side effects when used as long-term treatments. Natural products are an alternative source of new compounds with anti-inflammatory activity. The present work investigates the anti-inflammatory activity of chitosan extracted from shrimp shells waste, both alone and combined with polyphenols of *Cynara cardunculus* var. *scolymus* (*C. scolymus*). First, Shrimp shells were washed, dried, and ground. Second shrimp shells flour was demineralized and deproteinised to prepare chitin. Finally, Chitosan was obtained by deacetylation of chitin and then analysed based on its moisture, ash, protein, molecular weight and degree of deacetylation. The polyphenols of *C. scolymus* were prepared using methanol as solvent. The total phenolic and flavonoid content of *C. scolymus* were determined using spectrophotometric methods. The anti-inflammatory activity of Chitosan and *C. scolymus* extract alone or in combination was assessed using *in vitro* (Inhibition of protein denaturation and human red blood cell membrane stabilization methods) and *in vivo* (carrageenan induced mouse paw edema) methods. Results have shown that the amount of chitosan extracted was 5.80 ± 1.09 %; it contains 4.43 ± 0.57 , 1.32 ± 0.62 and 0.18 ± 0.04 % of moisture, ash and protein, respectively. Its molecular weight is 859.48 ± 21.62 KDa and its degree of deacetylation is 75%. The combination of chitosan and *C. scolymus* extract resulted in the most effective in preventing protein denaturation and erythrocytes membrane injury. Furthermore, the combination significantly inhibits the inflammation induced by injection of carrageenan to mice ($83,66 \pm 21,21$ %) in comparison with chitosan ($63,67 \pm 17,14$) and *C. scolymus* extract ($51,11 \pm 20,9$) when used alone. This suggests that chitosan, in conjunction with *C. scolymus* polyphenols might be used to prevent inflammation.

Key Words: chitosan, *Cynara scolymus*, polyphenols, inflammation





Cyanobacteria Magic: Cultivating Sustainable Solutions For Agriculture

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Abstract

In the dynamic realm of sustainable agriculture, attention increasingly turns to microalgae as a catalyst for positive change. These tiny organisms, prized for their renewable attributes and nutritional richness, offer a promising avenue for revolutionizing traditional farming methods. Leveraging the inherent capacity of microalgae to convert sunlight into nutrient-dense biomass through photosynthesis, a natural alternative to chemical fertilizers emerges. By cultivating microalgae, often utilizing organic waste or wastewater, proponents advocate for circular and sustainable resource management practices. Among these, *Spirulina* sp, a filamentous cyanobacterium renowned for its nutrient profile, takes center stage in addressing nutritional deficiencies. Harvested from Oubeira Lake and carefully cultivated, *Spirulina* biomass, alongside other microalgae strains, becomes integral to the development of eco-friendly agriculture fertilizers. The overarching objective of this endeavor is clear: to pioneer biofertilizers that minimize reliance on environmentally damaging chemicals, promoting the well-being of ecosystems, animals, and human health. Bloom collected from Oubeira Lake in October 2022, *spirulina* sp were isolated then cultured using Zarrouk's medium in a culture room at $35 \pm 2^\circ\text{C}$. The culture is then harvested by centrifugation, and the biomass is freeze dried then preserved at -80°C until further analysis. *Spirulina* biomass in addition to other microalgae strains will be used for the fabrication of the agriculture fertilizer.

Key Words: *spirulina* sp., Biofertilizers, Sustainable Agriculture, chemical fertilizer, animals and environment risque



Isolation of histamine producing *Enterococcus* strains from white cheeses

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Abstract

Enterococcus-associated biogenic amines are frequently found in foods such as cheese, fermented beverages, and fish. Histamine, tyramine, cadaverine, and putrescine are commonly detected biogenic amines in food items. Consumption of certain levels of biogenic amines can lead to symptoms like migraines, hypertension, nausea, and vomiting. Given these adverse health effects, our study aimed to investigate the histamine-producing capabilities of *Enterococcus* strains isolated from cheese using qualitative, quantitative, and molecular methods. In this study, 452 cheese samples obtained from markets and bazaars were analyzed. Suspicious *Enterococcus* spp. colonies were identified in 391 samples based on morphology. Amino acid decarboxylase activity test was performed to determine whether enterococci isolates were histamine producers. Of the isolates analyzed, 276 were found to produce histamine. Biochemical identification tests were performed on these histamine-producing isolates, revealing that 25 strains exhibited strong histamine production. Histamine concentrations produced by selected *Enterococcus* strains were determined through HPLC analysis, yielding concentrations ranging from 14,874 to 26,239 mg/L. Moreover, 16S rDNA sequence analysis was employed to identify 25 *Enterococcus* strains at the species level, and the presence of the amino acid decarboxylase gene region was investigated. Among these strains, 7 (28%) were identified as *E. faecalis* and 18 (72%) as *E. faecium*. The gene regions responsible for histamine production were detected in all 25 strains. These findings highlight the importance of maintaining stringent hygiene conditions during cheese production and storage, as the presence of *Enterococcus* strains capable of producing high levels of histamine underscores the need for increased vigilance in food safety practices.

Key Words: *Enterococcus* spp., Histamine, Cheese, HPLC, 16S rDNA

Histamin üreticisi *Enterococcus* suşlarının beyaz peynirlerden izolasyonu

Özet

Enterokoklarla ilişkili biyojen aminlere peynir, fermente içecekler ve balık gibi gıdalarda sıklıkla rastlanmaktadır. Histamin, tiramin, kadaverin ve putresin gıda maddelerinde yaygın olarak tespit edilen biyojen aminlerdir. Biyojen aminlerin belirli seviyelerde tüketilmesi migren, hipertansiyon, bulantı ve kusma gibi semptomlara neden olabilmektedir. Bu olumsuz sağlık etkileri göz önüne alındığında, çalışmamızda peynirden izole edilen *Enterococcus* suşlarının histamin üretme yeteneklerinin kalitatif, kantitatif ve moleküler yöntemler kullanarak araştırılması amaçlanmıştır. Bu çalışmada market ve pazarlardan temin edilen 452 adet peynir örneği analiz edilmiştir. Morfolojik olarak 391 örnekte şüpheli *Enterococcus* spp. kolonileri belirlenmiştir. Enterokok izolatlarının histamin üreticisi olup olmadığını belirlemek için amino asit dekarboksilaz aktivite testi yapılmıştır. Analiz edilen izolatlardan 276'sının histamin ürettiği tespit edilmiştir. Bu histamin üreten izolatlar üzerinde biyokimyasal tanımlama testleri yapılmış ve 25 suşun güçlü histamin üretimi gösterdiği ortaya çıkmıştır. Seçilen *Enterococcus* suşları tarafından üretilen histamin konsantrasyonları, HPLC analizi yoluyla belirlenmiş ve 14.874 ile 26.239 mg/L arasında değişen konsantrasyonlar elde edilmiştir. Ayrıca 25 *Enterococcus* suşunun tür düzeyinde tanımlanması için 16S rDNA dizi analizi kullanılarak aminoasit dekarboksilaz gen bölgesinin varlığı araştırılmıştır. Bu suşların 7'sinin (%28) *E. faecalis*, 18'inin (%72) *E. faecium* olduğu belirlenmiştir. Histamin üretiminden sorumlu gen bölgeleri 25 suşun tamamında tespit edilmiştir. Bu bulgular, peynir üretimi ve depolaması sırasında sıkı hijyen koşullarının korunmasının önemini vurgulamaktadır; çünkü yüksek düzeyde histamin üretebilen *Enterococcus* suşlarının varlığı, gıda güvenliği uygulamalarında daha fazla dikkatli olunması gerektiğinin altını çizmektedir.

Anahtar Kelimeler: *Enterococcus* spp., Histamin, Peynir, HPLC, 16S rDNA





ID: 320

Comparative Genomics of Sunflower MYB Transcription Factors and their Role in Drought Stress

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Abstract

Sunflower is the 3rd most important oil seed crop in the world. In Pakistan, sunflower is mainly cultivated in spring season and is badly affected by drought due to scarcity of irrigation water. Epicuticular wax act as a first line of defense to protect the plants from drought stress by sealing the areal parts of land plants to prevent them from non-stomatal water loss. The myeloblastosis (MYB) transcription factor (TFs) proteins are involved in various biotic and abiotic stresses. A comprehensive analysis of the sunflower and Arabidopsis *MYB* gene family was carried out to uncover the functions, gene structure, evolutionary history and expression pattern of these genes in sunflower. As the genome of sunflower has recently been sequenced and no such study was conducted in this crop. A blast search was used to find the relevant genes in sunflower. Physiochemical propertied indicated that these MYB genes were present throughout the genome however, subcellular localization indicated that most of these genes were located in nucleus. Phylogenetic analysis showed that MYB proteins were divided in four clades.

Key Words: Sunflower, MYB, Transcription Factors, Drought, Wax biosynthesis



ID: 321

The in vitro evaluation of antioxidant properties of two flavonoids compounds isolated from medicinal plant

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Abstract

Purpose: The aim of this study is to evaluate the antioxidant activities of two compounds, isolated from *Varthemia iphionoids* (Asteraceae family) methanol extract.

Methods: The plant material (19 kg) was extracted with ethanol at room temperature (7 days). The ethanol extract obtained was evaporated under vacuum and the resulting crude residue (1 kg) was dissolved in the presence of 10% aqueous methanol and delipidated with hexane. The aqueous methanol extract was evaporated to give a gummy residue (660 g). By column chromatography (silica gel, 400 mesh) and TLC followed by identification by NMR. Two flavonoids compounds were obtained.

Results : The antioxidant activities of tow identified flavonoids: kumatakillin (1) and Penduletin (2) were determined. The results indicated that the compounds showed a potent scavenging activity with DPPH radical and H₂O₂ in which was comparable to quercetin as standard, and had the ability to prevent the oxidation of β -carotene. In anti-hemolytic assay, the two compounds gave a TH₅₀ higher than standard and the best result was shown with (2) (TH₅₀ = 60.14 $\pm$ 0.72). Moreover, the evaluation of anticoagulant and thrombolytic potential showed that, the compounds had significantly prolonged the clotting time and exhibited an important thrombolytic activity compared to the control (*** p < 0.001).

Conclusion: These results are promising for further studies of the biological and pathological effects of these natural products.

Key Words: *Varthemia iphionoids*, Flavonoids, Free Radicals, Antioxidant



Salmonella spp. Prevalence in Raw Chicken Meat

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Abstract

Salmonella spp., one of the main causes of foodborne diseases worldwide, poses a major threat about public health and food safety with its high mortality rate. *Salmonella* infections, known as salmonellosis, one of the most reported foodborne illnesses worldwide, are one of a leading cause of acute diarrheal disease and are generally associated with the consumption of food products contaminated with *Salmonella* spp. Foods of animal origin, especially chicken and poultry products, are the most common sources of contamination for *Salmonella* spp. Investigating the prevalence of *Salmonella* spp. found in chicken and poultry products, which are frequently consumed due to their high nutritional value and affordable price, is important because of food safety as well as the serious economic losses caused by the treatment, prevention and control of the disease. In this study, the prevalence of *Salmonella* spp. in 140 different raw chicken samples obtained from butchers and markets in various districts of Ankara was investigated using TS EN ISO 6579 norms. Possible *Salmonella* spp. colonies were observed in 68 of the 140 samples examined. 68 isolates identified after biochemical confirmation tests were identified at the molecular level by 16S rRNA sequence analysis. As a result of molecular isolation, 4 out of 68 isolates (5.8%) were identified as *Salmonella enterica*.

Key Words: *Salmonella* spp., Raw chicken meat, Food safety

Çiğ Tavuk Etlerinde *Salmonella* spp. Prevalansı

Özet

Dünya çapında gıda kaynaklı hastalıkların başlıca nedenlerinden biri olan *Salmonella* spp. gösterdiği yüksek mortalite oranı ile halk sağlığı ve gıda güvenliği açısından büyük bir tehdit oluşturmaktadır. Tüm dünyada en fazla rapor edilen gıda kaynaklı hastalıklardan biri olan ve salmonellozis olarak bilinen *Salmonella* enfeksiyonları akut ishal hastalığının önde gelen nedenlerinden olup, genellikle *Salmonella* spp. ile kontamine olmuş gıda ürünlerinin tüketilmesiyle ilişkilendirilmektedir. Hayvansal kaynaklı gıdalar, özellikle tavuk ve kümes hayvanları ürünleri, *Salmonella* spp. için en yaygın bulaş kaynaklarıdır. Yüksek besin değeri ve uygun fiyatı nedeniyle sıklıkla tüketilen tavuk ve kümes hayvanı ürünlerinde *Salmonella* spp. prevalansının araştırılması, gıda güvenliğinin yanı sıra hastalığın tedavisi, önlemesi ve kontrolünün neden olduğu ciddi ekonomik kayıplar nedeniyle de önem taşımaktadır. Bu çalışmada Ankara'daki çeşitli ilçelerde bulunan kasap ve marketlerden temin edilen 140 farklı çiğ tavuk örneklerdeki *Salmonella* spp. prevalansı TS EN ISO 6579 normları kullanılarak araştırılmıştır. İncelenen 140 örneğin 68'inde muhtemel *Salmonella* spp. koloni varlığı gözlemlenmiştir. Biyokimyasal doğrulama testleri sonrasında tespit edilen 68 izolat 16S rRNA dizi analizi ile moleküler düzeyde tanımlanmıştır. Moleküler izolasyon sonucunda 68 izolatın 4 adedi (%5,8) *Salmonella enterica* olarak tanımlanmıştır.

Anahtar Kelimeler: *Salmonella* spp., Çiğ tavuk eti, Gıda güvenliği



Modelling Climate Change Impact on Soil Loss in Tokat

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Abstract

Understanding the potential impact of climate change requires implementing effective planning strategies in hillside terrain and mountainous areas. Many studies have been carried out using erosion models in the Tokat region, much less with the WEPP model. Thus, keeping this in view, the study aims to estimate the possible impact of projected climate change scenarios on soil loss and erosion vulnerability using the Statistical Downscaling Model (SDSM), MarkSim Weather Generator, and Water Erosion Prediction Project (WEPP) model. The present study downscaled four climate scenarios on the near future, noted the 2020 s (2010), mid-future, 2035 s, and 2065, far-future, and 2095 s under GFLD-CM3 with four Representative Concentration Pathway (RCP), 2.5, 4.5, 6.5 and 8.5 scenarios. GFLD-CM3 and RCP scenarios predicted increased temperature and annual rainfall depth during the 21st century. The calibrated WEPP model was used to simulate future soil loss. The study's results showed a possibility for climate change to increase the rate of soil loss unless conservation strategies or proper land use plans are implemented.

Key Words: WEPP, MarkSIM-DSSAT model, GFLD-CM3, RCP Model, Tokat

Tokat Yöresinde Toprak Kayıpları Üzerine İklim Değişikliğinin Modellenmesi

Özet

İklim değişikliğinin olası etkilerini anlamak, yamaç arazileri ve dağlık bölgelerde etkili planlama stratejilerinin uygulanmasını gerektirir. Tokat bölgesinde erozyon modelleriyle birçok çalışma yapılmış olmasına rağmen, WEPP modeli ile çok daha az sayıda çalışma gerçekleştirilmiştir. Bu nedenle, bu çalışma, İstatistiksel Alan Küçültme Modeli (SDSM), MarkSim Hava Durumu Üretici ve Su Erozyonu Tahmin Projesi (WEPP) modelini kullanarak projeksiyon senaryolarına dayalı olarak iklim değişikliğinin toprak kaybı ve erozyon hassasiyeti üzerindeki olası etkilerini tahmin etmeyi amaçlamaktadır. Çalışmada, GFLD-CM3 altında dört Temsili Konsantrasyon Yolu (RCP) senaryosu ile 2010, 2035, 2065 ve 2095 olmak üzere dört iklim senaryosu geleceğe yönelik olarak tahmin yapılmıştır. GFLD-CM3 ve RCP senaryoları, 21. yüzyılda sıcaklık artışı ve yıllık yağış derinliğinde bir artış öngörmüştür. Kalibre edilmiş WEPP modeli, gelecekteki toprak kaybını simüle etmek için kullanılmıştır. Çalışmanın sonuçlarına göre, gerekli koruma önlemleri ve uygun arazi kullanım planı yapılmadığı sürece, toprak kayıplarında belirgin bir artış söz konusu olduğu görülmüştür.

Anahtar Kelimeler: WEPP, MarkSIM-DSSAT model, GFLD-CM3, RCP Model, Tokat

Introduction

Climatological analyses conducted in various regions of Turkey have revealed an upward trend in total precipitation and a shift towards more intense rainfall events over the past century (SWCS, 2003). Moreover, all general circulation models (GCMs) considered in the SWCS report project that global mean temperature, precipitation, and the intensity of precipitation events will increase in the future with increasing greenhouse gas concentrations (IPCC Working Group I, 2001; US NAS, 2001). The increasing frequency and intensity of extreme precipitation events demand more accurate simulation in soil erosion modeling. The most significant soil loss is often caused by infrequent, severe storms (Edwards and Owens, 1991). The projected changes in climate present a substantial risk of increased soil erosion and subsequent environmental impacts, the severity of which remains to be quantified (SWCS, 2003). This information is needed to determine (i) whether a change in soil and water conservation practices is necessary under a changing climate and (ii) what practices should be adopted to adequately protect soil and water resources if a change is necessary.

The effects of projected changes in precipitation, temperature, and CO₂ on crop yields have been assessed by many researchers (e.g., Rosenzweig and Parry, 1994; Semenov and Porter, 1995; Mearns et al., 1997; Mavromatis and Jones, 1998). These studies have considered both mean and variance changes in precipitation and temperature.



Some results have shown that changes in climate variability (measured by variance) can profoundly affect crop yields. It's important to consider not only the average changes in precipitation and temperature but also the changes in the variance of these climate parameters that can affect crop yields. Climate variability and changes in mean climate conditions are crucial for crop production. Understanding their impacts on agricultural systems is vital for adapting to climate change.

The effects of global climate change on soil erosion and surface runoff have been assessed considering changes in precipitation intensity or frequency. It has been assumed that changes in mean precipitation occur due to changes in storm frequency, storm intensity, or a combination of both (Favis-Mortlock vd., 1991; Boardman ve Favis-Mortlock, 1993; Savabi vd., 1993; Pruski ve Nearing, 2002a,b). Pruski ve Nearing (2002a). Researchers have decomposed changes in average rainfall into components attributable to changes in storm frequency, storm intensity, or both, enabling them to compare the effects of varying storm characteristics. They found that changes in precipitation amount and intensity have a much greater impact on soil erosion and runoff production than changes in storm frequency. Specifically, a 1% change in precipitation that accounted for all changes in precipitation amount and intensity resulted in an average of 2.4% soil loss and 2.5% change in runoff. However, when changes in storm frequency alone explained all changes in precipitation, it led to only 0.9% soil erosion and 1.3% runoff change. Some other studies conducted in the US (Savabi et al., 1993) and the UK (Favis-Mortlock et al., 1991) have shown that a 1% rise in precipitation, caused only by changes in storm intensity, led to an average increase in soil erosion of 2-4%.

MarkSim is a significant climate scenario generation tool used to assess the impacts of climate change on agricultural production. This application is based on the widely used MarkSim stochastic climate model, developed by Jones and Thornton (2000; 2002). MarkSim can generate high-resolution (30 arc-seconds) climate scenarios for any region in the world. The model utilizes climate data from the global WorldClim dataset developed by Hijmans et al. (2005). The model's key features include powerful statistical methods for modeling daily and seasonal changes in climate variables such as precipitation and temperature. The ability to generate climate projections based on IPCC greenhouse gas emission scenarios (RCPs), direct data integration with the DSSAT crop modeling software, and a user-friendly web interface. Thanks to its comprehensive features, MarkSim emerges as a powerful tool for assessing the agricultural impacts of climate change, developing effective adaptation strategies, and conducting robust crop modeling.

This study assesses the impacts of climate change on agricultural production specifically in Tokat province. The study utilized the GFDL-CM3 general circulation model and RCP greenhouse gas emission scenarios in recent climate change experiments conducted by the Turkish State Meteorological Service. The GFDL-CM3 general circulation model has produced monthly climate projections for the Tokat region spanning the next 100 years. The RCP 2.5, 4.5, 6.5, and 8.5 scenarios, which represent a wide range of potential greenhouse gas emission pathways were utilized in this study.

The primary aim of the study is to assess the potential impacts of climate changes projected by the GFDL-CM3 model for the periods of the 2010s, 2035s, and 2065, 2095s on soil loss, in USLE-K parcel in Tokat province. The MarkSim climate scenario generator tool was used. MarkSim utilizes high-resolution climate data obtained from the WorldClim dataset to reflect both mean and variance changes in projected monthly precipitation and temperature variability into daily weather data.

Materials and Methods

Future Climate Scenarios

Daily weather data including solar radiation, precipitation, and temperature extremes was generated for the Tokat region using the MarkSim DSSAT model (<http://gisweb.ciat.cgiar.org/MarkSimGCM/>) with 1967-1995 as the reference period. The GFDL-CM3 model's 50 replications were averaged and a spatial resolution of 1.2587×2.5 (latitude $\times$ longitude) was used. The data was downloaded in DSSAT format for the years 2010, 2035, 2065, and 2095 under the RCP 2.6, 4.5, 6.0, and 8.5 scenarios. The weather data generated for the year 2010 based on the RCP 2.6, 4.5, 6.0, and 8.5 scenarios was used as a baseline for assessing the impacts of climate change in future years (2035, 2065, and 2095).

- The RCP 2.6 model represents a low greenhouse gas emissions scenario, aiming to stabilize atmospheric greenhouse gas concentrations at 450 ppm CO₂ equivalent by 2100. This scenario is projected to limit global temperature rise to 1.5-2 °C above pre-industrial levels. Due to less pronounced climate change impacts, it predicts a more stable and less uncertain precipitation pattern. (IPCC, 2013)
- RCP 4.5 represents a moderate greenhouse gas emissions scenario, projecting that greenhouse gas concentrations will reach approximately 650 ppm CO₂ equivalent by 2100. This scenario anticipates a global



temperature rise of around 2 °C. While both increases and decreases in precipitation are possible, overall, a more variable climate is expected (IPCC, 2013).

- The RCP 6.0 scenario represents a high greenhouse gas emissions pathway, projecting that greenhouse gas concentrations will reach approximately 850 ppm CO₂ equivalent by 2100. This scenario anticipates a global temperature rise of 2-3 °C, leading to significant climate change impacts. Extreme weather events and irregular precipitation patterns are likely to increase, putting pressure on water resources (IPCC, 2013).
- The RCP 8.5 scenario represents a very high greenhouse gas emissions pathway, projecting that greenhouse gas concentrations will reach approximately 1370 ppm CO₂ equivalent by 2100. This scenario anticipates a global temperature rise of 4 °C or more, leading to severe climate change impacts. The frequency of extreme weather events, such as heavy precipitation and prolonged droughts is expected to increase, causing significant problems for ecosystems and water management. These scenarios are crucial for assessing the potential impacts of climate change and its consequences for precipitation and temperature patterns (IPCC, 2013).

The modified parameters were used as inputs for the CLIGEN (V5.111) model to generate 20-year daily weather datasets corresponding to each emissions scenario. A control simulation using unmodified reference parameters was also conducted to produce a baseline climate dataset.

Study Area

This research was carried out at the Middle Black Sea Transit Belt Agricultural Research Institute Directorate, which is situated 10 kilometers from Tokat province on the Research Tokat-Turhal highway. The study utilized three different slope land areas. The research parcels are located at the coordinates N 40.19° and E 36.92°. The research site is located at an altitude of 601 meters above sea level. Tillage and weeding operations were carried out on the K plots in May, July, August, and October. The soil in plot A contains 25% sand and 45% clay and is classified as a clay texture. The Universal Soil Loss Equation (USLE) was applied to plots K, C, and P during the period 1975-1996. This study utilized the observed soil loss data from plot K for model calibration. No plants were grown on plot K, and the land was plowed parallel to the contour in May, July, August, and October.

Discussion and Conclusions

The table 1 presents the results of the analysis of both observed and projected rainfall data under various climate scenarios. The RCP 2.6 scenario indicates a decreasing trend in observed rainfall from the baseline year 2010 to the years 2035 and 2065 (Fig 2). However, a significant increase in rainfall observed in 2095. This situation could suggest that successful climate change policies can contribute to the restoration of the water cycle equilibrium. The RCP 4.5 scenario indicates a decreasing trend in rainfall from 2010 to 2035, followed by a significant increase in 2065. This increase suggests that extreme rainfall events may become more frequent due to changes in the climate system. However, the subsequent decrease in 2095 suggests that the impacts of climate change are complex and involve long-term uncertainties. The RCP 6.5 scenario indicates a decreasing trend in the observed data from 2010 to 2035. The increase in rainfall in 2065 suggests that rainfall patterns have significant variations as a result of climate change. The renewed decrease in 2095 highlights the long-term variability of climate conditions. The scenario's projection of the lowest rainfall in 2095 highlights the severe impacts of climate change and the pressure on water resources. This situation presents significant threats to agricultural productivity and water management.

Tablo 1. Projected precipitation using observed weather data of Tokat district for future years

Precipitation				
Years	Model 2.6	Model 4.5	Model 6.5	Model 8.5
2010	432.79	492.2	437.26	480.21
2035	420.2	455.4	422.67	443.8
2065	417.91	500.73	458.58	410.59
2095	495.17	460.09	425.02	367.52

It's concerning to see the continuous increase in average temperatures in Tokat province (Fig 2), as revealed by studies and future climate scenarios. The impact of climate change seems to be becoming more pronounced in the region, as indicated in Table 2. It's evident that events occurring in the ecosystem, such as the destruction of forest lands for construction and irresponsible irrigation of farmland, are contributing to this situation and negatively impacting air quality. It's crucial to address these issues to mitigate the effects of climate change in Tokat province



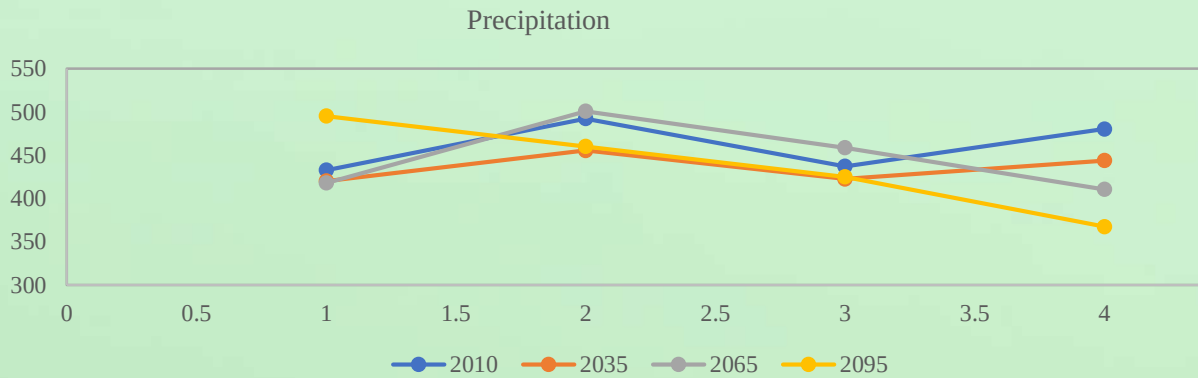


Figure 1. Impact of climate change on precipitation

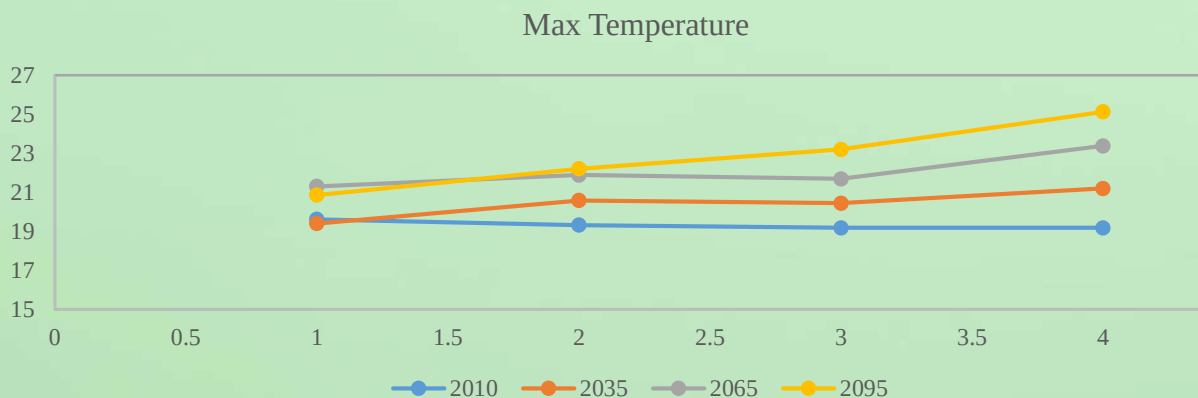


Figure 2. Impact of climate change on Max Temperature

Tablo 2. Projected Max Temperature using observed weather data of Tokat district for future years

Max Temperature				
Years	Model 2.6	Model 4.5	Model 6.5	Model 8.5
2010	19.6	19.31	19.17	19.17
2035	19.39	20.57	20.43	21.19
2065	21.29	21.88	21.68	23.37
2095	20.85	22.2	23.19	25.12

All models show notable increase in minimum temperatures throughout the study period (Table 3). This situation indicates that global warming is a problem for Tokat province too, leading to the projection of warmer winters in the future. Different climate models are based on varying assumptions about future greenhouse gas emissions and climate sensitivity. Therefore, every model presents a different scenario for temperature increase (Fig. 3). Model 8.5 projects a higher temperature increase compared to other models. This indicates that higher emission scenarios could lead to more severe consequences.

WEPP Model Results

The study utilized observed soil loss data for Tokat province between 1971 and 1995. The study used an uncalibrated WEPP Hillslope model to predict soil loss during this period. The obtained results are presented in Table 4 and the relationship between them is illustrated in Figure 4. The observed and predicted soil losses were found to be 0.639 and 1.359 kg/m², respectively. Although no soil loss was recorded in 1978, the model a prediction for that year. There is no observed or simulated soil loss data for both 1979 and 1990. When comparing the differences between observed and simulated data, it was found that the observed soil loss in 1975 (1.181 t/ha) was very close to the simulated value (1.36 t/ha). This indicates that the uncalibrated WEPP Hillslope model performed well in the initial years. However, the significant difference between the observed soil loss of 0.708 t/ha and the simulated value of 2.43 t/ha in 1981 suggests that the model was unable to adequately represent the actual conditions for that year. The maximum observed soil loss of 4.5666 t/ha and simulated value of 4.85 t/ha in 1983



for that year was quite accurate. These results demonstrate that the model accurately simulated the high soil loss for that year. In contrast, the measured soil loss in both 1984 and 1986 was significantly lower, at 0.6083 t/ha and 0.389 t/ha, respectively. This indicates that either effective soil conservation measures were being followed or the weather conditions were better during those years. Therefore, the simulated soil loss for the years 1985 and 1991 was higher than the observed values. The model overestimates soil loss in some years, suggesting that its predictions may not accurately reflect the actual situation. Although observed data is missing for 1995, the simulated value of 1.38 t/ha suggests that significant soil loss may have occurred in that year.

Tablo 3. Projected Min. Temperature using observed weather data of Tokat district for future years

Minimum Temperature				
Years	Model 2.6	Model 4.5	Model 6.5	Model 8.5
2010	8.13	7.88	7.69	7.82
2035	7.9	8.94	8.77	9.27
2065	9.54	9.95	9.67	10.98
2095	9.25	9.99	10.73	12.29

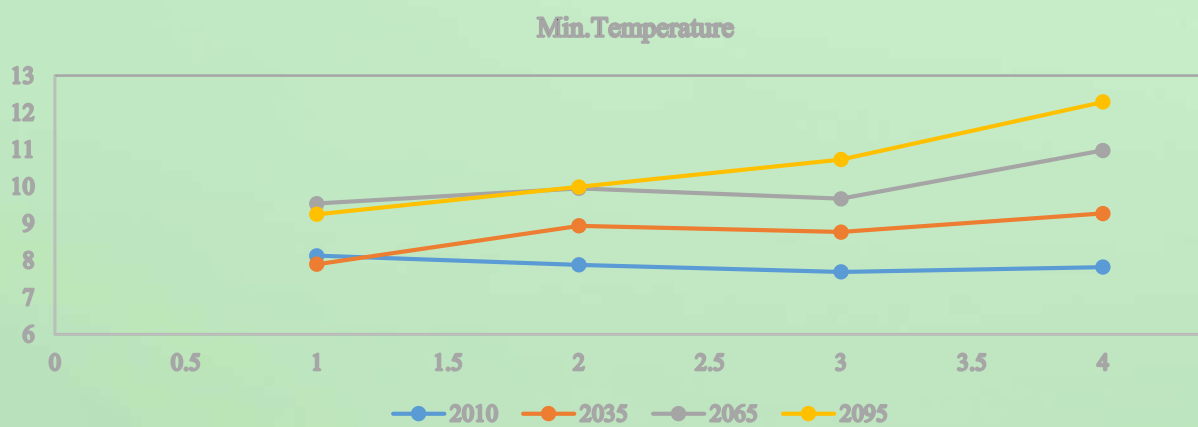


Figure 3. Impact of climate change on Min Temperature

Table 4. The uncalibrated WEPP Hillslope model results

Years	Observed Soil Loss	Uncalibrated WEPP Model Soil Loss
1975	1.181	1.36
1976	0.337	0.49
1977	0.553	0.62
1978	-	0.14
1979	-	-
1980	0.0007	0.32
1981	0.708	2.43
1982	0.0177	0.06
1983	4.5666	4.85
1984	0.6083	0.18
1985	0.1949	2.97
1986	0.389	0.04
1987	0.071014	0.1
1988	1.98119	3.34
1989	1.8986	3.56
1990	-	-
1991	0.12137	2.53
1992	0.12052	3.27
1993	0.2009	0.68
1994	0.46922	0.16
1995		1.38
Average	0.639	1.356



Figure 4 shows that the uncalibrated WEPP Hillslope model's estimates of soil loss are mostly consistent with the actual measurements, but there are significant differences at some points. The coefficient of determination was found to be 0.4685. This value indicates how well the model fits the observed data. An R^2 value below 0.5 indicates that the model is unable to establish a strong relationship between the variables, suggesting that the model's reliability is limited. An R^2 value below 0.5 indicates that the model cannot establish a strong relationship between the variables, meaning that the reliability of the model is limited.

Most of the points lie above the 1:1 line, indicating that the uncalibrated WEPP Hillslope model generally overestimates the observed soil loss. The model is especially overestimates low soil loss values and underestimates high soil loss values. These results are commonly observed for the uncalibrated WEPP Hillslope model. The hillslope is bare and has been plowed parallel to the contour. These findings indicates that the model has difficulty accurately representing the actual conditions, especially in erosion-prone conditions like these. It requires further development to better accommodate these unique conditions and improve the model's performance in these specific cases. Improving the model may require making structural changes, which could involve adding new parameters or adjusting existing ones. Furthermore, it is essential to calibrate the model's parameters to match the local conditions. The model's NSE value of 0.64 suggests that the model performs well, but there is potential for further improvement.

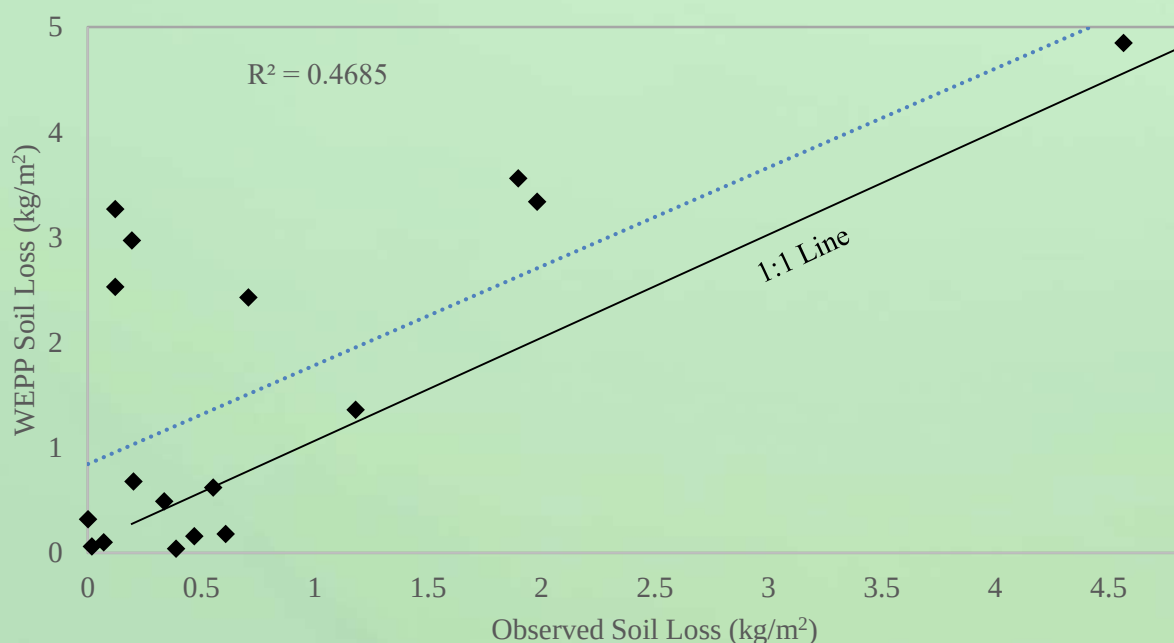


Table 6. Soil Loss Results from Future Climate Models

Years	Soil loss	
	Rate kg/m ²	Change %
RCP 2.6		
2010	0.485	-24.1
2035	0.485	-24.1
2065	0.796	24.57
2095	0.878	37.4
RCP 4.5		
2010	0.874	36.75
2035	0.846	32.4
2065	1.614	152.42
2095	1.445	126.12
RCP 6.5		
2010	0.875	36.84
2035	0.862	-34.91
2065	0.817	27.86
2095	1.390	117.6
RCP 8.5		
2010	1.171	83.27
2035	0.837	30.95
2065	1.178	84.34
2095	0.533	-16.62

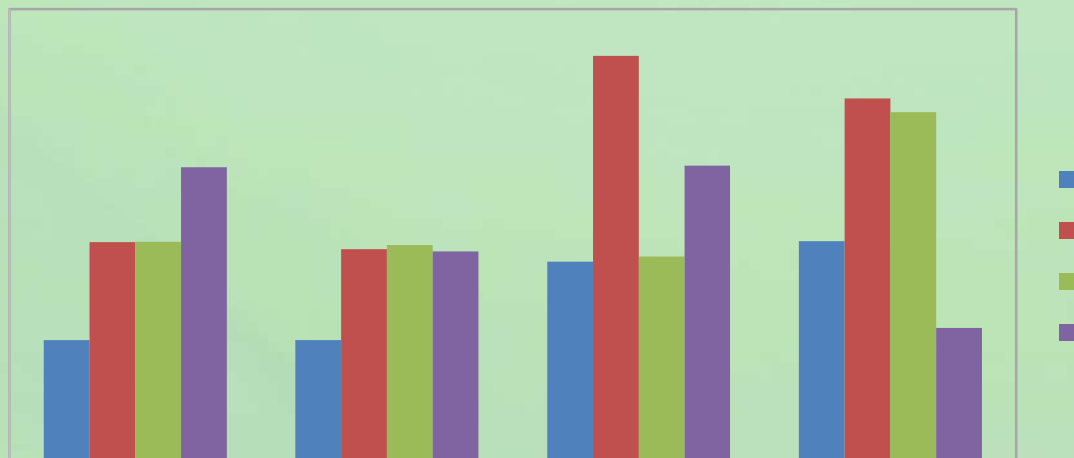


Figure 6. Relationship between Soil Loss and Climate Models

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β -lactamases and carbapenemases-Producing *Enterobacteriaceae*

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Abstract

Along with the recent spread of multidrug-resistant bacteria, outbreaks of extended-spectrum β -lactamase (ESBL) and carbapenemase-producing bacteria present a serious challenge to clinicians. β -lactam antibiotics are the most frequently used antibacterial agents and ESBLs, and carbapenemases confer resistance not only to carbapenem antibiotics but also to penicillin and cephem antibiotics. Therefore, resistance to carbapenems presents a significant threat to patients who are immunocompromised and are therefore susceptible to infections caused by multidrug-resistant bacteria all over the world. The mechanism of β -lactam resistance involves an efflux pump, reduced permeability, altered transpeptidases, and inactivation by β -lactamases. Various ESBLs and carbapenemases have been reported in the *Enterobacteriaceae* including *Enterobacter*, *Klebsiella*, *Escherichia coli* and other opportunistic species such as *Serratia*, *Acinetobacter*, and *Pseudomonas*. many different types of ESBLs and carbapenemases have emerged with different enzymatic characteristics. it is essential for clinicians to understand the characteristics of infecting pathogens. we summarize the current knowledge on carbapenem resistance by ESBLs and carbapenemases with the aim of aiding critical care clinicians in their therapeutic decision making.

Key Words: Multidrug resistance, *Enterobacteriaceae* , β -lactamases, β -lactamases , Classification



β -lactamases and carbapenemases-Producing *Enterobacteriaceae*

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Abstract

The production of agriculture has undergone new modifications as a result of agricultural technologies. These not only boost agricultural output but may also significantly raise the caliber of produced food, cut labor expenses, boost farmers' incomes, and achieve agricultural modernization. The research status and current agricultural technology achievements are carefully summarized in this study. In-depth discussions of thirteen significant agricultural technologies are provided in this article. Finally, some fresh concepts for each technology are offered and potential issues in establishing such sophisticated technologies are identified.

Key Words: *Agricultural technology, Progress, Farm automation, Smart agriculture*

Modern Teknolojilerle Tarım: İlerleme ve Potansiyel Dezavantajlar

Özet

Tarımsal üretim, tarım teknolojilerinin bir sonucu olarak yeni değişikliklere uğramıştır. Bunlar yalnızca tarımsal üretimi artırmakla kalmaz, aynı zamanda üretilen gıdanın kalitesini de önemli ölçüde artırılabilir, işgücü masraflarını azaltabilir, çiftçilerin gelirlerini artırabilir ve tarımsal modernizasyonu sağlayabilir. Bu çalışmada araştırma durumu ve mevcut tarımsal teknoloji başarıları dikkatlice özetlenmiştir. Bu makalede on üç önemli tarım teknolojisinin derinlemesine tartışmaları sunulmaktadır. Son olarak, her teknoloji için bazı yeni kavramlar sunulmakta ve bu tür gelişmiş teknolojilerin oluşturulmasındaki potansiyel sorunlar belirlenmektedir.

Anahtar Kelimeler: *Tarım teknolojisi, İlerleme, Çiftlik otomasyonu, Akıllı tarım*





ID: 327

Biodegradation of Hydrocarbures by Indigenous Hydrocarbonoclastics Bacteria isolated from the East-Algerian Littoral

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Abstract

The environments contaminated by hydrocarbons contain indigenous micro-organisms which have developed resistance and potential biodegradation of this pollutants. The objective of our work is to isolate and identify indigenous hydrocarbonoclast micro-organisms from the East-Algerian coastline and evaluate their potential of biodegradation. After isolation, biochemical, and molecular identification with RNA 16S, 53 strains of microorganisms have been isolated. We selected four strains; *Vibrio alginolyticus* PB-WC 11099, *Exiguobacterium aurantiacum* strain NB11_3A, *Halomonas venusta* strain NY-8 and *Dietzia* sp CNJ898 PLO4 for the growth test in the presence of different classes of hydrocarbons: alkanes-mono-aromatics and refined hydrocarbons as unique source of carbon and energy. A total hydrocarbon assay was carried out before and after each growth by a visible UV spectrophotometer at a wavelength 436 nm after extraction with pentane, removal of the polar substances, and evaporation of the extraction solvent and an oxidative decomposition of sample. The results of total hydrocarbon rates achieved after growth of the four selected autochthonous bacteria with the hydrocarbons tested show that all the strains appear to degrade the hydrocarbons with different rates. Thus, the maximum degradation is obtained with *Exiguobacterium aurantiacum* strain NB11_3A in the presence of benzene 02.21 mg/l, followed by the degradation of heptane of *Halomonas venusta* strain NY-8 with a rate of 3.12 mg/l and *Vibrio alginolyticus* PB- WC 11099 with a value of 3.76 mg/l. With *Exiguobacterium aurantiacum* strain NB11_3A we have the lowest degradation rate in the presence of cyclohexane, namely 21.23 mg/l. *Vibrio alginolyticus* PB-WC 11099 gave the best results with all the hydrocarbons tested (alkanes and mono-aromatics). The degradation of refined petroleum gasoline was also observed with all bacterial species selected with different rates. *Dietzia* sp CNJ898 PLO4 and *Vibrio alginolyticus* PB-WC 11099 use a wide range of hydrocarbons as the sole source of carbon and energy.

Key Words: Hydrocarbons, Hydrocarbonoclastics Bacteria, Bioremediation, Algeria.





ID: 328

Biodegradation of Hydrocarbures by Indigenous Hydrocarbonoclastics Bacteria isolated from the East-Algerian Littoral

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Abstract

The success of modern agriculture in increasing crop yields, ensuring global food security, and promoting economic growth in the agricultural sector is largely dependent on agrochemicals. Yet they can have a detrimental effect on the environment. Agrochemicals in bulk storage may provide serious threats to the environment and/or human health because many of them are hazardous, especially in the case of unintentional spillage. The extensive use of agrochemicals to combat agricultural pests and disease vectors poses major risks to human health and the environment, including depletion of soil, pollution of water supplies, and harm to organisms that are not intended targets, such as pollinators and aquatic life. Unjudicious use of agrochemicals is responsible for the majority of the negative consequences, since it breeds pesticide-resistant insects and reduces biodiversity through biotransformation. Pesticides pose a risk to the environment's sustainability and the stability of the world economy. The article aims to address various types of agrochemicals, their applications, and their harmful consequences on environmental issues, particularly those involving groundwater supplies and ecological systems. The article also explores agrochemical substitutes for a future with less environmental impact.

Key Words: agrochemicals, Environment, Agriculture, Pesticides





ID: 329

Reproduction of Mollusks From Different Localities in The Southern Mediterranean Coast

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Abstract

Mediterranean Sea biota is under great stress due to the discharges made by different activities. Mollusks are used to monitor environmental health. For this reason, a study was carried out to investigate the status of reproduction of the bivalves *Donax trunculus* along Annaba Mediterranean Gulf subjected to different anthropogenic ejections. Individuals have been collected in the first three months of the year from a location prone to contamination and localities subjected to organic and industrial contaminations. The sex ratio of *Donax trunculus* is macroscopically identifiable in February and March because gonad differentiation is possible only during the period of sexual activity. Testicular tissues showed histopathological modification in bivalves obtained from the organic and industrial polluted localities during January, February, and March. On the other hand, results demonstrated that the testicular structure of animals collected from the non-polluted site appeared unaffected. In summary, testicular histological profiles of *D. trunculus* have been altered by the two types of contaminations during the study period.

Key Words: Anthropogenic ejections, histopathology, bivalves, *Donax trunculus*, reproduction.



Functional Properties And Usage Area Of Coffee By-Products

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Abstract

In this study, the bioactive properties of coffee by-products and their use in foods were investigated. Coffee is among the most widely consumed beverages today. The coffee fruit goes through many stages and many by-products are formed until it becomes consumable. Apart from the seed, the coffee fruit produces silver skin, parchment shell, pulp and husk. Coffee by-products have high phenolic compound content and antioxidant activity. For this reason, coffee by-products are also very valuable consumption products with their high phenolic compounds and antioxidant activity. Coffee by-products have many positive effects on human health. It is suitable for direct consumption; It is also possible to add it to many food formulations. Thanks to its integrability into foods, its consumption area can be expanded today. Coffee by-products are also used in nutraceutical and pharmaceutical fields. Coffee by-products are used in many industrial areas besides food. Evaluation and availability of by-products; It is very important for recycling and the environment.

Key Words:

Kahve Yan Ürünlerinin Fonksiyonel Özellikleri Ve Kullanım Alanları

Özet

Bu çalışmada, kahve yan ürünlerinin biyoaktif özellikleri ve gıdalarda kullanımı araştırılmıştır. Kahve günümüzde en yaygın tüketilen içecekler arasındadır. Kahve meyvesi tüketilebilir hale gelinceye kadar birçok aşamadan geçmekte ve birçok yan ürün oluşmaktadır. Kahve meyvesinden çekirdek dışında gümüş kabuk, parşömen kabuk, pulp ve kabuk çıkmaktadır. Kahve yan ürünleri yüksek fenolik bileşen içeriğine ve antioksidan aktiviteye sahiptir. Bu sebeple kahve yan ürünleri de yüksek fenolik bileşenleri ve antioksidan aktivitesi ile oldukça kıymetli tüketim ürünüdür. Kahve yan ürünlerinin insan sağlığına birçok olumlu etkisi mevcuttur. Doğrudan tüketim için uygun olduğu gibi; birçok gıda formülasyonuna ilavesi de mümkündür. Gıdalara entegre edilebilirliği ile de tüketim alanı günümüzde yaygınlaşmaktadır. Kahve meyvesi yan ürünleri nutrasötik ve farmasötik alanlarda da kullanılmaktadır. Kahve meyvesi yan ürünlerinin gıda dışında endüstriyel olarak da birçok alanda kullanımı mevcuttur. Yan ürünlerinin değerlendirilmesi ve kullanılabilirliği; geri dönüşüm ve çevre içinde oldukça önem taşımaktadır.

Anahtar Kelimeler:



Sulama Durumu Tahmini için Makine Öğrenimi Algoritmalarının Karşılaştırmalı Analizi

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Özet

Sulama, tarımsal verimlilik açısından kritik bir faktördür. Doğru sulama planlaması, bitki büyümesi ve verimlilik açısından hayati öneme sahiptir. Bitkilerin ihtiyaç duyduğu su miktarının doğru bir şekilde belirlenmesi, su kaynaklarının etkin kullanımı ve tarımsal üretkenliğin maksimize edilmesi açısından büyük önem taşır. Sulama kararları genellikle karmaşıktır ve çeşitli faktörlerin etkileşimini içerir. Makine öğrenimi; çok çeşitli ve dinamik faktörleri dikkate alarak, sulama tahminleme işlemlerini oldukça yüksek bir doğrulukla gerçekleştirebilir. Makine öğrenimi tabanlı sulama durumu tahminin, su kaynaklarının daha verimli kullanılmasını sağlar ve bitki sağlığını ve tarımsal verimliliği artırır. Geleneksel yöntemlere ve Nesnelerin İnterneti tabanlı yaklaşımlara kıyasla, makine öğrenimi ile desteklenen sistemlerin, daha hassas sulama kararları verebildiği tespit edilmiştir. Bu çalışmada, Kaggle'dan elde edilen sulama veri kümesi kullanılarak sulama durumu tahmini için makine öğrenimi algoritmaları kullanılmıştır. Veri kümesinde eksik ve yanıltıcı veriler düzeltilmiş, bağımlı (sulama durumu) ve bağımsız (hava sıcaklığı, nemi, toprak nem değeri, yağış durumu) parametreler elde edilmiştir. Güneydoğu Anadolu Bölgesi'ndeki illere (Adıyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa ve Şırnak) odaklanılarak farklı koşullarda algoritmaların doğrulukları test edilmiştir. Her bir il için ayrı ayrı yapılan analizlerde, makine öğrenimi algoritmalarından; Karar Ağaçları (Decision Tree), Destek Vektör Makineleri (SVM), Rastgele Orman (Random Forest), Naive Bayes, Gradyan Artırma (Gradient Boosting), Doğrusal Regresyon (Lineer Regresyon), K-En Yakın Komşu (KNN) ve Yapay Sinir Ağı modeli kullanılarak sulama tahminleme işlemi gerçekleştirilmiştir. Veri kümesi üzerinde yapılan tahminler sonucunda elde edilen doğruluk oranları karşılaştırılmış ve en etkili algoritmaların; Rastgele Orman (%95), Karar Ağacı (%97), Gradyan Artırma (%93) ve Yapay Sinir Ağı (%98) modeli ile tüm şehirlerde %90'ın üzerinde tahminleme doğruluğu elde edilmiştir. Diğer algoritmalar da yüksek doğruluk oranları ile (%75 üzeri) dikkate değer performans sergilemişlerdir. Her bir il için yapılan analizlerde, algoritma performans sıralamasının benzer olduğu belirlenmiştir. Sonuç olarak, bu çalışma makine öğrenimi algoritmalarının tarımsal sulamada oldukça yüksek bir performansla kullanılabileceğini göstermektedir.

Anahtar Kelimeler: Sulama durumu tahmini, makine öğrenimi, tarımsal sulama, yapay zekâ



Utilisation of Roughages (Rice Straw) Treated with Mineral Feed to Cattle in Tandjilé Province, Chad

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Abstract

The study was conducted in Tandjilé Province Chad (GPS coordinates: 9° 39' 45" 25" N latitude and 16° 43' 24° 46" E longitude). The aim of the study was to determine the effect of treating roughages with minerals feed to cattle in dry season in Tandjilé. Thirty six Arab Zebu bulls weighing between 254-255 kg and aged 5- 6 years were assigned into three (3) treatments (T1, T2 and T3) with 12 replication per treatment in completely randomized design. The bulls were fed the experimental diets after returning from natural free grazing pasture and water provided *ad-libitum*. Data generated were subjected to analysis of variance. The results of the experimental feed indicated that the total weight gain (22.00kg), average daily weight gain (244g/head/day) were observing in T2. Daily dry matter intake and total dry matter intake were significantly higher ($P<0.05$) in group of bulls receiving rice straw treated with urea mixed with groundnut haulm plus cowpea haulm and cotton seedcake (T2). Lower values were obtained on group (T3) of bulls fed untreated rice straw mixed with groundnut haulm plus cowpea haulm and cotton seed cake (T3). However, the final weight gain were significant different among all treatments. The treated of rice straw with organic and inorganic mineral supplemented with groundnut haulm and cowpea haulm and cotton seedcake increased the weight gain and dry matter intake of bulls. It is recommended that grazing bull diets be supplemented with treated rice straw containing Doom fruit salt, poultry manure or urea mixed with cotton seedcake, groundnut and cowpea haulm during dry season for an improved performance.

Key Words:

Introduction

Livestock in Africa accounts for one-third of the global population (AU-IBAR, 2016) and about 40% of agricultural GDP, ranging from 10 to 80% (Panel, 2020). In the Sahel, livestock is the main activity of the pastoral populations. The feeding of domestic animals has always been based on natural pastures. These pastures of very good quality during the rainy season are abundant and consist mainly of annual plants (Diatta *et al.*, 2007). Transhumant pastoralism (70-90 %) remains the mode of production adapted to the Sahelo-saharian ecosystems (OCDE/CSAO, 2008). African livestock also have significant impacts on the environment (Gerber *et al.*, 2013). Land area for grazing and feed availability in high livestock producing areas are progressively becoming a serious threat to livestock production (Muhammad, 2004). Degradation of above ground biomass combined with climate change has strongly contributed to the reduction of forage supply (Diarra & Breman, 1998). Livestock will be increasingly important in the future in sub-Saharan Africa because the demand for animal-source food is projected to increase due to population growth, increased income and urbanization. By 2050, consumers in low and middle income countries will demand 107 million tons of meat and 5.5 million tons more milk than they did in 2005/2007 (Alexandros & Bruinsma, 2012). One of the important innovations is that the Sahel has experienced in recent decades the expansion of agro-pastoralism, that is to say the combination of crop and livestock production within the same farm. This new form of resource exploitation was born from the strategy of farmers and pastoralists to limit risks to face climate uncertainty (OCDE/CSAO, 2008). However, the savannahs, steppes, fallows and agricultural residues constitute the basis of livestock feed, even in sedentary farms or in the process of intensification (César, 2005).

Many Sahelian countries, such as Mali, Niger, Burkina Faso and Chad, have heterogeneous production systems, depending on their geographical location: the arid or semi-arid northern regions are mainly known by the practice of transhumant livestock farming (ECOWAS, 2008). The southern regions, which had more fertile land for agriculture is confronted by land pressure management. In most of these countries, the professions of transhumant herder and farmer have long been linked to "ethnic" affiliations and caste systems. Historically, this professional specialization structured exchanges between social groups sharing the same stock of resources (Banoïn & Jouve, 2000). Chad is a large landlocked country spanning north-central Africa. It covers an area of 1,284,000 km².

The Chadian livestock population is composed of 93.8 million cattle and 34.6 million heads of poultry. These groups represents 73% of the total number of livestock (FAO, 2018). It is essentially made up of ruminants such as goats (32.5%), sheep (28.2%), cattle (26.5%) and camels (6.8%). Poultry is dominated by chicken farming with



26.6 million heads (FAO, 2018). These figures place Chad in 3rd place in Africa in terms of livestock population (FAO, 2018). Livestock farming in Chad is the second largest source of income after petroleum (Marty, Pabamé, Djatto & Nabia., 2010). Chad is a country with agro-pastoral vocation (80%), contributing 28.3% to the national GDP (INSEED, 2014).

However, the successive stages in the evolution of a savannah subjected by a pastoral exploitation is marked by the modification of the structure of the grasses, quantitative changes in the composition of grasses, floristic composition, and disappearance of the herbaceous layer and to some extent degradation of rangelands (Hiernaux, 1996).

Most of ruminants in Africa depend on natural pasture and crop residues during the long dry season during which the quality and availability of the pastures decreases leading to an imbalance of essential nutrients resulting in poor performance (Tendonkeng *et al.*, 2018). Cereals in general, and especially rice, are not only the staple food for people in sub-Saharan Africa (Sohl, 2005), but they also produce large quantity of crop residues that are abandoned or burnt in the fields (Yaning *et al.*, 2012). Rational exploitation of these crop residues can be a promising way to overcome the quantitative and qualitative forage deficit especially during the long dry periods. The low quality of the residues does not provide enough nutrients to the small ruminants to maintain high production levels. The high level of lignification and limited ruminal degradation of the carbohydrates and the low content of nitrogen are the main deficiencies of the rice straw affecting its value as feed for ruminants (Tendonkeng *et al.*, 2016). Treating rice straw with urea or by supplementing with protein sources improve, intake, digestibility and ruminant performance when compared to untreated rice straw feeding alone (Wanapat *et al.*, 2009). However, the use of rice straw in animal nutrition remains limited by its low ingestion and digestibility due to its low crude protein content, available energy and high fiber and silica content (16%) (Van Soest, 2006; Huyen *et al.*, 2012). Several studies have shown that the treatment of 5% urea roughages improves their dietary values (Fawzy *et al.*, 2014). Supplementation is therefore necessary in addition to treatment to achieve significant production (Upreti & Orden, 2008). The objective of the research was to determine the effect of treating rice straw with mineral in cattle performance.

Materials And Methods

The study was conducted to investigate the effects of treated rice straw with two minerals to improve the nutritive value of rice straws and untreated rice straw both combined with concentrates supplements on the performance of bulls. The trial was conducted in Tandjilé Province (GPS coordinates: 9° 39' 45" 25" N latitude and 16° 43' 24" 46" E longitude) part of the Soudan zone which receives between 900 to 1200 mm of rainfall annually. It has an herbaceous vegetation of tropical savannahs which provides between 75 to 90 % of total biomass of the ecosystems (Garnier & Dajoz, 2001). It is characterized by a Sudanese tropical climate with a long dry season (7 months) and a short rainy season (5 months). The thermal regime is marked by a relatively cold period from December to February (from 11° to 22° C) and a hot period from March to June (from 39 to 45° C) (INSEED, 2014). Three local farms were chosen for the demonstration based on accessibility and availability of large number of animals. The treatment combinations and quantity formulated are shown in Table 1.

Table 1: Quantity of Organic and Inorganic Mineral Treatments Use treating Rice Straw for Animal feed.

Variables	Treatment	Quantity (g)
Doom fruit salt (T1)	T2+W+R	2+100+250
Urea (T2)	T3+W+RS	4+100+250
Rice straw only (T3)	T7=W+RS	250+125

T= Treatment; W= Water; RS= Rice Straw; T1= Doom fruit salt; T2= Urea; T3= Control; W= Water; RS= Rice Straw.

Two minerals Doom fruit salt as organic and urea as inorganic mineral were used to treat the rice straw for 28 days and fed to the animals. The rice straw (*Oryza sativa* L.) was obtained after harvesting rice in the fields at ITRAD-Farm Mala, Tandjilé Province of Chad.

Before treatment the rice straws were air dried for two days. The selected mineral were used to treat rice straw for a period of 28 days and fed to bulls with farmer practices as control. After treatment, the rice straw was opened for 72 hours on free air and mixed with cottonseed cake, groundnut and cowpea haulms and then feed to the animals.

The supplementation trial was conducted for 90 days and involved a total of thirty six bulls. The on-farm experiment was conducted in a randomized complete block design. The supplementation was offered at 2% body weight per head per day. The bulls were separated in three treatments. In each treatment batches of 12 animals were divided into three (3) replicate groups of four (4) animals.

-Treatment one: 12 cattle divided into three replication groups of 4 animals each and were supplemented with a livestock feed composed of dry rice straw treated with lye (extracts from ash of burnt doom fruits) mixed with cottonseed cake, cowpeas haulms and groundnuts haulms every evening after the animals return from the pasture. The supplementation was offered at 2% body weight per head per day.



-Treatment two: 12 cattle divided into three replication groups of 4 animals each and were supplemented with a livestock feed formulation composed of dry rice straw treated with urea mixed with cottonseed cake, cowpeas haulms and groundnuts haulms offered every evening after the animals return from the pasture.

-Treatment three: 12 cattle divided into three replication groups of 4 animals which were supplemented with a livestock feed formulation composed of untreated dry rice straw mixed with cottonseed cake, cowpeas haulms and groundnuts haulms every evening after the animals return from the pasture.

The bulls were dewormed with Ivermectin 1 ml for 50 kilogram live weight a week to the commencement of the trial.

The treated straw was given as feed supplement in the evening after animals returned from grazing.

An adaptation period was observed for 14 days during which, 5 kilogram of treated straw + 5 kilograms of untreated straw + water was given to each group (group I and II) of animal per day every afternoon.

After the adaptation period, the supplement was giving to groups of four animal. Each group received a quantity of mixed supplementation of 40% of rice straws, 20% of cottonseed cake, 20% of groundnut haulm and 20% of cowpea haulm at the rate of 2kg/100kg live weight per day throughout the 3 months of experimentation.

Table 2. Proportion (%) of Mixed Feed Stuff

Treatments	Rice straw	Cotton cake	seed	Groundnut haulms	Cowpea haulms	Total
T1 (Doom fruit salt)	40	20		20	20	100
T2 (Urea)	40	20		20	20	100
T3 (Untreated straw)	40	20		20	20	100

The data records were collected on baseline body weight (kg) at monthly intervals. Feed intake is determined by providing the animals with a known quantity of feed. The leftover is collected the next day in the morning. The difference between feed given the previous and leftover (ort) is the amount of feed taken by the animal. The animals were weighed at beginning of the experiment and every month. The weight gained by each animal is determined by subtracting the initial weight from the animal's final weight.

The data collected were saved in Microsoft Excel (2016) and analysed using Statistix 10, and JMPPRO/16 software. The means were separated using LSD at 0.05.

Results

Chemical composition of the experimental diet

The results revealed that there was a significant difference among the experimental diets for the parameters evaluated with exception of CP. The DM content values ranged from 89.29 to 92.9%. The highest value was recorded in T3 (92.9%) having untreated straw whereas, the least value was recorded in T2 (89.29%) having rice straw treated with urea. The Crude Protein ranged from 11.20%-18.16%, CF24.15%-27.43%, EE 4.41%-4.59%, Ash 5.47%-6.41%, NFE 51.72%-58.03%, ADF 27.13%-29.68%, and NDF 40.41%-43.41%.

Rice straw treated with urea treatment had the highest CP in absolute term among the treatments and the lowest was noticed in untreated rice straw treatment or control treatment. Rice straw treated with Doom fruit salt had the highest CF (27.43%) values and the lowest (24.15%) value was obtained in rice straw treated with urea. EE value was higher in rice straw treated with Doom fruit salt and the lowest values is obtained in rice straw treated with urea and untreated rice straw treatment. Values for Ash were significant ($P>0.05$) among the treatments with T1 (Rice straw treated with Doom fruit salt) having the highest value and T2 (rice straw treated with urea) the lowest. Values for CP were similar ($P>0.05$) among the treatments, however in absolute term Crude protein was observed to be higher in the treatment T2. ADF, NDF, Nitrogen Free Extract values were significantly greater ($P<0.05$) in untreated rice straw. However the CF was significantly greater ($P<0.05$) in T1 (27.43%) containing rice straw treated with Doom fruit salt whereas T2 or rice straw treated with urea registered the lowest value.

Table 3: Chemical composition of the experimental diet

a, b, c means are significantly different from one another. SEM= Standard Error of Mean; T1=Treatment 1(Rice straw treated with doom fruit

Treatments	Parameters							
	DM	Ash	CP	CF	EE	ADF	NDF	NFE
T1	89.23 ^c	6.41 ^a	13.62 ^b	27.43 ^a	4.59 ^a	27.33 ^b	40.41 ^c	52.91 ^b
T2	91.02 ^b	5.47 ^c	18.16 ^a	24.15 ^c	4.40 ^b	27.13 ^b	42.39 ^b	51.72 ^b
T3	92.90 ^a	6.02 ^b	11.20 ^c	24.63 ^b	4.41 ^b	29.68 ^a	43.41 ^a	58.03 ^a
SEM	0.033	0.023	1.655	0.009	0.007	0.043	0.043	0.139
P-value	0.001	0.007	0.964	0.001	0.013	0.003	0.001	0.005

salt + Cotton seed cake +groundnut haulms + cowpea haulms); T2= Treatment 2(Rice straw treated with urea + Cotton seed cake +groundnut haulms + cowpea haulms); T3= Treatment 3(untreated rice straw + Cotton seed cake +groundnut haulms + cowpea haulms). DM= Dry Matter, CP= Crude Protein, CF= Crude Fiber, EE= Ether Extract, NFE= Nitrogen Free Extract.



The trial involved thirty six (36) bulls weighing averagely between 254-255.kg. The experiment was conducted on-farm in a randomized complete block design. The bulls consisted of three groups of 12 animals each. Three type of supplementations were given to three groups of animals. The final weight gain recorded varied from 267.46-275.86 kg and the DWG ranged from 136 to 244g. The TWG recorded varied from 12.26 to 22.0 kg and the average daily weight gain per group was shown in table 20.

The average daily weight gain was statistically significant ($p<0.05$) among the three treatments. However, the initial and final weight gain were at par or similar among treatments. The group fed rice straw supplemented with urea (T2) recorded the highest (244g/day) result while T3 recorded the lowest daily weight gain (136g/day).

The group of animals fed rice straw treated with urea plus residues and concentrate was significantly higher compare to others groups. The analysis shows that there was a significant difference in the mean daily body weight gain of bulls used in the experiment. The bulls fed the treated rice straw supplement had the highest mean daily body weight gain which was significantly higher than the other those which received untreated rice straw treatments. All the groups of bulls fed recorded the significant difference ($P<0.05$).

The total weight gain and daily weight gain obtained were all significant.

Animals fed with urea-treated straws had remarkable results in terms of ADWG. The ration composed of 40% treated rice straw in combination with 20% cowpea haulm, 20% groundnut haulm and 20% cottonseed gave an ADWG of 244 g, compared to an ADWG of 181 g for T2 and 136 g for the control T3 ration. This resulted in an average increase of 16.36 kg for the group receiving the T1 treatment, 22 kg for the group receiving T2 compared to 12.26 kg for the control receiving T3.

Results of feeding treated rice given to cattle showed a significant increase in weight in 90 days. On the other hand, cattle fed during the same period with untreated straw did not obtain enough increasing body weight. The comparison of the effect of supplementation of T1 and T2 with control T3 (untreated rice straw) showed a difference of 4.10 kg for T1 and 9.74 for T2 compared to the control. It has also been noted and improved feed intake in T1.

The highest mean total dry matter forage intake was recorded in T3 for the bulls fed by untreated rice straw supplement. There was significant difference ($P<0.05$) in the mean forage intake by group. The highest mean total feed intake was recorded by the bulls group fed the untreated rice straw supplement (T3), this was followed by the bulls group fed by rice straw treated with urea (T2) and the group received the treated rice straw treated with doum fruit salt (T1) recorded the least mean total feed intake.

There was significant difference ($P<0.05$) in the final body weight of the bulls. The highest feed conversion ratio was recorded for the bulls fed the untreated rice straw supplement.

Table 4: Live Weight Changes (Kg) of Bulls Supplemented with Organic and inorganic mineral and Feed Intake as Affected by Dietary Treatment

Parameters						
Treatments	IWG	FWG	TWG	ADWG	DFI	TDMI
T1	254.30	270.66	16.36 ^b	0.181 ^b	17.9c	1611 ^c
T2	253.86	275.86	22.00 ^a	0.244 ^a	18.17b	1636 ^b
T3	255.20	267.46	12.26 ^c	0.136 ^c	18.47a	1663 ^a
SEM	0.55	0.73	0.72	0.008	0.00	0.00
P-value	0.222	0.001	0.001	0.001	0.001	0.001

a, b, c means are significantly different from one another. SEM= Standard Error of Mean; T1=Treatment 1(Rice straw treated with doum fruit salt + Cotton seed cake +groundnut haulms + cowpea haulms); T2= Treatment 2(Rice straw treated with urea + Cotton seed cake +groundnut haulms + cowpea haulms); T3= Treatment 3(untreated rice straw + Cotton seed cake +groundnut haulms + cowpea haulms). IWG= Initial Weight Gain, FWG= Final Weight Gain, TWG= Total Weight Gain, ADWG= Average Daily Weight Gain. DFI= Daily Feed Intake, TDMI= Total Dry Matter Intake.

Discussion

The valorization of straw by treatment with traditional salt extracts from Doom fruits after burning and distillation and urea could thus constitute an alternative mean to increase its fodder value. The use of rice straw in feeding ruminants is justified in the Province of Tandjilé especially by its appreciable production, the large availability, the cost and above all the possibility of improving their value food using those different fertilizers.

The experimental by treated rice straw positively influenced ($P < 0.05$) average final weight gain and average daily weight gain. The corresponding increases in weight gains were greater for treatment T2 and treatment T1 compared to control (T3). The total weight gain ranged from 12.26 to 22.00. However, the Maximum weight per animal head was observed in T2 compared to T1. Average daily weight gain (ADWG) demonstrated that there was a response to taking treated rice straw supplement, as the highest total body weight gain correspond to taking quality supplement (T2 and T1). This shows that feed utilization was better with bulls fed treated rice straw supplements (T2 and T1). These ADWG values in this study were lower than the work of Wuanor *et al.*, (2015) who reported ADWG values of 0.81 to 1.34 kg/day for feedlot Bunaji bulls supplemented at different levels of a diet at basis of industrial agricultural by-products and the conclusions of Norris *et al.*, (2002), on foreign cattle breeds and their



crosses in feedlots in Botswana and also those of Madziga (2013), who reported ADWG values of 0.96 Kg/day for zebu Azawak in feedlots in Botswana. Kardaya, (2018) reported ADWG ranged from 0.60 to 0.65 kg/day for zebu Bali however, Ortiz *et al.*, (2002) for the same species found the result ranged from 0.37 to 0.41kg.

The total average weight gain obtained in this study was almost similar to the finding of Galloway *et al.*, (2011) who got the value ranged from 0.19kg to 0.36kg respectively for 86 days of supplementation.

The average TDMI supplement, particularly by groups of bulls having received the treated rice straw treatment, shows the weight gain. The average weight gain resulting from the proposed supplement intake can be explained by the quality for treated rice straw over untreated rice straw. Food intake shows that the treatment had an effect on it.

Total food consumption differed between treatments due to differences in minerals used in the treatments. The animals receiving the diet containing urea and Doom fruit salt tended to leave some residues of uneaten straw unlike those of the untreated rice straw diet (control). Golombeski *et al.*, (2006) previously reported that a decrease in food intake during urea treatment was caused by the bitter taste of urea.

The study by Ortiz *et al.* 2002, Golombeski *et al.* 2006 and Galloway *et al.*, (2011), reported that a slow-setting urea supplement increased ($P < 0.05$) the body weight of zebu cattle.

The present findings are in line with other authors (Ortiz *et al.*, 2002), who also noted during their experience that higher final weight of bulls fed urea straw was related to their initial weight. Feeding bulls with an improved ration based on rice straw treated with organic mineral (Doom fruit salt) and inorganic, mineral (urea) increases feed efficiency and ADWG.

Conclusion

The study showed that there is a great potential to improve rice straw with organic and inorganic mineral for feeding ruminants. The possibility of feeding bulls with supplements after their return to free grazing in the evening with ad libitum fodder based on rice straw treated with fertilizer Doom fruit salt (T1) and urea (T2) were been well demonstrated. The result of this study will provide useful information to cattle breeders in the Tandjilé province in southern Chad. The treated of rice straw with organic and inorganic mineral supplemented with GH and Cowpea Haulm and cotton seedcake increased the weight gain and dry matter intake of bulls. It is recommended that grazing bull diets be supplemented with treated rice straw containing Doom fruit salt, poultry manure or urea mixed with cotton seedcake, groundnut and cowpea haulm during dry season.

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Stem Cells in Fish

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Abstract

In 2022, the production of fisheries and aquaculture reached 187 millions tonnes in Turkey. Three different fish species (sea bass, sea bream and rainbow trout) have been becoming important in this sector growing 16% in the last 10 years. Stem cells are classified as undifferentiated cells. They have the potential for self-renewal after becoming the specialized cells. The first study is begun in 1992 on zebra fish, *Danio rerio*. In this study, it is going to give some information on definition, classification, resources, characteristics, application areas and explanation of some previous studies about stem cells.

Key Words: Stem cells, Metabolism, Fisheries, Fish

Balıklarda Kök Hücreler

Özet

2022 yılında, Türkiye balıkçılık ve akuakültür 187 milyon tona ulaşmıştır. Üç farklı balık türü (levrek, çipura ve gökkuşağı alabalık) son 10 yılda % 16 büyümeye gösteren bu sektörde önemli olmuştur. Kök hücreler farklılaşmamış hücreler olarak sınıflandırılır. Kendini yenileme potansiyeline sahiptir ve sonrasında özelleşmiş hücre olurlar. Bu konuda ilk çalışma zebra balıkları, *Danio rerio* üzerine 1992 de başlamıştır. Bu çalışmada, tanımlama, sınıflandırma, kaynaklar, özellikler, uygulam alanları ve kök hücreler üzerine önceden yapılmış hakkında açıklayıcı bilgi verilecektir.

Anahtar Kelimeler: Kök hücreler, Metabolizma, Su ürünleri, Balık



Clinical and molecular determinants of ataxia-telangiectasia in Pakistani ethnicity

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Abstract

Cerebellar ataxia is characterized by nystagmus, tremor, dysarthria, and cognitive impairment. An autosomal recessive condition called ataxia-telangiectasia (AT) is characterized by immune system abnormalities, telangiectases, cerebellar ataxia, and a propensity for cancer. It results from a homozygous or compound heterozygous mutation in the ATM gene at chromosome 11q22. The ATM encodes for the ATM protein, which is one of the proteins that phosphorylates important substrates involved in cell cycle regulation and/or DNA repair in response to damage to DNA. Due to a lack of integrated registries and genetic testing capabilities, prevalence data for cerebellar ataxia are sparse in some Asian countries, most notably Pakistan. The purpose of this research is to shed more light on the genetic and clinical signs of hereditary ataxia in a family from Pakistan. We investigated a Pakistani family that displayed clinical signs of ataxia telangiectasia using whole exome sequencing. On the family members that were available, a segregation analysis was done. The proband's symptoms began at the age of five years old and included muscular weakness, telangiectasia, severe dysarthria, slurred speech, and difficulty walking. We identified a homozygous frameshift variation c.3503dup (p.Cys1168TrpfsTer11) in ATM. The findings of this study contribute to a better knowledge of the genetic architecture and phenotypic diversity of the illness in the Pakistani community.

Keywords: Cerebellar Ataxias; Whole exome sequencing; Pakistan; Consanguinity



Indoor Air Quality, Personal Care Products and Bioherbicides based on Essential Oils

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Abstract

The unclear content of most essential oils, which are readily available in cosmetic stores, local markets and street bazaars, the lack of a legal framework for upper and lower limits of safe use, the unintentional use by non-specialists ignoring the principles of aromatherapy, and the lack of a legal control and law sanction mechanism to monitor their purity have a negative impact on confidence in aromatherapeutic applications. The aim of this review is to provide a risk assessment of diffusers, personal care products and bioherbicides containing different essential oils marketed to consumers of all ages under the labels natural, organic, herbal, etc.

Key Words: Essential oil, indoor air quality, personal care products, health risk

Esansiyel Yağ Temelli İç Mekan Hava Kalitesi, Kişisel Bakım Ürünleri ve Biyoherbisitler

Özet

Kozmetik mağazalarından, yerel marketlerden, semt pazarlarından kolaylıkla temin edilebilen çoğu esansiyel yağın net olmayan içeriği, güvenli kullanım alt ve üst limitlerinin yasal bir çerçevede belirlenmemiş olması, aromaterapi prensipleri göz ardı edilerek alanında uzman olmayan kişilerce bilinçsiz kullanımı, saflıklarını denetlemeye yönelik yasal bir kontrol ve yaptırım mekanizmasının henüz olmaması gibi nedenler, aromaterapotik uygulamalara olan güveni olumsuz yönde etkilemektedir. Bu derlemenin amacı, doğal, organik, bitkisel, naturel vb. sınıflarla her yaştan tüketicinin kullanımına sunulan farklı esansiyel yağları içeren difüzörlere, kişisel bakım ürünlerine ve biyoherbisitlere yönelik bir risk değerlendirmesi yapmaktır.

Anahtar Kelimeler: Esansiyel yağ, iç mekan hava kalitesi, kişisel bakım ürünleri, sağlık riski

Giriş

Gelişen ve gelişmekte olan ülkelerde ikamet eden, yarı veya tam zamanlı bir işte çalışan, hatta çalışmayan insanların çoğu zamanlarının büyük bir kısmını kapalı ortamlarda geçirmektedir. 2019'da Çin merkezli olarak ortaya çıkan ve ölümcül bir enfeksiyon olarak tıp literatüründe yerini alan Covid-19 salgını da kapalı mekanlarda geçirilen sürenin artmasına ivme kazandırmıştır. Gün içerisinde çalışmak, dinlenmek, spor yapmak, sohbet etmek, yemek yemek vb. amaçlarla vakit geçirdiğimiz kapalı ortamlardaki hava kalitesinin iyileştirilmesi, halk sağlığı açısından da önem taşımaktadır.

Kapalı ortamdaki hava içeriğinin ve kalitesinin modifiye edilmesinde tüsüler, kokulu mumlar gibi yanıcı kaynaklar tercih edilebilirken, oda spreyleri ve difüzörleri gibi seçenekler de yaygın kullanılmaktadır. Bununla birlikte, bu tür materyaller tarafından ortama salınan uçucu bileşenlerin, kapalı bir mekanda uzun süre solunmasının nelere yol açabileceğine dair endişeler de mevcuttur.

Kirby ve ark. (2021) tarafından yapılan bir çalışmada, esansiyel yağların solunum yoluyla alınmasının pnömoniye neden olabileceğine dair bir olgu sunulmuştur. Akşamları rahatlamak için esansiyel yağ buharı kokladığını ve ilerleyen saatlerdeki dinlenme sırasında nefes darlığı çektiğini belirten kadın hastada (31 yaş) ilk aşamada, bireyin nefes darlığı şikayetiyle ilişkili olabileceği düşünülen olası nedenler ele alınmıştır. Bu kısımda, hastanın 14 yaşında skolyoz ameliyatı öyküsüne sahip olduğu ve hayatının herhangi bir evresinde sigara ya da elektronik sigara kullanmadığı ifade edilmiştir. Hastanın ilk tanısında, semptomların gece boyunca aerosolize esansiyel yağ kullandıktan sonra başladığı rapor edilirken, göğüs röntgeninde dokulardaki hücreler arası boşluklarda hafif yaygın işaretler gözlenmiştir. Esansiyel yağın daha az sıklıkta kullanılmasının semptomlarda iyileşmeye neden olmadığı belirlenerek, göğüs tomografisi de istenmiş ve radyolojik değerlendirmeler sonucunda akciğerlerde nodüller, interlobüler septal kalınlaşma, tomurcuk halinde ağaç ve minör hava hapsi paterni tespit edilmiştir. Sonuç olarak hastaya hipersensitivite pnömonisi teşhisi konularak, aerosolize esansiyel yağ kullanımını hayatından çıkartması gerektiği tavsiye edilmiştir. Esansiyel yağ kullanımının tamamen kesilmesini takip eden süreçte ise, semptomlar ve radyografik bulguların düzeldiği bildirilmiştir.

WHO (2021), özellikle okullarda bulunan 15 adet uçucu organik bileşene maruz kalmanın sağlık açısından riskli olabileceğini ifade etmektedir. Bu bileşikler formaldehit, asetaldehit, benzen, etilbenzen, ksilen (o, m, p), stiren,



toluen, 1,2,3 trimetilbenzen, 1,4 diklorobenzen, bütül asetat, limonen, α -pinen, tetra ve tri-kloroetilen ve naftalin olarak rapor edilmiş ve olası risklerin, kapalı alanların sık sık havalandırılması veya bu bileşenlerin doğrudan solunmasından kaçınılması ile makul düzeye indirgenebileceği vurgulanmıştır.

Yatıştırıcı ve sakinleştirici özellikleriyle öne çıkan lavanta yağı, dünyanın hemen her kesiminde uzun yıllardır tercih edilmektedir. İn vitro ve in vivo laboratuvar çalışmalarından elde edilen bilgiler, lavanta yağının major uçucu bileşenleri linalool ve linalil asetatın, serotonin taşıyıcısı ve monoamin oksidaz (MAO), γ -aminobutirik asit (GABA) ve N-metil-D-aspartat (NMDA) reseptörleri dahil olmak üzere çeşitli nörofarmakolojik hedeflerle etkileşime girebileceğini belirtmektedir (Donelli ve ark., 2019).

Lavanta yağının masaj yoluyla uygulanmasının da, linalool ve linalil asetatın deriden absorpsiyonla alınmasını sağladığı ve masajdan yalnız 5 dk sonra, her iki bileşenin de kanda tespit edilebilir düzeye eriştiği, en yüksek konsantrasyona 20 dk' da ulaşıldığı ve genellikle masajdan sonraki 90 dk içerisinde her iki bileşenin de kandan elimine edildiği bildirilmiştir (Jäger ve ark., 1992).

Yanak boşluğu olarak da bilinen ağız içi kısmının geçirgenliğinin deriden 4.000 kat daha fazla olduğu ve buradaki emiliminde gastrointestinal sisteme kıyasla 3 ila 9 kat daha fazla olduğu göz önüne alındığında, gargara yapmak vb. amaçlarla direkt ağız içine alınan esansiyel yağların kan dolaşımına hızla girebildiği tespit edilmiştir (Galey ve ark., 1976; Thosar, 2011).

Dünyanın en çok bilinen ve yaygın kullanılan gargaralarından biri olan Listerine, 1879 yılında ilk kez dört esansiyel yağ karışımı olarak formüle edilmiştir. Daha sonra, yağların her biri tek bir bileşenle yer değiştirerek, içerik %25 etanol çözeltisi içerisinde sunulduğundan Listerine artık tıbbi bir bitkisel ürün olarak değerlendirilmemiştir (Vlachojannis ve ark., 2012).

FDA "Reçetesiz İnsan Kullanımına Sunulan Ağız Sağlığı Bakımı İlaç Ürünleri Alt Komitesi" (Subcommittee on Oral Health Care Drug Products for Over-the-Counter Human Use) tarafından 2003 yılında yapılan bir incelemede, Listerine'in etkili ve güvenli olduğu sonucuna varılmış ve bu süreçte yayınlanan çalışmalarda da diş eti iltihabı ve plak oluşumunun önlenmesi için gereken kriterleri sağladığı gözlenmiştir (Vlachojannis ve ark., 2012).

Literatür bulguları Listerine'in ağız sağlığına faydalı olduğu iddiasını desteklerken, başta etanol içeriği olmak üzere, ürünlerdeki bazı bileşenlerin uzun vadeli kullanımının güvenli olduğuna dair endişelerde açıklığa kavuşturulmayı beklemektedir. Araştırmacılar endişeler giderilinceye kadar, yüksek riskli popülasyonların (çocuklar, alkol bağımlıları, etanol metabolizmasında genetik eksiklikleri olan hastalar) ağız sağlığının korunmasında alkol içermeyen gargaraların kullanımını önermektedir (Vlachojannis ve ark., 2012).

Listerin kullanımının güvenliğinin değerlendirilmesi için FDA tarafından yürütülen çalışmalar sonucunda (FDA, 2003);

(i) Her bir esansiyel yağ bileşeninin konsantrasyonunun kendi güvenlik aralığında olması (bir ağız gargarası için % 21.6 ila 26.9 alkollü bir hidroalkolik taşıyıcı içerisinde % 0.092 okaliptol, % 0.042 mentol ve % 0.064 timol kombinasyonu)

(ii) Ürünün uzun (100 yıldan fazla) ve güvenli bir pazarlama geçmişine sahip olması (tüketici şikayetlerinin az olması, satılan her 38.700.000 doz için bir adet yan etki bildirilmiştir)

gibi nedenlerle Listerine'in mukozal irritasyon potansiyelinin minimum olduğu ve esansiyel yağ bileşenlerinin %25 etanol içerisinde sunulmasının da etiket talimatlarına göre kullanıldığında güvenli olduğu sonucuna varılmıştır.

FDA raporundan sonra yayınlanan bir çalışmada ise (Fischman ve ark., 2004), 61 yaşındaki 19 kadın denekte 14 gün boyunca günde üç kez 30 s boyunca 20 ml Listerine ile gargara yapan, bireylerin yumuşak doku muayenelerini gerçekleştirilmiştir. Muayenelerin 7. gününde sadece iki denekte oral mukozal anormallikler tespit edilirken, muayenenin 14. gününde normal görünümlü kolayca silinen asemptomatik bir 'beyazımsı tortudan' gözlenmiş ve sonuç olarak ağız mukozası normal izlenmiştir.

Esansiyel yağ içeren gargaraların ciddi bir yan etki olmaksızın, 6 aya kadar kullanıldığı bazı çalışmalar ise, esansiyel yağların oral alımının sağlık üzerinde olumsuz etkiye neden olmadığını destekler niteliktedir (Sharma ve ark., 2010; Samuels ve ark., 2012).

Listerine dünya çapında en yaygın kullanılan ağız gargaralarından biri olmasına rağmen genotoksitesi hakkındaki bilginin çok sınırlı olması nedeniyle, genetik çalışmalarda yürütülmüştür.

Türkez ve ark. (2012) tarafından yürütülen bir çalışmada, genetik hastalığın ilerlemesinin doğrudan bir göstergesi kabul edilen son noktalar olarak mikronükleus ve tek hücre jel elektroforez testleri kullanılarak Listerine'nin in vitro genotoksik potansiyeli araştırılmıştır. Çalışma verileri, kontrol grubu ve sadece listerinle muamele edilen grupların mikronükleus ve tek hücre jel elektroforez testleri arasında istatistiksel olarak anlamlı bir fark olmadığını ($p > 0.05$) göstermiştir. Diğer bir ifadeyle, Listerin kullanımının insan lenfositleri üzerinde genotoksik bir etkisi söz konusu değildir.

Bu konudaki en güncel veri ise 2022 yılında FDA tarafından geçerli bir ürün bildirim sertifikasına sahip olmaması nedeniyle "Listerine coolmint pocket mist"i, satın almamaları ve kullanmamaları konusunda yapılan halk sağlığı uyarısıdır. Nane, okaliptus ve kekik esansiyel yağlarının major bileşenleri menthol, eucalyptol, thymol gibi uçucuları içeriğinde barındıran bu ürün FDA'nın ürün bildirim sürecinden geçmediği için, tüketiciler açısından



potansiyel tehlike taşıdığı ve cilt tahrişi, kaşıntı, anafilaktik şok, organ yetmezliği dahil bazı olumsuz reaksiyonlara yol açabileceği bildirilmiştir (FDA, 2022).

Son yıllarda, kanserden üreme bozukluklarına kadar olumsuz birçok yan etkisi kanıtlanmış olan sentetik herbisitler yerine biyo-bazlı ürünlerin tarımda kullanılması da önem kazanmıştır. β -pinen, farnesen, öjenol, 1,8-sineol, juglon, α -pinen, kafur, limonen, mentol, sitral, karvakrol, timol, geraniol vb. uçucu bileşenler ve elbette bu bileşenleri içeren tüm esansiyel yağların, konsantrasyonlarına bağlı olarak herbisidal aktivite sergilediği ve biyoherbisit olarak değerlendirilebileceği bildirilmiştir (Werrie ve ark., 2020; Maes ve ark., 2021).

Esansiyel yağların biyoherbisit olarak kullanımının sentetik molekülere kıyasla iki büyük avantajı şu şekilde özetlenebilir (Koul ve ark., 2008);

- (i) Yüksek uçuculuk özellikleri nedeniyle toprak, gıda veya sudaki kalıntıları önemli ölçüde azaltmaları
- (ii) Bileşiminde birkaç etki moduna sahip bileşikler içermesi nedeniyle yabancı ot direnci geliştirme olasılığını azaltmaları.

Tüm bu biyolojik avantajlarına rağmen, esansiyel yağların biyoherbisit olarak kullanım riskleri de muhakkak değerlendirilmelidir. Özellikle esansiyel yağa maruz kalma süresi ve maruz kalma şekline bağlı olarak rapor edilen spesifik riskler söz konusudur. Herbisiti uygulayacak kişinin esansiyel yağ solüsyonunu hazırlaması, tankı doldurması sırasında deri yoluyla temas etmesi akut toksisite nedeniyle, ürünün uygulanması sırasında uçucu kısmın solunması da kronik herbisit zehirlenmesine yol açmaktadır. Bu bakımdan bireyin uygulama şekli (sırt çantalı püskürtme düzeneği, tractor kabininden püskürtme), koruyucu ekipman tercih edip etmemesi, uygulama yapılacak ortam sıcaklığı, rüzgar yönü ve şiddeti gibi iklimsel koşullar da birer risk etmeni olarak değerlendirilmelidir (Mossa, 2016).

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Determination of Evapotranspiration and Optimum Irrigation Schedule For Cotton in Çukurova Region Using CROPWAT Model

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Abstract

The agriculture sector is actively looking for the most effective ways to manage water resources. Proper water management is crucial for increasing agricultural productivity and optimizing the region's water usage efficiency. The aim of this study was to estimate the irrigation water requirement, reference and crop evapotranspiration and irrigation schedule for cotton in Çukurova region over a 31-year period (1990-2020) using the CROPWAT model. To ensure appropriate water utilization and planning, information regarding the climate data was obtained from the Adana station of Turkish State Meteorology Service. The soil and crop data were sourced from Turkey's Ministry of Food, Agriculture, and Livestock. The CROPWAT 8.0 model was used to determine the irrigation dates, irrigation amount, effective rainfall, net irrigation requirement (NIR), and yield reduction for rainfed and various irrigated circumstances. The findings indicated that the average reference evapotranspiration (ET_o), crop evapotranspiration (ET_c) for cotton and effective rainfall were 804 mm, 731 mm, and 27 mm respectively. It was also estimated that the dates of irrigation after planting (DAP) were 72 days, 101 days, 131 days and 170 days. The total amount of irrigation water used during the growing period at critical depletion and user defined were 700 mm and 545 mm respectively, thus 155 mm of water was saved (22%). Data of maximum crop yield obtained at critical depletion by CROPWAT was associated with data from Turkish Statistical Institute (TUIK) (2014-2020) and TUIK data is compared with CROPWAT data which was estimated under rainfed condition. According to the result 51% of yield reduction was simulated when irrigation was not applied.

Key Words: CROPWAT, Evapotranspiration (ET_o), Net Irrigation (NIR), Effective rainfall, Crop yield



The Effects of Spray Drying Parameters on The Functional Properties of Safflower Protein Isolate

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Abstract

This study aimed to investigate the effect of spray drying parameters on the functional properties of safflower protein isolate. Safflower protein was extracted using the alkaline extraction and isoelectric precipitation method and then spray dried at different inlet air temperatures (160, 170, 180 °C), aspiration rates (44, 52, 60 m³/h), and feed flow rates (16, 18, 20 mL/min). In the spray drying of safflower protein, increasing the aspiration rate had an increasing effect on the solubility of the protein, while increasing the inlet air temperature had a decreasing effect. The water holding capacities of safflower protein isolate increased with increasing inlet air temperatures. However, increasing the feed flow rate was found to have a decreasing effect on the water retention capacity of proteins (from 1.67 g water/g protein to 1.47 g water/g protein). Increasing inlet air temperature from 160 to 180 °C resulted in an increase from 2.40 to 2.60 g oil/g protein in the oil binding capacities of safflower protein isolates. The increasing aspiration rate had a significant decreasing effect on the foaming capacity of the samples ($p < 0.05$), while the effects of inlet air temperature and feed flow rate were insignificant ($p > 0.05$). The emulsion activity and stability values of safflower protein isolates changed in a range of 49.75-54.50% and 81.28-87.51%, respectively. The effect of spray drying parameters on the emulsion properties of the samples was found to be insignificant ($p > 0.05$). As a result, it was found that spray drying parameters affected some functional properties of safflower protein isolate. Thus, determining the spray drying parameters in the production of safflower protein isolate is crucial in providing the functional properties needed for different food applications. This research was supported by the Turkish Scientific and Technological Research Council (TÜBİTAK, Project No: 222O238).

Key Words: Safflower, plant protein, solubility, foaming capacity, emulsion activity

Püskürtmeli Kurutma Parametrelerinin Aspir Protein İzolatının Fonksiyonel Özellikleri Üzerine Etkileri

Özet

Bu çalışmada püskürtmeli kurutma parametrelerinin aspir protein izolatının fonksiyonel özellikleri üzerine etkisinin araştırılması amaçlanmıştır. Aspir proteinini, alkali ekstraksiyon ve izoelektrik noktada çöktürme yöntemi kullanılarak ekstrakte edilmiş ve ardından farklı hava giriş sıcaklıklarında (160, 170, 180 °C), aspirasyon hızlarında (44, 52, 60 m³/saat) ve besleme akış hızlarında (16, 18, 20 mL/dak) kurutulmuştur. Aspir proteininin püskürterek kurutulmasında aspirasyon hızının artması protein çözünürlüğünü artırıcı etki gösterirken, hava giriş sıcaklığının artmasının azaltıcı etkisi olmuştur. Aspir proteinini izolatının su tutma kapasitesi artan hava giriş sıcaklığıyla birlikte artmıştır. Bununla birlikte, artan besleme akış hızının proteinlerin su tutma kapasitesini azaltıcı (1.67 g su/g proteinden 1.47 g su/g proteine) etkisi bulunmuştur. Hava giriş sıcaklığının 160 °C'den 180 °C'ye artırılması, aspir protein izolatlarının yağ bağlama kapasitelerinin 2.40'dan 2.60 g yağ/g protein değerine armasına neden olmuştur. Artan aspirasyon hızının örneklerin köpürme kapasitesi üzerinde önemli bir azaltıcı etkisi bulunurken ($p < 0.05$), hava giriş sıcaklığı ve besleme akış hızının etkisi ise önemsizdir ($p > 0.05$). Aspir protein izolatlarının emülsiyon aktivite ve stabilite değerleri sırasıyla %49.75-54.50 ve %81.28-87.51 aralığında değişmiş olup püskürtmeli kurutma parametrelerinin örneklerin emülsiyon özelliklerine etkisi önemsiz bulunmuştur ($p > 0.05$). Sonuç olarak püskürtmeli kurutma parametrelerinin aspir protein izolatının bazı fonksiyonel özelliklerini etkilediği tespit edilmiştir. Bu nedenle aspir protein izolatının üretiminde püskürtmeli kurutma parametrelerinin belirlenmesi, farklı gıda uygulamaları için ihtiyaç duyulan fonksiyonel özelliklerin sağlanması açısından büyük önem taşımaktadır.

Bu araştırma Türkiye Bilimsel ve Teknolojik Araştırma Kurumu (TÜBİTAK, Proje No: 222O238) tarafından desteklenmiştir.

Anahtar Kelimeler: Aspir, bitkisel protein, çözünürlük, köpürme kapasitesi, emülsiyon aktivitesi





Effect Of Lower Niger River Basin Development Authority Irrigation Technologies Usage On Rice Farmers Output In Kwara State, Nigeria

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Abstract

The water crisis being experienced is not about having too little water to satisfy human needs especially in agriculture but a crisis of proper utilization. Irrigation activities in Nigeria have been put into practice on small-scale irrigation schemes and the utilization on large scale production level needs to be investigated. The study therefore, assessed the effect of Lower Niger River Basin Development Authority (LNRBDA) irrigation technologies usage on rice farmers output in Kwara State, Nigeria. A multistage sampling procedure was employed in selecting 178 respondents for the study. The data collected for the study were analyzed using descriptive statistics such as frequency counts, percentages, mean, Weighted Mean Score (WMS) and standard deviation, while Paired T-test analysis was used to test significance difference between the output of rice per hectare before and during the LNRBDA irrigation technologies. The study showed that LNRBDA irrigation technologies were beneficial to rice farmers by aiding their financial buoyancy. Also, the result of paired t-test analysis showed significance difference between the output of rice per hectare in 2016 (Pre-LNRBDA irrigation technologies) and in 2019 (during utilization of irrigation technologies) by the rice farmers ($p=0.000$, $t= 8.642$). It was concluded that LNRBDA irrigation technologies obviously led to increase in the output of rice farmers. Therefore, there is the need for concerned stakeholders such as rice farmers' groups and extension experts to collaborate with LNRBDA thereby organizing trainings to sensitize and improve their knowledge on the use of the available LNRBDA irrigation technologies, as this is expected to enhance their production level.

Key Words:

Introduction

To achieve improvement in food security and respond to menace of climate variability in the country there is necessity to look beyond rainfed agriculture in order to have all year round production of agricultural produce. This study is significantly tailored to assess the technologies transferred on rice production. Nigeria has a high population growth rate, and the demand for food is increasing rapidly. Without efficient irrigation technologies, it will be challenging to meet the food demands of the nation. Food and Agriculture Organization (FAO, 2020).

The World Bank, through its Nigeria Sustainable Rural Water Supply and Sanitation Project, has been focusing on improving access to irrigation technologies in rural areas of Nigeria. The project aims to enhance agricultural productivity and promote sustainable water management practices to alleviate poverty and boost economic growth (World Bank, 2019). According to Ugbo (2020), irrigation technologies in Nigeria is a necessity to combat the negative impacts of climate change because drought and unpredictable rainfall patterns are becoming more prevalent, making irrigation crucial for ensuring a stable food supply.

The Nigerian Irrigation and Drainage Society (NIDS) highlights the significant potential of irrigation technologies to boost agricultural production in Nigeria. They emphasize that about 20% of the land suitable for irrigation in Nigeria is currently being utilized, indicating the need for increased adoption of irrigation technologies to maximize productivity. (NIDS, 2018). Similarly, Nigerian Investment Promotion Commission (NIPC) recognizes the importance of irrigation technologies as a means of diversifying Nigeria's economy and reducing dependence on oil. They encourage both local and foreign investors to explore irrigation investment opportunities in the country (NIPC, 2019).

However, financial constraint is one of the major barrier to the utilization of irrigation technologies in Nigeria. Small holders farmers mostly lack the necessary capital to invest in irrigation equipment and infrastructure (Adewumi, 2021 *et al.*). Similarly, the absence of adequate extension services hinders the effective adoption and utilization of irrigation technologies in Nigeria. Farmers often lack technical knowledge and skills required for proper operation and maintenance of irrigation systems. In a study conducted by Omoteso *et al.* (2020), it was found that the lack of extension services was a vital constraint to the adoption of irrigation technologies in North Central Nigeria.

Considering that Nigeria is well endowed with water and land resources for irrigation farming, utilization of these resources can close the demand supply gap of rice in the country. A considerable increase in production is essential for Nigeria to meet up with the growing demand considering its fast growing population. The utilization of the



irrigation facilities and participation of farmers with the parastatal have been low due to wrong perception or inadequate information of their activities. (Alalade *et al*, 2017). Limited infrastructure such as water storage facilities, reservoirs, and distribution networks pose problems to the use of irrigation technologies in Nigeria. According to Usman *et al* (2019), poor infrastructure development was identified as a significant constraint to the adoption and expansion of irrigation technologies in Northwestern Nigeria.

There are numerous irrigation schemes or projects in Kwara State, Nigeria and majority of them are under the supervision of Lower Niger River Basin Development Authority (LNRBDA), examples are the Oke-Oyi Irrigation Scheme, Tada Shonga irrigation Project, Oyun irrigation Project, Rogun irrigation Project, Erin-Ile Water Supply and Irrigation Project.

Despite the efforts of the River Basin and Rural Development Authorities (RBRDAs) and other stakeholder in utilizing the water bodies of the country, through construction of large dams, canal development, introduction of various irrigation technologies, providing extension services on use of irrigation services and provision of irrigation schemes in order to increase food production, Nigeria is yet to reach food sufficiency level. One of the reasons ascribed for this inadequacy is the low level of utilization of farmers in the dry season irrigation for farm production by the small scale farmers, who are majorly the food producers for the local consumers in this country. This study therefore broadly analyse the effect of the utilization of Lower Niger River Basin Development Authority (LNRBDA) irrigation technologies on rice farmers output in Kwara State, Nigeria. Specifically, the study identified the irrigation technologies used by LNRBDA rice farmers; ascertained the frequency of utilization of the identified irrigation technologies used for rice cultivation; ascertained the output of rice farmers before and during the utilization of LNRBDA irrigation technologie and determined the benefit derived from the utilization of irrigation technologies by LNRBDA rice farmers.

Methodology

This research was carried out in Kwara State, Nigeria. Kwara State is located on latitude of 8.5' and 8° 30' 00''N and longitude of 5' and 5° 00' 0'' E of the equator. Kwara State is bounded in the north by Niger State and naturally by River Niger to the East is Kogi State, while it shares boundary with Oyo, Ekiti, Osun State in the south Agriculture is the main source of the economy and the principal cash crops are: cotton, coffee, tobacco, beniseed and palm produce. (Kwara State Government, 2017).The state is blessed with a river basin named lower niger River Basin Authority and this aids irrigation farming in the study area.

Lower Niger River Basin has one area office located in Ilorin, Ilorin area office have about ten functional project offices. Abati, Erin-Ile, Okuta, Oke-Oyi, Kaima, Ilala, Mosagada, Yashika, Omu-Aran and Asa.From the LNRBDA ten functional project offices, simple random sampling technique was used to select 50% functional project offices which includes: Oke-oyi, Kiama, Okuta, Mosagada and Asa. In addition. Also, simple random sampling technique was used in the selection of 50% of registered rice farmers with LNRBDA. Therefore, a total number of one hundred and seventy-eight registered rice farmers with LNRBDA were used for this study (LNRBDA, 2020).

The instrument used to elicit information from the rice farmers is a well-structured interview schedule which involved personal interview with the respondents. The variable for the study includes both the dependent and independent variables. The dependent variable is the effect of utilization of LNRBDA irrigation technologies. This is the output of rice per hectare which is measured at ratio level in kilogram. Data collected for the study were coded using Paired T-test analysis to determine significant difference between output of rice before and during the use of LNRBDA irrigation technologies

LNRBDA Irrigation Technologies Available

The result in Table 1 reveals the available LNRBDA irrigation technologies by rice farmers All (100.0%) of the respondents indicated the availability of tillage operation (ploughing and harrowing); 99.4% indicated the availability of LNRBDA irrigation technologies such as fertilizer application (NPK 15:15:15 and Urea); 98.9% indicated transplanting seedlings; 98.3% indicated seeded planting and use of perdimethadin; 97.8% and 97.2% indicated measuring the water use efficiencies and uniformity co-efficiencies while 96.6% indicated tillering and supplying, application of efficiency and water storage efficiency as LNRBDA irrigation technologies available to the rice farmers in the study area.

Also, 94.4% of the respondents indicated use of both propanil +2, 4-D amine and cover large acres in smaller time as available LNRBDA irrigation technologies; 93.9% indicated application of pesticides and fertilizer while 91.6% indicated conveying water to the surface of soil as available LNRBDA irrigation technologies in the study area. In addition, 88.8%, 83.6%, 83.2% indicated the availability of water test, use of reaper machine and use of robot gun as LNRBDA irrigation technologies in the study area. Meanwhile, 78.2%, 76.5%, 76.0% and 74.9% indicated use of hand sickle, developed to conserve water, FARO 52 and allowing percolation with run-off as available LNRBDA technologies respectively in the study area.



Furthermore, almost 70.0% of the respondents indicated development of similar rainfall and water drop into smaller droplet as available LNRBDA irrigation technologies while 32.4% and 39.2% indicated FARO 61 and FARO 44 respectively as LNRBDA irrigation technologies available in the study area. Lastly, 21.8% and 19.0% indicated use of ringing bell and use of combine harvester as LNRBDA irrigation technologies available in the study area for use by the rice farmers. Generally, this result implies that LNRBDA as an agency has made available different irrigation technologies to aid rice cultivation in the study area, and this is expected to improve rice production if well utilized. The result is in tandem with the findings of Alalade *et al.*, (2017) where majority (92.5%) of the respondents had prior knowledge of irrigation technologies. They affirm that irrigation technologies has increased their productivity.

Table 1. Distribution of respondents according to available LNRBDA irrigation technologies

LNRBDA irrigation technologies*	Availability	
	Frequency	Percentage
Check basin		
Water conservation technology	137	76.5
Percolation with run-off technology	134	74.9
Sprinkler		
Similar to rainfall technology	122	68.2
Smaller droplets of water technology	121	67.6
Center Pivot		
Fast spraying with smaller time technology	169	94.4
Pesticides and fertilizer application technology	168	93.9
Furrow		
Surface water target technology	164	91.6
Agronomic practices		
Ploughing and Harrowing)	179	100.0
Seeded planting	176	98.3
Transplanting seedlings	177	98.9
Tillering and Supplying	173	96.6
Fertilizer application(NPK 15:15:15 and Urea)	178	99.4
Weed control		
Perdimethadin	176	98.3
Propanil +2,4-D amine	169	94.4
Pest control		
Use of Robot gun	149	83.2
Ringing bell	39	21.8
Rice varieties		
FARO 44	54	30.2
FARO 52	136	76.0
FARO 61	58	32.4
Water management		
Water use efficiency measurement	175	97.8
Water storage efficiency	173	96.6
Uniformity co-efficiencies	173	96.6
Water test	174	97.2
Harvesting		
Use of hand sickle	140	78.2
Use of reaper machine	150	83.6
Use of combine harvester	34	19.0

Source: Field survey, 2022, * Multiple response

Benefits derived from the utilization of LNRBDA irrigation technologies

Table 2 revealed the various benefits derived by the rice farmers from the utilization of LNRBDA irrigation technologies in the study area. All (100.0%) the respondents indicated improvement on financial bouyancy and improvement in skills/knowledge about hybrid rice cultivation as benefits derived from the utilization of LNRBDA irrigation technologies while 99.4% indicated help in all year round cultivation, increase social status of rice farmers, reduced in pest and disease infestation on the rice farm, improved in awareness about technologies in rice production, brought about good relationship with extension contact, aids increment in the size of rice farmland cultivated and motivated fellow farmers interest in cultivation of rice respectively.



Furthermore, 98.9% of the respondents indicated increased frequency of access to LNRBDA officials; 98.3% indicated access to government provision of rice farm input while 97.8% indicated provision of opportunity to access credit facilities as benefits derived from the utilization of LNRBDA irrigation technologies respectively. Generally, this result implies that rice farmers in the study area have benefitted immensely from the utilization of LNRBDA irrigation technologies, an indication that LNRBDA has contributed to the development of the rice farmers, rice cultivation and the economy of the study area due to the introduction of the irrigation technologies to the rice farmers. This result is in consonance with the findings of Alalade *et al.*, (2017) who noted increase in standard of living of the rice farmers and increase in their social status as major benefit farmers derived from the use of irrigation technologies.

Table 2. Distribution of respondents according to benefits derived from the Utilization of LNRBDA Irrigation technologies

Benefits derived*	Frequency	Percentage
It aids all year round cultivation	178	99.4
It aids rice farmers financial buoyancy	179	100.0
It increase social status of rice farmers	178	99.4
Improvement in skills and knowledge about hybrid rice cultivation.	179	100.0
It has reduced pest and disease infestation on the rice farm	178	99.4
It has improved my awareness about technologies in rice production	178	99.4
It has brought about good relationship with extension contact	178	99.4
It has increased the frequency of access to LNRBDA officials	177	98.9
It has aid increment in the size of rice farmland cultivated	178	99.4
It has motivated fellow farmers interest in cultivation of rice	178	99.4
It provides opportunity to access credit facilities	175	97.8
It offers access to government provision of rice farm input	176	98.3

Source: Field survey, 2022, * Multiple response

Distribution of respondents according to the output of rice farmers before the year 2016 and during 2019 production cycle utilization of LNRBDA technologies

LNRBDA agency allocated same size of farmland to rice farmers in the study area per area office, hence this ensures that farmers were given access to LNRBDA irrigation technologies used for rice cultivation. This was done to ensure easier comparison of the output of the farmers and to reveal the level of expertise of the farmers on the use of irrigation technologies made available to them. The result gotten from the farmland as indicated by the respective rice farmers is discussed

Almost 60.0% of the respondents indicated they harvested not more than 2000kg per production cycle; 41.9% indicated they harvest above 4000kg while 0.6% indicated they harvest between 2001-4000kg of rice per production cycle respectively. The mean rice output harvested per production cycle by rice farmers before the year 2016 in the study area was revealed to be 2333.0kg. This result affirms that rice cultivation is dominated in the study area and produced for commercial bases, though on a low scale level of production.

Meanwhile, output gotten from the respondents for during the use of LNRBDA irrigation technologies in the year 2019 indicates that there is improvement in the yield of rice farmers. The result reveals that 67.1% of the respondents indicated they harvest above 4000kg of rice during the use of LNRBDA irrigation technologies; 28.0% indicated between 2001-4000kg of rice output per production cycle while only 5.0% indicated not more than 2000kg as rice output per production cycle during the use of LNRBDA irrigation technologies in the year 2019. The mean rice output during the use of LNRBDA irrigation technologies was revealed to be 4121.8kg. This result implies that rice farmers output increased significantly with the use of LNRBDA irrigation technologies, an indication that LNRBDA irrigation technologies are having a positive effect on the farmers and their welfare. The result is in consonance with the findings of Alalade *et al.*, (2017), where farmers have increased production rate due to the use of irrigation technology. This is expected to have effect on their financial buoyancy and ultimately improve their standard of living.

Table 3: Distribution of respondents according to rice yield per production cycle before 2016 and during 2019 utilization of LNRBDA technologies

Output (Kg)	Before use of LNRBDA in the year 2016 F (%)	During use of LNRBDA in the year 2019 F (%)
≤2000	103 (57.5)	9 (5.0)
2001-4000	1 (0.6)	50 (28.0)
Above 4000	75 (41.9)	120 (67.1)
Mean	2333.0kg	4131.8kg

Source: Field survey, 2022



Paired T-test analysis showing significance difference between output of rice before and during the use of LNRBDA irrigation technologies

The result of paired T-test in Table 4 revealed that there is significant difference between the output of rice before and during utilization of irrigation technologies by the rice farmers ($t=-8.642$; $p=0.000$). This result implies that irrigation technologies have had a direct influence on the increase in the output of rice.

Table 4 T-test analysis showing difference between output of rice before and during utilization of LNRBDA irrigation technologies

Variable	mean	t-value	df	Sig. value	Decision
Output before and during utilization of LNRBDA irrigation technologies	2115.084	8.642	178	0.000	Significant

Source: Computed Data, 2022

Conclusion and Recommendations

From the research findings, it was confirmed that rice farmers in the study area had benefitted immensely from the presence of LNRBDA in the study area, as irrigation technologies provided by the agency is being utilized to aid rice production by the rice farmers in the study area. LNRBDA irrigation technologies have obviously impacted the rice output with increase in their output.

The study recommended that rice farmers' groups should organize trainings to sensitize and improve their knowledge on the use of the provided LNRBDA irrigation technologies as governments cannot do it all, this is expected to improve their expertise in the use of the LNRBDA irrigation technologies which will enhance increased in output of rice cultivated in the study area.

Also, The LNRBDA irrigation technology has been impactful to respondents in the study area, therefore, there is need for LNRBDA authorities to spread the innovation to other areas of coverage so that more rice farmers can benefit from it.

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Yield and soil status disparity under rice-wheat cropping system: A 40 years Journey

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Abstract

Long-term soil fertility experiment is valuable for evaluating the effects of continuous cropping on the capacity of a soil to sustain nutrient supply and the productivity. Thus, experiment was conducted to know the impact of different dose and source of fertilizers on crop yields under rice-wheat system in Directorate of Agricultural Research (DoAR), Bara. The experiment was carried out in Randomized Complete Block Design (RCBD) with 12 treatment and three replication from 1991 to till date. In this study, we used the latest seven years data viz. 2015, 2016, 2017, 2018, 2019, 2020 and 2021 for evaluating the yield and yield attributes of rice. The result showed that 50%N +FYM treated plot fb 100:30:30 NPK provided stable yield 3670-3835 kg/ha in rice and 2505-2694 kg/ha in wheat. However, inherent soil nutrient capacity still supporting more than 1999±550 kg/ha yield without any fertilizer application. The use of NPK plot had higher yield in decreasing trend and decreasing soil status. The pH was highly reduced in other treatment to average 5.4 but remain slightly decline in control from initial. The organic matter, N, P, and K was constantly high in FYM treated plot but notice declined in other plot. So, this concluded that use of organic matters with reduce N could provide stable and higher yield and enhance soil status over long period of time.

Key Words: Fertilizer, Nutrient, Rice, Soil-Fertility, Yield

Introduction

Rice and wheat are the most important staple food crops of Nepal and mostly grown in Terai region. The production and productivity of these crops is comparatively less than neighboring country like India and China (MoALD, 2021), but the production has increased markedly with the introduction of modern technologies based on chemical fertilizer application and organic amendment (S. et al., 2001). Continuous cropping pattern removes the huge nutrient from the soil with harvested grain and straw that causes the depletion of soil fertility (Haque et al., 2019; Nishida, 2016; Rawal et al., 2017; Talpur et al., n.d.). Several evidences showed intensive cultivation leads to decrease of soil organic carbon and soil fertility continuously (Haryuni et al., 2020), through the process of leaching, erosion and intensifying global warming. These causes farmers to focus for adding more inputs to obtain the same yields (De Datta & Gomez, 1975). In other hand, non-judicious use of chemical fertilizers causes the environment effect and finally causes deterioration of physical, chemical and biological component of soil fertility (Dong et al., 2012). Soil fertility is important natural input cost for sustainable and stable yield (Regmi et al., 2003).

In Nepal, the productivity decline due to lack of application of optimum NPK fertilizer inputs due to unavailability in market at the time of application and unaware of management practices (Rawal et al., 2017). Deficient in macro and micro-nutrient are the important factor causing the yield loss this days (S. et al., 2001; Talpur et al., n.d.; Yang et al., 2020). So, sole dependent on chemical fertilizer could cause long term harmful to both soil and human health and suffer from decline in yield and unstable and finally food hunger. Sustainable management and fertility improvement can be done through organic amendment and stubble incorporation (Gao et al., 2023; Yang et al., 2020). These added organic matter in soil act as a very reactive and ubiquitous soil quality indicators that influence the productivity and physical well-being of soils (Diacono & Montemurro, 2010).

Long term soil fertility experiment (LTFT) are valuable for evaluating the impact of continuous cropping on the capacity of a system to sustain nutrient supply and productivity. Reports from different LTFT conducted in Nepal revealed that organic amended plot provides the stable yield over year and also cut off half nitrogen in preceding crop wheat (Shrestha 2021), cause of wheat yield decline due to K deficiency in both rice-wheat and stable yield in NPK and FYM used (Rawal et al., 2017).

In the present study, the experiment of LTFT of rice-wheat system conducted over 4 years in DoAR, Parwanipur, Madhesh Province, Nepal to study the yield and yield attributes response to different fertilizer used.



Materials and Methods

Long-term experiment is valuable for evaluating the effects of continuous cropping on the capacity of a system to sustain nutrient supply and the productivity. This experiment was started in 1980/81 to evaluate the effects of organic manure and inorganic fertilizers on crop yields and to study the effects of N with or without P and K in the long run under rice-wheat system. The experiment was carried out in Randomized Complete Block Design (RCBD) with 12 treatment (Table 1 and 2) with 3 replication in DoAR, Parwanipur, Madhesh Province, Nepal over 2018-2021. Individual plot was allocated 24 m². Fertilizer was applied as per the treatment. All P and K and ½ N was applied in basal dose while two split of remaining N was applied as Top dress. Swarna Sub-1 varieties has been used and two seedling were transplanted in 20X 20 cm spacing. The transplantation of rice was done in 15-30 July of each year and wheat sown at october 15-20. Gautam varieties of wheat was used. Inter-cultural operation was conducted as required. Yield and yield attributes were observed at the time of harvesting. Yield was adjusted based on moisture percent in grain as formula as (Mulvaney & Devkota, 2020)

$$\text{Adjusted Yield (Kg/ha)} = \frac{\text{Yield at Harvested Moisture} \times (100 - M\% \text{ at harvest})}{(100 - \text{standard } M\%)}$$

Harvested Index was calculated as (Amanullah & Inamullah, 2016)

$$HI = \frac{\text{Economic Yield (Kg/ha)} \times 100}{\text{Biological Yield (kg/ha)}}$$

Sterility (Mitsuya et al., 2019)

$$\text{Sterility} = \frac{\text{No of unfilled grain} \times 100}{\text{Total grain}}$$

Statistical analysis was done through Genstat ver. 2015, and ranking of mean separation done by using Duncan Multiple Range Test (DMRT). Statistical significance for all analyses was evaluated at $P < 0.05$ unless otherwise stated.

Table 1. Treatments of long-term soil fertility experiment under rice-wheat system 2018-2021

Treatments	Rice (N:P ₂ O ₅ :K ₂ O kg ha ⁻¹)	Treatments	Rice (N:P ₂ O ₅ :K ₂ O kg ha ⁻¹)
T ₁	0:0:0	T ₇	50:0:0
T ₂	100:0:0	T ₈	50:20:0
T ₃	100:30:0	T ₉	FYM @ 10 t ha ⁻¹
T ₄	100:0:30	T ₁₀	100:30:30 + 25 kg ZnSO ₄ ha ⁻¹
T ₅	100:30:30	T ₁₁	50:0:0 + FYM 10 t ha ⁻¹
T ₆	100:0:30	T ₁₂	50:0:0 + Chopped straw 10 t ha ⁻¹

Table 2. Treatments of long-term soil fertility experiment under rice-wheat system 2018-2021

Treatments	Wheat (N:P ₂ O ₅ :K ₂ O kg ha ⁻¹)	Treatments	Wheat (N:P ₂ O ₅ :K ₂ O kg ha ⁻¹)
T ₁	0:0:0	T ₇	50:0:0
T ₂	100:0:0	T ₈	50:20:0
T ₃	100:30:0	T ₉	FYM 10 t/ha
T ₄	100:0:30	T ₁₀	100:30:30
T ₅	100:30:30	T ₁₁	100:30:30
T ₆	100:30:30	T ₁₂	100:30:30

Result and Discussion

Gami et al 2000 reported that there was significant difference in yield of rice at 1981-2000 interval and Shrestha et al., 2015 also showed the same. The result from 2015-2021 of consecutive year revealed that use of fertilizer especially N play great role in yield. With the increase of N as compared to control plot, yield has doubled from 1980 to 3089 kg/ha. With decrease in N, yield has declined upto 33 %. Interestingly, plot treated with 50 N kg/ha with FYM 10t/ha had higher yield 3630-3835 kg/ha which can reduces the use of chemical fertilizer in future days. However use of complete NPK fertilizer had although maintained their yield at par but, it showed the decreasing trend in yield.



Table 3. Rice yield over 40 years at different time interval

Treatment	Rice Yield (Kg/ha)		
	1981-2000	2000 to 2014	2015-2021
0:0:0	2540 c	1927.7±109.5 h	1980±424.8 g
100:0:0	3550 ab	3058.1±119.7 def	3089±882.8de
100:30:0	3610 ab	3330.4±10.5 bcd	3359±929.2 bcd
100:0:30	3700 ab	3128.8±106.5 cdef	3236±959 cd
100:30:30	3985 a	3571.2±88.6 abc	3302±846.4 bcd
100:0:0	3770 ab	3494.3±123.7 abcd	3778±864.9 a
50:0:0	3085 bc	2527.6±92.4 g	2671±674.4 f
50:20:0	3515 ab	2746±100.0 fg	2723±730 ef
FYM 10 t/ha	3280 ab	2808.7±109.5 efg	3207±877.4cd
100:30:30+25 Kg ZnSO ₄	3855 a	3706.2±103.8 ab	3616±909.5 abc
50:0:0 +FYM 10t/ha	3670 ab	3835.2±101.6 a	3691±869.4 ab
50:0:0 +10t/ha chopped straw	3630 ab	3276.6±110.9 bcde	3064±812.9 def
P value	<0.001	<0.001	<0.001
HSD value	NA	497.1	385.2
CV (%)	12	21.2	7.2
	Gami et al., 2000	Shrestha et al., 2015	

Table 4. Wheat Yield over 40 years at time interval

Treatment	Wheat Yield (Kg/ha)		
	1981-2000	2000 to 2014	2015-2021
0:0:0	1025	577.2±28.8 e	526±184.6
100:0:0	2030	944.1±66.4 de	826±331.1
100:30:0	2055	1614.6±112.3 b	1299±882.0
100:0:30	2290	1449.6±70.8 bc	1188±788.7
100:30:30	2420	2454.9±107.8 a	2448±943.2
100:30:30	2430	2258.8±114.5 a	2526±980.9
50:0:0	1705	1128.4±58.1 cd	1004±527.0
50:20:0	1905	1358.7±88.3	1629±680.6
FYM 10 t/ha	1435	1203.3±55.6 bcd	924±335.8
100:30:30	2505	2398.8±126.9 a	2634±944.9
100:30:30	2465	2533.8±113.1 a	2876±725.7
100:30:30	2570	2478.7±121.5 a	2740±711.3
P value	<0.001	<0.001	<0.001
HSD value	NA	434.9	385.2
CV (%)	6.5	29.2	7.2
	Gami et al., 2000	Shrestha et al., 2015	

At the time of 1981-2000, use of complete fertilizer at recommended dose showed highest yield, and N and P was found important nutrient for enhancing yield of wheat. With the increment of N, it had double yield and with decline, it had reduced yield by almost 25%. FYM used in wheat had no significant impact over long period. The plot with no fertilizer had decline yield by more than 50 % over 40 years period. It means, inherent capacity of soil can now only support for 500 to 600 kg/ha yield of wheat and may decline in coming days. Use of fertilizer in currently doesn't mean to support the yields of crop but the practice made in previous crops. The appropriate use of chemical fertilizer had enhanced wheat yield over 40 years regardless of previous management practices. Shrestha et al., 2015 had also reported the similar cases in the experiments of 2000 to 2014.

Considering the cropping pattern and management practice in consecutive crop and year, over seven consecutive year (2015-2021) stated that no NPK plot (3032 kg/ha) provided very least total yield, and with increase of N only had increased yield by 51% and in addition of P, K, increased yield by 22%. In the same, use of complete fertilizer enhanced by 3 times as compared to control and 40 % above over +NP, +NK plot. Use of micro-nutrient over completed had higher yield over long period of time, in mean time, 50 N+10t/ha FYM (9444 kg/ha) had highest yield over these period. The application of P,K in one crop had been used for consecutive crop while in term of N, had been used in same crop. 10t/ha chopped straw+50kg N/ha followed by complete NPK had significant higher yield and at par with 50 N+10t/ha FYM treated plot. Gami et al., 2000 also reported that NPK+Zn fb NPK, 50N kg/ha+10t/ha FYM fb NPK, 100N fb NPK had significant yield over 20 years. The application of nutrient in one crop had influence over other and accumulative impact. Shrestha et al., 2015, had same concern over 14 years of experiment.



Table 5. Total cereal yield (equivalent to rice) in Kg/ha under different fertilizer application during 2015-2021

Treatment		Total Yield		
Rice	Wheat	1981-2000	2000-2014	2015-2021
0:00:00	0:00:00	3565	3082.1	3032 e
100:00:00	100:00:00	5580	4946.3	4742 d
100:30:00	100:30:00	5665	6559.6	5956 c
100:00:30	100:00:30	5990	6028	5611 cd
100:30:30	100:30:30	6405	8481	7155 b
100:00:00	100:30:30	6200	8011.9	8829 a
50:00:00	50:00:00	4790	4784.4	4679 d
50:20:00	50:20:00	5420	5463.4	5882 c
FYM 10 t/ha	FYM 10 t/ha	4715	5215.3	5056 cd
100:30:30+25 Kg ZnSO ₄	100:30:30	6360	8503.8	8885 a
50:0:0 +FYM 10t/ha	100:30:30	6135	8902.8	9444 a
50:0:0 +10t/ha chopped straw	100:30:30	6200	8234	8544 a
P value	P value			<0.001
HSD value	HSD value			326.3
CV (%)	CV (%)			8.7

Table 6. Total C, N, P and K of soils during 1998-1999

Treatment	pH			Total N (g Kg ⁻¹)			Total P (mg/kg)			Total K (mg/kg)		
	1998	2019		1998	2019					1998	2019	
		After Rice harvest	After wheat harvest		After Rice harvest	After wheat harvest	1998	After Rice harvest	After wheat harvest		After Rice harvest	After wheat harvest
Control	7.1	5.9	6.6	0.68	0.82	0.67	5	11.2	7.14	220	48.55	40.6
NPK	6.7	5.9	6.1	0.75	0.87	0.74	10	31.14	23.93	220	44.59	36.67
FYM	7.3	5.9	7	1.11	1.05	0.85	17	61.1	71.4	220	56.48	56.03
50 Kg N+10t FYM	6.8	5.6	6.3	0.94	0.99	0.94	17	47.3	48.9	210	56.48	44.59
50:0:0 +10t/ha chopped straw	6.5	5.9	6.1	0.86	0.78	0.77	8	14.4	48.5	230	48.5	48.5

Table 7. Soil status over different period under different fertilizer application

Rice	P (mg/kg)	OM%	K	N	pH	Wheat	N%	P	OM	K	pH
0:00:00	11.2 f	1.52 bc	48.55	0.082 bc	5.9	0:00:00	0.067 b	7.14 c	0.969 b	40.63 abc	6.6 ab
100:00:00	10.3 f	1.06 c	40.63	0.069 c	5.6	100:00:00	0.069 b	8.43 c	1.041 b	38.65 abc	5.7 e
100:30:00	31.14 c	1.50 bc	44.59	0.082 bc	5.9	100:30:00	0.070 ab	23.93 bc	1.070 ab	36.67 bc	6.1 bcd
100:00:30	11.32 f	1.20 c	46.57	0.079 c	5.6	100:00:30	0.070 ab	8.31 c	1.079 ab	52.51 a	6.1 bcd
100:30:30	21.6 cde	1.20 bc	40.63	0.087 bc	5.8	100:30:30	0.074 ab	21.53 bc	1.224 ab	50.53 ab	6.0 cde
100:00:00	13.6 ef	1.66 c	48.55	0.077 c	5.6	100:30:30	0.066 b	12.28 bc	0.934 b	42.61 abc	5.9 de
50:00:00	9.39 f	1.40 c	46.57	0.079 c	5.6	50:00:00	0.072 ab	10.24 c	1.155 ab	46.57 abc	6.3 bcd
50:20:00	19.01 def	1.60 bc	54.50	0.082 bc	6.4	50:20:00	0.078 ab	19.61 bc	1.365 ab	34.69 c	6.5 bc
FYM 10 t/ha	61.1 a	2.29 a	56.48	0.105 a	5.9	FYM 10 t/ha	0.085 ab	71.14 a	1.609 ab	50.53 ab	7.0 a
100 ¹	25.7 cd	1.29 c	56.48	0.076 c	6.2	100:30:30	0.074 ab	19.13 bc	1.230 ab	34.69 c	6.2 bcd
50 ²	47.3 b	2.09 ab	56.48	0.099 ab	5.6	100:30:30	0.094 a	48.92 abc	1.897 a	44.59 abc	6.3 bcd
50 ³	14.4 ef	1.35 c	48.55	0.078 c	5.9	100:30:30	0.077 ab	53.96 ab	1.314 ab	48.55 abc	6.1 cde
P value	<0.001	<0.001	Ns	0.001	Ns	P value	Ns	0.02	Ns	0.04	<0.001
HSD value	9.16	0.56	19.4	0.016	0.87	HSD value	0.021	37.4	0.738	13.09	0.41
CV (%)	23.5	21.8	23.4	11.6	8.7	CV (%)	16.9	86.1	35.1	17.8	3.9

1: 00:30:30+25 Kg ZnSO₄; 2: 50:0:0 +FYM 10t/ha; 3: 50:0:0 +10t/ha chopped straw

At initial stage, the soil pH condition was nearly neutral but after regular application of NPK and FYM in Rice has declined soil pH to 5.6 but it has been recovered to initials after wheat cultivation. FYM treated plot maintained the soil pH over 40 year at neutral state, other plots had moved to acidic condition. Similar result was demonstrated by (Rai & Khadka, 2014). The total nitrogen in soil was ranged from 0.68- 1.11 g Kg⁻¹ where least in control, moderate in NPK, 50N+ FYM and 50N+ chopped straw plot and highest in FYM treated plot in 1998 but increase of N was immediately after rice harvest but decline after wheat in all context. Minimum decline was found in



control plot. The total P was found higher in plot where FYM was added continuously followed by 50N+ FYM and used of NPK fertilizer plot while control and 50N+ chopped straw plot with least total P. The decline of Total K was very rapid over 40 years. FYM treated plot had slow remove of K from soil and 50N+ chopped straw plot, however there was decline in other plot. Similar report in Tarahara by (Rai & Khadka, 2014).

Variation of yield over year

The yield was highly varied with year. There was fluctuation yield may due to climate factor like rainfall and temperature, and other-side management practice of researcher as change with time. Similar case was observed in other context of RARS farm (Rai & Khadka, 2014; Shrestha et al., 2015)

Conclusion

The rice-wheat is common cropping pattern of Nepal. The nutrient management become more challenging to attain higher yield due to unavailability of fertilizer at planting time and requirement bulk organic matter. Soil condition is decline in another part. This long term experiment concluded that use of 50% N + 10t FYM in rice fb 100:30:30 NPK/ha in wheat could balance both yield and soil status for long term and sustainable farming system. Use of balanced NPK can be used for quick response to gain yield but long turn it has decline trend in yield and degrade soil status. Regular use of FYM could provide stable yield but optimum yield could be harvested. Reduce use of high chemical fertilizer with use of organic fertilizer could be solution for optimum and stable production over climate change scenario.

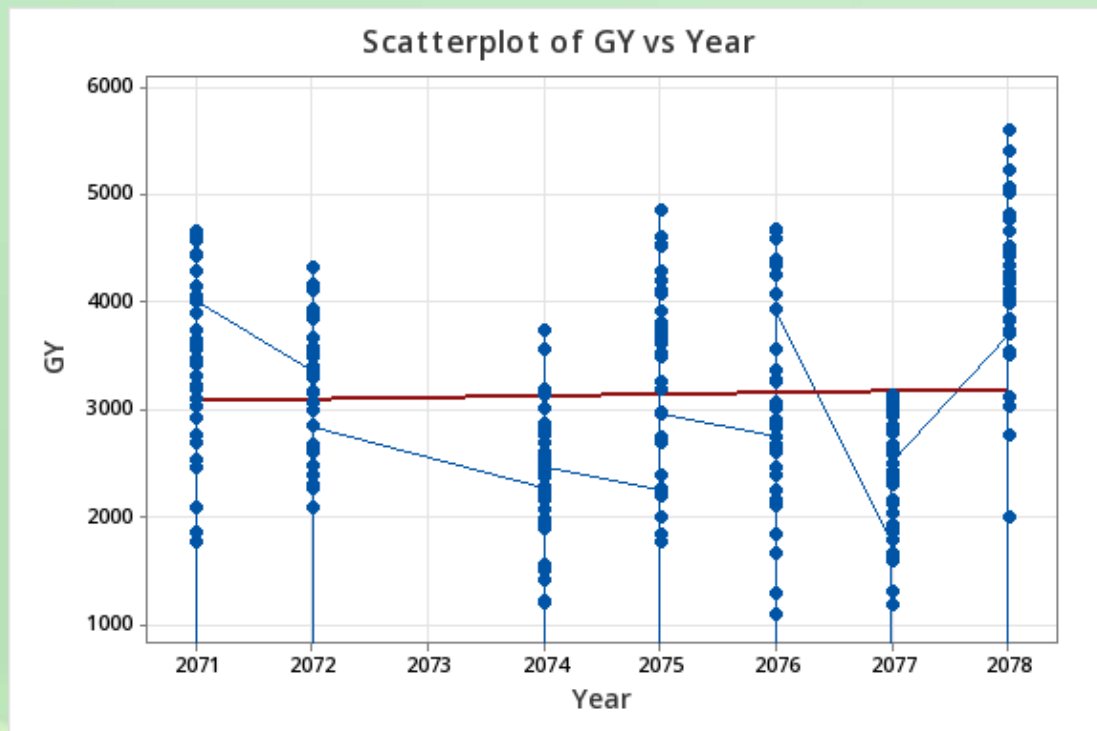


Figure 1. Variation of rice yield during different year

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Utilization of Organic Wastes for the Production of Bacterial Polyhydroxyalkanoates

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Abstract

Due to their incapability to degrade, synthetic plastics can no longer be used forever and have become a global problem. Disposable plastics that are biodegradable and biocompatible and have comparable properties to traditional plastics are replacing conventional plastics. The current study was focused on using cost-effective carbon sources, such as industrial and organic wastes. Four bacterial species were used with the different carbon sources such as potato and banana peel extract (0.5%, 1.0%, 1.5%, 2.0%, 2.5%), corn and dairy industry effluent (2.0%, 4.0%, 6.0%, 8.0%, 10.0%) for PHA production. With potato peels, *Alcaligenes* sp., *B. subtilis*, *B. cereus*, and *P. aeruginosa* yielded 91%, 91%, 93%, and 63% PHA. *Alcaligenes* sp., *B. subtilis*, *B. cereus*, and *P. aeruginosa* produced 95%, 93%, 91%, and 92% of their respective growth rates with banana peels extract. When *Alcaligenes* sp., *B. subtilis*, and *B. cereus* were tested on cheese whey, the results were best at 10% concentration, producing 94%, 98%, and 98% PHA, respectively. Using 2%, 4%, and 8% cheese whey, *P. aeruginosa* yielded 97% PHA. As a result, the maximum PHA yield in effluent from the dairy industry was achieved after 24 to 48 hours of incubation. The isolated biopolymers were analysed by FTIR, revealing that the extracted powder is PHA and PHB. FTIR spectra of obtained PHA powder showed absorption bands at 3375.09 cm⁻¹, 3251.92 cm⁻¹, 2923.63 cm⁻¹, 2922.39 cm⁻¹, 2853.38 cm⁻¹, 2852.42 cm⁻¹, 1801 cm⁻¹, 1743.08 cm⁻¹, 1742.51 cm⁻¹, 1644.59 cm⁻¹, 1633 cm⁻¹, 1462.79 cm⁻¹, 1462.54 cm⁻¹, 1460.53 cm⁻¹, 1461.80 cm⁻¹, and the rest of the peaks were lying in the region between 1100 cm⁻¹ and 600 cm⁻¹.

Key Words: Biopolymers, Biodegradable polymers, Polyhydroxyalkanoates, Polyhydroxybutyrate, Organic wastes



Physical Properties of Chestnut Honey-Pollen Powders Obtained by Different Drying Methods

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Abstract

Honey and bee pollen of chestnut botanical origin are special among beekeeping products due to their rich bioactive components. Although these natural products can be directly consumed, they can be converted into different products to increase their consumption. Honey powder is a product that has been studied in recent years, and obtained by drying honey with various carrier substances such as gum arabic, starch, and maltodextrin. Moreover, the use of bee pollen as a carrier material has positive effects on the potential benefits of honey powders. Herein, it was aimed to research the effect of spray and vacuum drying on bulk density, flowability, solubility, hygroscopicity, wettability, particle microstructure, and color properties of chestnut honey (*Castanea sativa* pollen: 93.28%) and bee pollen (*Castanea sativa* pollen: 82.75%) powder. Chestnut bee pollen, gum arabic, and water (1:1:10 w/w/v) were mixed at 400 rpm for 10 min and that mixture was added to chestnut honey and mixed at the same conditions. The prepared mixture was dried with spray (140°C, 14 mL/min flow rate, and 82% aspiration) and vacuum (45-60°C, 200 mbar) drying systems. Carr index values as flowability indicator of spray and vacuum-dried samples were 42.02% and 33.70%, respectively. The flowability of honey powders was low due to the stickiness among particles. While the vacuum-dried sample had a low wettability time due to larger particle size, it was much longer in the spray-dried sample. Furthermore, the vacuum-dried sample had a lower hygroscopicity value (30.04%) than the spray-dried sample (37.26%), and chestnut bee pollen (32.58%). However, the spray-dried sample particles had a more homogeneous microstructure. The results highlighted that honey powder can be obtained by adding bee pollen as a carrier material with both drying methods, but the physical properties of powders should be improved by changing the product formulation and/or optimizing the drying conditions.

Key Words: *Castanea sativa*, spray drying, vacuum drying, flowability, hygroscopicity

Farklı Kurutma Yöntemleri ile Elde Edilen Kestane Balı-Polen Tozlarının Fiziksel Özellikleri

Özet

Kestane botanik kökenli bal ve arı poleni ürünleri, zengin biyoaktif bileşenleri nedeniyle arıcılık ürünleri arasında özel bir yere sahiptir. Bu doğal ürünler doğrudan tüketilebildiği gibi farklı ürünlere dönüştürülerek tüketimleri artırılabilir. Bal tozu, son yıllarda üzerinde çalışılan ve balın arap zamkı, nişasta ve maltodekstrin gibi çeşitli taşıyıcı maddelerle kurutulmasıyla elde edilen bir üründür. Ayrıca taşıyıcı malzeme olarak arı polenin kullanılması bal tozlarının potansiyel faydaları üzerinde olumlu etkilere sahiptir. Bu çalışmada püskürterek ve vakumla kurutmanın kestane balı (*Castanea sativa*: %93.28) ve arı poleni (*Castanea sativa*: %82.75) tozunun yığın yoğunluğu, akışkanlığı, çözünürlüğü, higroskopikliği, ıslanabilirliği, parçacık mikro yapısı ve renk özellikleri üzerine etkisinin araştırılması amaçlanmıştır. Kestane arı poleni, arap zamkı ve su (1:1:10 a/a/h) 400 rpm hızla 10 dakika karıştırılmış ve bu karışım kestane balı üzerine ilave edilerek aynı koşullarda karıştırma işlemi yapılmıştır. Hazırlanan karışım püskürterek (140°C, 14 mL/dk akış hızı ve %82 aspirasyon) ve vakum (45-60°C, 200 mbar) kurutma sistemleriyle kurutulmuştur. Püskürtülerek ve vakumla kurutulan örneklerin akışkanlık göstergesi olan Carr indeksi değerleri sırasıyla %42.02 ve %33.70 olarak bulunmuştur. Bal tozlarının tanecikleri arasındaki yapışkanlıktan dolayı akışkanlığının düşük olduğu değerlendirilmiştir. Vakumla kurutulan örneğin partikül boyutlarının büyüklüğü nedeniyle ıslanabilirlik süresi düşük olmasına rağmen, püskürtülerek kurutulan örnekte bu süre daha uzun olarak tespit edilmiştir. Ayrıca, vakumla kurutulan örneğin higroskopisite değeri (%30.04), püskürtülerek kurutulan örneğe (%37.26) ve kestane arı polenine (%32.58) göre daha düşük olarak belirlenmiştir. Ancak püskürtülerek kurutulan örnek patiküllerinin daha homojen bir mikro yapıya sahip olduğu değerlendirilmiştir. Sonuçlar, hem püskürterek hem de vakumlu kurutma ile taşıyıcı malzeme olarak arı poleni ilave edilerek bal tozu elde edilebileceğini, ancak tozların fiziksel özelliklerinin ürün formülasyonunun değiştirilmesi ve/veya kurutma koşullarının optimize edilmesi yoluyla iyileştirilmesi gerektiğini vurgulamıştır.

Anahtar Kelimeler: *Castanea sativa*, püskürterek kurutma, vakumla kurutma, akışkanlık, higroskopisite



ID: 345

Effects of Humic Acid Applications along with Reduced Nitrogen Fertilization on Potato Tuber Yield and Quality

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Abstract

This research was conducted in 2020 to determine the effects of leonardite-derived humic acids (Humas-15, Liquid Humus and Humico Maximix-K) with different properties, along with reduced nitrogen fertilization, on tuber yield and quality in potatoes (cv. Van Gogh). In the study, chemical fertilizer applications were made as basic fertilization (20 N 10 P 10 K), reduced fertilization I (15 N 10 P 10 K) and reduced fertilization II (10 N 10 P 10 K). Humic acids were applied twice with irrigation water, at the beginning of the flowering period and 15 days later. Humas-15 and Liquid Humus were applied at 1.0 and 2.0 lt/da doses, and Humico Maximix-K was applied at 400 and 800 g/da doses. A total of seven traits (tuber number per plant, tuber yield per plant, marketable tuber yield, total tuber yield, dry matter content, reducing sugar content and total sugar content) were measured. Reducing nitrogen applications with humic acid applications significantly affected all the traits studied. Humic acid applications combined with reduced nitrogen fertilization increased number of tubers per plant by up to 13%, marketable tuber yield by up to 18% and total tuber yield by up to 16% compared with the control. Total and reducing sugar contents varied between 1.27-1.58% and 159-389 mg/100g fw, respectively depending on the applications. In the study, the highest tuber yield was obtained from 1.0 and 2.0 L/da Humas-15 and 2.0 L/da Liquid Humus applications applied together with reducing nitrogen applications which have close values to the recommended fertilization applications.

Key Words: Potato, Humic acid, Reducing nitrogen application, Tuber yield and quality

Azaltılmış Azotlu Gübreleme ile Birlikte Hümkik Asit Uygulamalarının Patatesin Yumru Verimi ve Kalitesine Etkileri

Özet

Bu araştırma, azaltılmış azotlu gübrelemeye ilave olarak farklı özelliklere sahip leonardit kaynaklı hümkik asitlerin (Humas-15, Liquid Humus ve Humico Maximix-K) patatesten (cv. Van Gogh) yumru verimi ve kalitesi üzerine etkilerini belirlemek amacıyla 2020 yılında yapılmıştır. Çalışmada kimyasal gübre uygulamaları temel gübreleme (20 N 10 P 10 K), azaltılmış gübreleme I (15 N 10 P 10 K) ve azaltılmış gübreleme II (10 N 10 P 10 K) olarak yapılmıştır. Hümkik asitler çiçeklenme dönemi başında ve 15 gün sonra olmak üzere sulama suyuyla birlikte iki kez uygulanmıştır. Humas-15 ve Liquid Humus 1,0 ve 2,0 lt/da dozlarında, Humico Maximix-K ise 400 ve 800 g/da dozlarında uygulanmıştır. Çalışmada bitki başına yumru sayısı ve verimi, pazarlanabilir ve toplam yumru verimi, kuru madde içeriği, indirgen şeker içeriği ve toplam şeker içeriği parametreleri incelenmiştir. Azaltılmış azotlu gübrelemeye ilave olarak yapılan hümkik asit uygulamaları incelenen tüm özellikleri önemli ölçüde etkilemiştir. Azaltılmış azotlu gübrelemeyle birlikte hümkik asit uygulamaları, kontrole kıyasla bitki başına yumru sayısını %13'e, pazarlanabilir yumru verimini %18'e ve toplam yumru verimini ise %16'ya kadar artırmıştır. Toplam ve indirgen şeker içerikleri, uygulamalara bağlı olarak sırasıyla %1,27-1,58 ve 159-389 mg/100g taze ağırlık arasında değişmiştir. Araştırmada en yüksek yumru verimi, önerilen kimyasal gübreleme uygulamalarına yakı değerlere sahip olan azaltılmış azotlu gübreleme I ile birlikte yapılan 1,0 ve 2,0 L/da Humas-15 ve 2,0 L/da Liquid Humus uygulamalarından elde edilmiştir.

Anahtar Kelimeler: Patates, Hümkik asit, Azaltılmış azotlu gübreleme, Yumru verimi ve kalitesi





ID: 575

Assessment of Inorganic Phosphorus Fractions of Fruits and Vegetable Dumpsite Soils as a Strategy for Mitigating Eutrophication Hazard

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Abstract

Phosphorus is essential for plant growth, but mishandling phosphorus-rich waste can harm the environment. This study assessed inorganic phosphorus in fruit and vegetable dumpsite soils and its relation to soil properties. Soil samples were collected from the study site using simple random sampling at depths of 0-15cm, 15-30cm, and 30-60cm and were analyzed for calcium-bound phosphorus (Ca-P), reductant soluble phosphorus (RS-P), Fe-bound Phosphorus (Fe-P), aluminium-bound phosphorus (Al-P), and Soluble/loosely bound P. The data obtained was analyzed using the student's t-test to compare the different fractions in fruit and vegetable dumpsite soils. The results showed no significant differences between fruit and vegetable dumpsite soils in all the inorganic P fractions. However, vegetable dumpsite soils recorded higher soluble P, Al-P, Fe-P, RS-P, and Ca-P levels of 11.65, 36.29, 41.95, 40.75, and 41.35 mg/kg, respectively. These values were not significantly different from 9.75, 34.01, 39.28, 37.11 and 41.03 mg/kg recorded by fruit dumpsite soil for soluble P, Al-P, Fe-P, RS-P and Ca-P respectively. Also, the concentration of the inorganic P fractions for vegetable dumpsite soil is in the order; Fe-P> Ca-P>RS-P>Al-P>soluble P, while that of fruit dumpsite soil is in the order; Ca-P>Fe-P> RS-P>Al-P>soluble P. Soluble phosphorus significantly impacts eutrophication due to its rapid release into water. However, low levels of soluble P in fruit and vegetable dumpsite soils are not a major concern. In vegetable dumpsite soil, Fe-P would pose a greater threat during anoxic events while, in fruit dumpsite soil, Ca-P would contribute more to eutrophication due to its high concentration in this soil, especially in alkaline conditions.

Keywords: Fruit and Vegetable; Dumpsite soils; Inorganic phosphorus fractions; Eutrophication; Nigeria



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Impact of Foliar-Applied Essential Oils on Growth, Yield and Quality of Potato (*Solanum tuberosum* L.)

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Abstract

In this study, effects of sage (*Salvia officinalis* L.), oregano (*Origanum onites* L.), rosemary (*Rosmarinus officinalis* L.), dill (*Anethum graveolens* L.), cumin (*Cuminum cyminum* L.), fennel (*Foeniculum vulgare* var. dulce L.) and *Echinophora tenuifolia* L. subsp. *sibthorpiana* (Guss.) essential oils applied to plant leaves at different doses on potato growth, tuber yield and quality were investigated. Essential oils were applied to the upper parts of the plant by spraying at doses of 300, 600, 900 and 1200 ppm three times at 15-day intervals, starting 15 days after the completion of emergence. The number of main branches, number of tubers per hill, tuber yield per hill, marketable and total tuber yield, chlorophyll content, starch content, reducing and total sugar content parameters were examined. The effects of essential oil applications on tuber yield and quality were found to be statistically significant, and this effect varied according to application doses. Compared to the control, essential oil applications increased the marketable tuber yield by approximately 38% (300 ppm rosemary essential oil) and the total tuber yield by up to 28% (600 ppm rosemary essential oil). However, rosemary and oregano oils caused phytotoxicity and reduced tuber yield when applied in high doses. Except for sage and oregano, other essential oils positively affected chlorophyll synthesis. Essential oil applications reduced the accumulation of reducing sugar, which negatively affects tuber quality, and the lowest reducing sugar contents were detected in tubers to which fennel and oregano essential oils were applied. In the study, it was understood that tuber yield in potatoes could be increased significantly with the applications of 300 and 600 ppm rosemary essential oil and 300 ppm cumin essential oil.

Key Words: Potato, Essential oil, Foliar application, Tuber yield and quality

Yapraktan Yapılan Uçucu Yağ Uygulamalarının Patatesin (*Solanum tuberosum* L.) Gelişimi ile Yumru Verimi ve Kalitesine Etkileri

Özet

Bu çalışmada, bitki yapraklarına farklı dozlarda uygulanan tıbbi adaçayı (*Salvia officinalis* L.), İzmir kekiği (*Origanum onites* L.), biberiye (*Rosmarinus officinalis* L.), dereotu (*Anethum graveolens* L.), kimyon (*Cuminum cyminum* L.), tatlı rezene (*Foeniculum vulgare* var. dulce L.) ve çörtlük otu (*Echinophora tenuifolia* L. subsp. *sibthorpiana* (Guss.)) uçucu yağlarının patatesten yumru verimi ve kalitesine etkileri araştırılmıştır. Uçucu yağlar çıkışların tamamlanmasından 15 gün sonra başlanmak üzere 15 gün aralıklarla 3 kez bitki üst aksamına 300, 600, 900 ve 1200 ppm dozlarında püskürtme şeklinde uygulanmıştır. Araştırmada ana dal sayısı, ocakta yumru sayısı, ocak verimi, pazarlanabilir ve toplam yumru verimi, klorofil miktarı, nişasta oranı, indirgen ve toplam şeker içeriği parametreleri incelenmiştir. Uçucu yağ uygulamalarının yumru verimi ve kalitesine etkileri istatistiki açıdan önemli bulunmuş, bu etki uygulama dozlarına göre farklılık göstermiştir. Kontrol ile karşılaştırıldığında, uçucu yağ uygulamaları ile pazarlanabilir yumru veriminde yaklaşık % 38 (300 ppm biberiye uçucu yağı), toplam yumru veriminde ise % 28'e (600 ppm biberiye uçucu yağı) varan verim artışı sağlanmıştır. Bununla birlikte, biberiye ve kekik uçucu yağları yüksek dozlarda uygulandıklarında fitotoksisteye neden olarak yumru verimini azaltmıştır. Adaçayı ve kekik hariç diğer uçucu yağlar klorofil sentezini olumlu yönde etkilemiştir. Uçucu yağ uygulamaları yumru kalitesini olumsuz yönde etkileyen indirgen şeker birikimini azaltmış, en düşük indirgen şeker içerikleri rezene ve kekik uçucu yağı uygulanan yumrularda saptanmıştır. Çalışmada, 300 ve 600 ppm biberiye uçucu yağı ile 300 ppm kimyon uçucu yağı uygulamaları ile patatesten yumru veriminin önemli derecede artırılacağı anlaşılmıştır.

Anahtar Kelimeler: Patates, Uçucu yağ, Yaprak uygulamaları, Yumru verimi ve kalitesi



Improvement Of *Bacillus Subtilis* Natto Viability By Alginate And Xanthan Gum As A Wall Material

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Abstract

In this study, *Bacillus subtilis* natto was encapsulated by alginate with (coated or mixed) or without xanthan gum as a supplement component and evaluated for survival in simulated gastric fluid (SGF) and simulated intestinal fluid (SIF). The results showed that *B. subtilis* natto biomass had a thrombolytic ability compared to the control sample. The viability of encapsulated *B. subtilis* natto was improved, and alginate 2% (w/v) had a high encapsulation efficiency. There was no difference between the samples with or without the xanthan gum supplement. In SGF and SIF tests, the *B. subtilis* viability in samples supplemented with xanthan gum was higher than that of the samples using only alginate, and there was no significant difference between containing xanthan gum mixing or coating. The results indicated that adding xanthan gum is necessary to increase alginate's protective effect on *B. subtilis* natto.

Keywords: *Bacillus subtilis* natto, alginate, xanthan gum, encapsulation.

Introduction

Probiotics are strains of live bacteria introduced directly into the human body through the oral route (food in general and functional foods in particular) in a specific dose to support health (C. Zhang et al., 2021). The probiotic microorganisms include *Bifidobacteria*, *Lactobacillus plantarum*, *Lactobacillus acidophilus*, *Lactobacillus paracasei*, *Bacillus subtilis* natto, etc. *Bacillus subtilis* natto has received much attention thanks to its outstanding ability to dissolve thrombolysis and reduce cardiovascular disease (Wang et al., 2020). *B. subtilis* natto is a bacillus, gram-positive, arbitrarily aerobic, has moving ability, is spore-forming, and has been proven to be safe in experimental studies on animals and humans (Hong et al., 2008; J. Zhang et al., 2020). In addition, *B. subtilis* natto is known for its ability to produce nattokinase, a protease containing 275 amino acids, which has been shown to have potent fibrinolytic activity (Lampe & English, 2016). However, although the *B. subtilis* natto viability in intestinal and gastric fluid conditions is strong, the vegetative cells of the strain are susceptible to these environments (Hong et al., 2008). In the spore form, *B. subtilis* natto has the ability to overcome adverse conditions such as simulated gastrointestinal conditions. However, the germination rate of these spores in the gastrointestinal tract is very low (Hatanaka et al., 2012). Therefore, protecting *B. subtilis* cells in a vegetative form achieves host health benefits for the host is necessary. Previous studies showed that encapsulation effectively protects probiotic bacteria under adverse conditions such as production process, storage, and simulated gastrointestinal conditions. Many encapsulation techniques and different wall materials have been studied, in which extrusion compression is a simple and low-cost encapsulation method, and the operating conditions are not harsh to improve encapsulation performance (Frakolaki et al., 2021). In addition, alginate, which is a natural carrier, is an inexpensive and non-toxic material commonly used in extrusion encapsulation (Afzaal et al., 2019). The extrusion technique with alginate as the primary wall material significantly improved the viability of probiotic bacteria under simulated gastrointestinal conditions (Afzaal et al., 2019). However, due to the porous structure of the alginate gel network, it facilitates the diffusion of H⁺ ions, causing cell death and reducing the encapsulation efficiency (Chavarri et al., 2010; Vaziri et al., 2018). To limit this issue, additional coatings such as chitosan, pectin, gelatin, and xanthan gum were included to improve the alginate gel structure network and enhance the viability of probiotic bacteria (Chavarri et al., 2010; Khorshidi et al., 2021; Vaziri et al., 2018). Xanthan gum, a natural material with safe properties, is unaffected by pH conditions, thermally stable, and entirely biodegradable (Singhvi et al., 2019). These properties could be a potential supplement to limit the porous structure of the alginate gel network. This study evaluated the bacterial strain's thrombolytic ability of the biomass and the culture fluid compared with the control. Besides, the protection efficiency of alginate with or without xanthan gum supplement on *B. subtilis* viability in simulated gastric fluid (SGF) and simulated intestinal fluid (SIF) was also assayed.



Materials and methods

Materials

B. subtilis natto strain was obtained from strain collection of the Faculty of Food Science and Technology, Ho Chi Minh City University of Industry and Trade. The strain was cultured in nutrient broth for 20 hours. The biomass after culture was collected by centrifugation and continued to wash the biomass with 10 ml of saline water twice. Then, the biomass was collected and suspended in saline water. Alginate (Zhanghai et al.) and xanthan gum (Himedia) Co., Ltd) were sterilized at 121°C for 15 minutes before use.

Test the ability of bacteria to dissolve thrombosis

200 µl of pig blood (slaughter pig's blood was stored at 4°C before use) and 400 µl of distilled water was added into the Eppendorf tubes. The tube was then shaken and let for 1 hour to allow the blood to clot. After coagulating blood, the Eppendorf tube was added 100 µl of fluid culture or biomass of *B. subtilis*, and saline water was used as control samples. The Eppendorf tube was incubated at 37°C, and check the hemolysis every two hours of incubation.

Evaluation of the effect of carrier on encapsulation performance *B. subtilis* natto

The encapsulated process by extrusion compression technique was carried out according to Lieu et al. (2019) with the following main steps: Alginate (2.5% w/v) with or without xanthan gum 0.5% (w/v) (AX samples) or alginate (2.5% w/v) (A samples) was mixed with *B. subtilis* natto. The mixture was then put into a piston, dripped into CaCl₂ solution through a 0.5 mm needle, and incubated to solidify completely. The inoculants were then collected, and the A sample was further incubated in xanthan gum at 0.5% (w/v) (sample AXc) to form a xanthan gum coating. The encapsulation efficiency was calculated according to the following formula (Lieu et al., 2019):

$$\text{Encapsulation yield (\%)} = \frac{\sum \log CFU_{\text{after}}}{\sum \log CFU_{\text{before}}} \times 100\% \text{ (Lieu et al., 2019)}$$

Effect of simulated gastrointestinal conditions on the viability of *B. subtilis* natto encapsulated

The viability of *B. subtilis* natto under simulated digestive fluid conditions was carried out according to Lieu et al. (2020). Simulated gastric fluid (SGF) (containing 9 g/l NaCl) was adjusted to pH 2 by 5M HCl, and simulated intestinal fluid (SIF) (containing 9 g/l NaCl + 3 ml/l cow bile) was adjusted to pH 6.5 by 5M NaOH. One gram of the sample was added to 99 ml of NaCl pH 2 (corrected with 5M HCl) and incubated for 2 hours. Then, 1 ml of the SGF solution was transferred to the SIF condition and incubated for 4 hours. The *B. subtilis* natto in free cell form was used as control samples. The viability of *B. subtilis* natto was assayed by plating on a nutrient agar medium.

Statistical analysis

Experimental data were analyzed by ANOVA one-way using IBM SPSS Statistic 25 software. The mean was compared by Tukey's test at the 5% probability level ($p < 0.05$). The experiments were repeated three times, and the results are represented as mean $\pm$ standard deviation.

Results and discussion

The ability of bacteria to dissolve thrombosis

The thrombolytic ability of *B. subtilis* natto was shown in Figure 1. The results obtained show that there was a significant difference in the hemolytic ability between the three samples. The post-culture liquid and biomass of *B. subtilis* natto showed significantly different hemolysis compared with the distilled water control (Figure 1).



Figure 1. Dissolve thrombosis test. The order of samples is as follows: Sample 1 is the culture fluid of bacteria, sample 2 is distilled water, and sample 3 is the bacterial biomass solution.



The hemolytic ability of *B. subtilis* natto is one of the meaningful properties of this strain. Previous studies have shown that *B. subtilis* natto cultures can effectively dissolve thrombosis. Ju et al. (2019) showed *B. subtilis* Subsp. natto WTC016 isolated from the soil had a thrombolytic ability (Ju et al., 2019). A study by Hong et al. (2009) indicated that post-culture fluid of *B. subtilis* had thrombolytic lecithinase activity performed on tryptose blood agar (5% sheep blood) (Hong et al., 2009). Similarly, Moharam et al. (2019) demonstrated that cultures of the *B. subtilis* Egy strain could dissolve thrombosis (Moharam et al., 2019). These studies demonstrated that the fluid obtained after the culture of *B. subtilis* natto contains the enzyme nattokinase and has effective thrombolysis. The results obtained from this study showed that, in addition to the culture fluid obtained, the biomass of *B. subtilis* natto also showed thrombolytic potential (Figure 1). This suggests that maintaining the viability of *B. subtilis* natto is necessary to enable them to exert their beneficial effects on the host organism.

The effect of carrier on encapsulation performance *B. subtilis* natto

The role of wall material in the viability of *B. subtilis* natto was presented in Figure 2. The experiment compared wall materials such as alginate and xanthan gum (mixing or coating to alginate) for encapsulation efficiency. The encapsulation efficiency of A, AX, and Axc was $94.85 \pm 1.92\%$; $94.22 \pm 1.55\%$; and $92.65 \pm 2.13\%$ respectively.

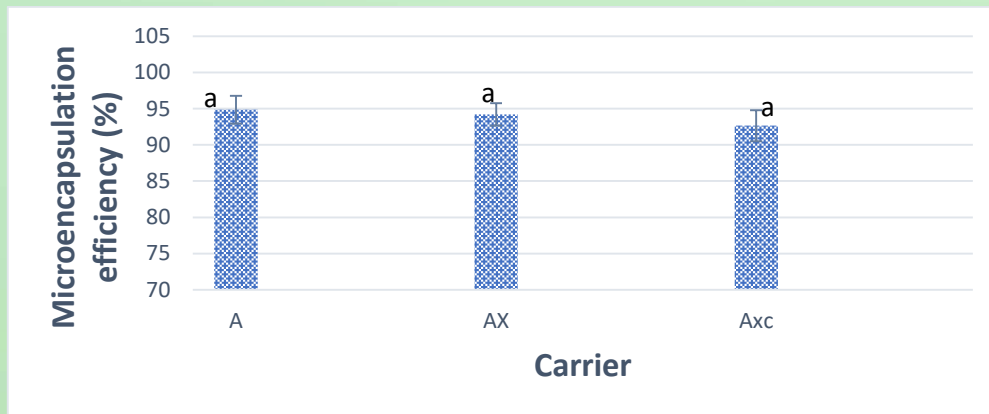


Figure 2. Effect of the carrier on the encapsulation efficiency *Bacillus subtilis* natto

During fermentation, *B. subtilis* natto produced beneficial metabolic compounds (Hong et al., 2008). However, the sensory produced by this strain (Nie et al., 2017) is the cause of consumer pickiness. Therefore, encapsulation of *B. subtilis* natto could reduce the unexpected sensory property. Many wall materials are used for the encapsulation process, and alginate is used due to its safety, low cost, and high efficiency (Afzaal et al., 2019). Alginate was commonly used as wall material for extrusion and emulsion techniques. The emulsion technique helps to produce particles with a smaller size than the extrusion technique (My Dong et al., 2020). However, particles obtained by the extrusion technique are more straightforward, and the composition does not contain oil, which is a component of the preparation process by emulsification. Previous studies showed that alginate wall material had high encapsulation efficiency. Sohail et al. (2011) demonstrated that the encapsulation efficiency of *L. rhamnosus* GG and *L. acidophilus* NCFM was higher than 90% with alginate 2% (w/v) (Sohail et al., 2011). Similarly, the encapsulation efficiency of *Bacillus subtilis* SL-13 by alginate 2% (w/v) was 90.92% (Tu et al., 2015). Despite high encapsulation efficiency, the alginate structure is easily broken during drying (Kusuktham et al., 2013). Therefore, the combination of alginate with wall material has also received much attention. The combination of alginate with additional wall material has been reported in previous studies. The encapsulation efficiency of *L. plantarum* NCDC201 and *L. casei* NCDC297 in alginate-coated alginate was 72.48% and 63.54%, respectively (Rather et al., 2017). Singh et al. (2019) showed that the encapsulation efficiency of *Lactobacillus gastricus* BTM7 in the mixture of skimmed milk powder and alginate was over 75% and reached the highest in the ratio of 1:1 mixture of skimmed milk powder and alginate with an efficiency of 94% (Singh et al., 2019).

Similarly, the encapsulation efficiency of two bacterial strains, *L. plantarum* and *L. rhamnosu*, by alginate, alginate - Skim milk mixture, and alginate - skim milk coated with chitosan were higher than $94.54 \pm 0.03\%$ (Padhmavathi et al., 2021). In addition, the influence of the concentration of wall materials on the ability to protect bacteria has also been studied. The study by Mandal et al. (2006) showed that the higher the alginate concentration, the greater the viability of *L. casei* NCDC298 bacteria (Mandal et al., 2006). The low concentration of alginate wall material affected the shape of the shrink particles, and the convex surface was not smooth after drying (Kusuktham et al., 2013; Ramos et al., 2018). These effects can make the particles easily broken or have high permeability affected probiotic bacteria inside the particles. The results obtained from this study showed that alginate 2% (w/v) gave a high encapsulation efficiency, and there was no difference between the samples (Figure 2). This showed that adding xanthan gum, either coated or combined, had no significant effect on the encapsulation efficiency.



Effect of simulated gastrointestinal conditions on the viability of *B. subtilis* natto encapsulated

The viability of *B. subtilis* natto after two hours of incubation under SGF and SIF conditions was presented in Figure 3. Under SGF conditions, in samples containing free cells, the density of *B. subtilis* natto decreased rapidly from 9.21 ± 0.19 to 6.78 ± 0.2 Log CFU/ml. In contrast, for encapsulated bacteria, the reduction was significantly less ($p < 0.05$). Specifically, the *B. subtilis* viability in A, AX, and Axc samples was reduced from 9.35 ± 0.11 to 7.41 ± 0.14 log CFU/ml; 9.33 ± 0.15 to 7.80 ± 0.13 log CFU/ml, and 9.15 ± 0.16 to 7.96 ± 0.14 log CFU/ml, respectively.

The viability of *B. subtilis* natto in free cell form was significantly affected by the SGF medium (Figure 3). The survival rate of *B. subtilis* was decreased by 4 logs CFU/ml after incubation in simulated digestive fluid conditions and remained at 5.58 Log CFU/ml. In the case of encapsulated samples, the viability of encapsulated *B. subtilis* in A, AX, and Axc samples was 6.25 ± 0.18 Log CFU/ml, 6.91 ± 0.14 Log. CFU/ml, and 6.96 ± 0.2 Log CFU/ml respectively.

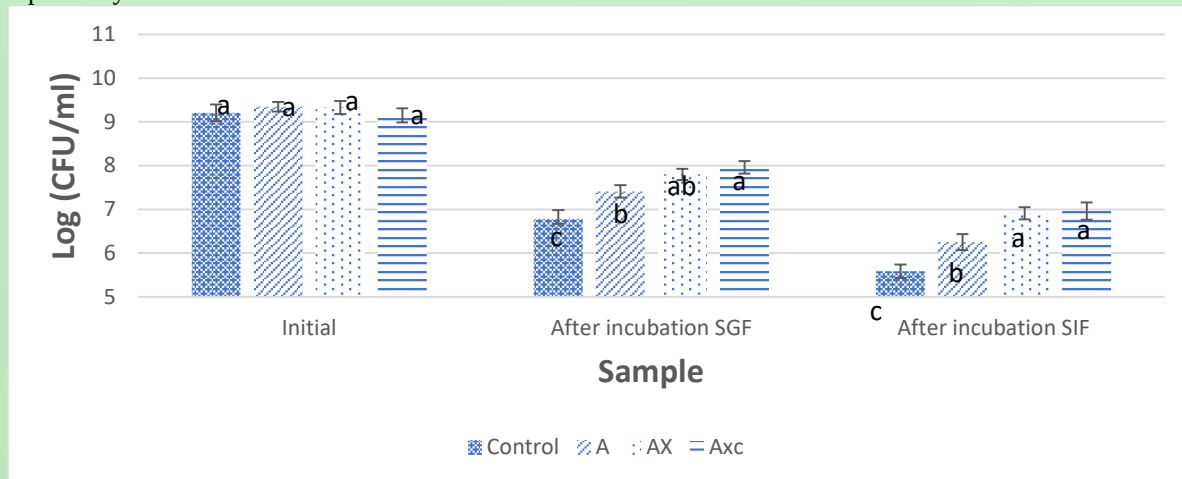


Figure 3. Effect of SGF and SIF on the viability of *Bacillus subtilis* natto. The letters a, b, c, and d represent significant differences between samples ($p < 0.05$)

The health benefits of *B. subtilis* natto depend on their enzyme production ability (Ju et al., 2019). *B. subtilis*, in the form of spores, gave the germination rate in the digestive fluid only 8% (Hatanaka et al., 2012). All cellular activity is stopped in the spore state, and enzyme production does not occur. Therefore, it is essential to exist as vegetative cells. Previous studies showed that *B. subtilis* was sensitive to low pH conditions, leading to spore formation to protect them from the effects of simulated digestive fluid. However, the spore counts after 6 hours of surviving under the above conditions reached about $74 \pm 1\%$, and the re-germination rate of spores was not high, about 8%, leading to not bringing high efficiency to the digestive system (Hatanaka et al., 2012).

The encapsulation technique showed a significant improvement in the viability of the bacteria under SGF conditions. Zhang et al. (2021) showed that the survival rate of encapsulated *B. subtilis* 04178 in the alginate-chitosan mixture was 18.19% more effective than that of the unencapsulated control under pH 2.5 conditions (Zhang et al., 2021). Similarly, the protective effect of *Lactobacillus gastricus* BTM7 in the mixture of skimmed milk powder and alginate under the SGF condition was nearly 2 Log CFU/ml higher than that of free-form bacterial cells (Singh et al., 2019). A study by Rather et al. (2017) also demonstrated that the viability of encapsulated *L. plantarum* NCDC201 cells was 47.5% higher than that of free bacteria at pH 2 for 2 hours (Rather et al., 2017). Besides, the survival rate of encapsulated bacteria was 1.5 to 4 Log CFU/ml higher than free cell bacteria, as reported by Xiao et al. (2020) and Shu et al. (2018) (Shu et al., 2018; Xiao et al., 2020). Alginate is a widely used food additive because of its proven safety and is also used to protect probiotics from extreme conditions (Chavarri et al., 2010; Vaziri et al., 2018). However, the porous gel structure of alginate was affected by low pH, high permeability, and low stability, reducing the protective power of this material under low acid conditions (Chavarri et al., 2010; Vaziri et al., 2018). The supplement wall material helps to limit the porous structure of the gel network of alginate, which improves the viability of probiotic bacteria under low pH conditions. Padhmavathi et al. (2021) indicated that a mixture of alginate-skim milk wall material coated with chitosan significantly improved the viability of probiotic bacteria (Padhmavathi et al., 2021). Similarly, My et al. (2020) suggested that the calcium-alginate coated with skim milk showed higher *L. acidophilus* viability than the mixture of calcium-alginate and skim milk or calcium-alginate alone (My Dong et al., 2020). Xanthan gum is a suitable complementary material with low pH stability thanks to its rigid, helical structure and thermal stability (Singhvi et al., 2019). Thanks to the addition of xanthan gum to the alginate gel structure, the viability of the probiotics was significantly enhanced (Khorshidi et al., 2021; Shu et al., 2018). The present study showed that the viability of encapsulated *B. subtilis* in alginate was significantly improved compared with the control sample (Figure 3). The *B. subtilis* viability in samples supplemented with xanthan gum (AX and Axc samples) was higher than that of the samples using only



alginate (A sample), and there was no significant difference between containing xanthan gum mixing or coating (Figure 3).

Besides the SGF condition, the SIF condition also affects probiotic bacteria. Previous studies showed that the viability of encapsulated probiotic cells was significantly higher than that of the free cell samples (Shu et al., 2018; Singh et al., 2019; Xiao et al., 2020). Rather et al. (2017) indicated that the viability of *L. plantarum* NCDC201 and *L. casei* NCDC297 in encapsulated form was higher than in free cell form at about 4 Log CFU/ml and 5 Log CFU/ml, respectively (Rather et al., 2017).

A study by Padhmavathi et al. (2021) showed that the mixed alginate-skim milk coated with chitosan remarkably improved the viability of *L. plantarum* and *L. rhamnosus* in SIF conditions (Padhmavathi et al., 2021). My et al. (2020) suggested that the interference of skim milk with the cross-linking of the calcium ions with alginate degraded the particle structure and decreased the *L. acidophilus* viability in simulated digestive fluid compared to that of the mix of alginate- skim milk (My Dong et al., 2020). Similarly, Padhmavathi et al. (2021) indicated that skim milk was used for encapsulation and chitosan coating, making the microspheres stronger than uncoated ones. In this study, there was no significant difference in the protective effect of AX and Axc, showing that in SIF conditions, the protective effect of the two methods was the same (Figure 3). These results indicated that the xanthan gum concentration (0.5% w/v) was suitable for encapsulation which did not interfere with the alginate structure.

Conclusions

The results obtained from the study showed that *B. subtilis* natto biomass had a thrombolytic ability compared to the control sample. The survival rate of *B. subtilis* natto was significantly affected under SGF and SIF conditions. The wall material by alginate enhanced the *B. subtilis* natto viability, and adding xanthan gum is necessary to increase the protective effect of *B. subtilis* natto of alginate.

The authors declare that there is no conflict of interest regarding the publication of this article.

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Assessment of eggshell color and yolk fatty acid profiles in two laying hen strains housed with or without access to legume or aromatic plant species outdoor

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Abstract

Plant species vary regarding aspects including taste, palatability, and bioactive compounds. Consequently, the intake of different plant species by laying hens results in the consumption of associated nutrients and the expectation is the modification of shell color and yolk fatty acid profiles of eggs. Here, we investigated the effect of housing environment on shell color and yolk fatty acid profiles of eggs obtained from Lohmann Sandy (LS) and Lohmann LSL Classic (LW) strains. Housing environments included deep litter (DL), free access to outdoor *Mentha piperita* (*M. piperita*), *Petroselinum crispum* (*P. crispum*), and *Medicago sativa* (*M. sativa*). 260 four-week-old birds were randomly distributed to DL and outdoor plant-associated groups, with four and three replicates, respectively, and 10 birds per replicate. Range accessibility was granted at 12 weeks of hen age for outdoor plant-associated groups. Shell color and yolk fatty acid profiles were analyzed at 25 weeks of hen age. There was greater variability among the housing environments regarding the shell color: redness (a*) and yellowness (b*) at the broad end, brightness (L*), a*, b*, and shell color (ΔE^*) at Centre and pointed end ($P < 0.01$; $P < 0.05$). The overall ΔE^* was also significantly highest in eggs collected from *M. sativa* and *P. crispum* hens and lowest in eggs from *M. piperita* hens. Palmitic (C16:0), stearic (C18:0), oleic (C18:1n9c), linoleic (C18:2n6), and alpha-linolenic (C18:3n3) fatty acids were significantly higher in eggs obtained from *M. sativa* and *M. piperita* than DL and *P. crispum* hens, each category with similar values ($P < 0.01$; $P < 0.05$). While the total saturated fatty acids were highest and lowest in *M. sativa* and *P. crispum*, respectively, total unsaturated fatty acids were highest and lowest in *P. crispum* and *M. sativa*, respectively ($P < 0.01$; $P < 0.05$). No differences were observed in myristic acid (C14:0) and arachidonic acid (C20:4 n-6) among the housing environments ($P > 0.05$). Additionally, all the yolk fatty acid profiles were similar between the laying hen strains ($P > 0.05$). It was concluded that most of the yolk fatty acid profiles could be modified when hens are granted free access to outdoor *M. sativa* and *M. piperita*. Genetic influence on fatty acid profiles needs further studies. *M. sativa* and *P. crispum* may have the potential to modulate the shell color intensity.

Keywords: aromatic plants, eggshell color, fatty acid profiles, free-range system, laying hen

Introduction

Cage-free systems such as floor or litter or deep litter and free-range systems are becoming popular among consumers, owing to the perception that they offer a welfare-friendly environment to laying hens. In particular, in the free-range production system, it is recommended that hens have free access to outdoor vegetated areas (Sossidou et al., 2015; Hammershøj & Johansen, 2016), which can modify egg composition through the consumption of different plant species and small organisms such as worms and insects.

In addition, the demand for cage-free eggs has come along with the growing interest in functional foods that can play a critical role in preventing certain human diseases (Ferrier et al., 1995; Golzar Adabi et al. 2013). The proficiency in the utilization of eggs as functional foods is well-established (Surai and Sparks, 2001), where the approach of manipulation of layer diet can modify yolk fatty acid contents. There is evidence that intake of plants via supplementation of forage materials to poultry feed or free access to vegetated outdoor areas can modify yolk fatty acid compositions (Lopez-Bote et al., 1998; Karsten et al., 2010; Hammershøj & Steenfeldt, 2012; Mugnai et al., 2014; Hammershøj & Johansen, 2016; Kop-Bozbay et al., 2021). However, the nutritional relevance of plant species is an important factor, which is associated with the amount of plants hens can consume and consequently, influence ingested fatty acids, resulting in enriched yolk fatty acids (Sossidou et al., 2015; Hammershøj & Johansen, 2016). Furthermore, it can be argued that some plant species comprise nutrients that can modify yolk fatty acids or modulate the transfer of ingested fatty acids to yolk. While there is vast information regarding the potential of pastures such as *Medicago sativa* in enriching yolk fatty acid contents (Hammershøj & Johansen, 2016), the reverse is true for aromatic plants. These plants have been highly studied as additives in layer feed with inadequate information about their potential as outdoor forage materials.



Also, the genetic structure of hens can influence some fatty acids (Sarica et al., 2009; Sözcü et al., 2021). In particular, this effect is linked to genotype or strain differences in the plant intake, ingestion of nutrients from different plants, and their transfer to egg compartments (Lorenz et al., 2013) in outdoor laying production systems or systems where there is dietary manipulation through the addition of forage materials to layer diets.

Shell color is a critical egg quality trait, with color preference, varying among consumers and regions. Thus, shell color has a genetic basis, with greater variability among genotypes and strains as reported by Lordelo et al. (2020). However, there is little information regarding the effect of outdoor plant species on shell color, warranting further studies.

This study examined the eggshell color quality and yolk fatty acid compositions from two laying hens housed with or without free access to *Mentha piperita*, *Petroselinum crispum*, and *Medicago sativa* vegetated areas. It was hypothesized that access to different outdoor aromatic plant species and a legume pasture may boost laying hens differently with bioactive compounds, and this could lead to the enrichment/improvement of yolk fatty acid profiles and the modification of the eggshell color intensity.

Materials and methods

Ethical approval

The egg samples used in the study were obtained from a long-term study involving two commercial laying strains housed in four housing environments, carried out at Ayhan Şahenk Agricultural Application and Research Centre of Niğde Ömer Halisdemir University, Niğde province, Türkiye. The Niğde Ömer Halisdemir University animal experiments local ethics committee approved the animal use protocol (approval number: 2021/04), and the management of birds followed the guidelines for the regulation of animal experiments by the Ministry of Food, Agriculture and Livestock, Türkiye.

Bird's housing and management

Reports (Tainika et al., 2024a, b) provide details on birds, housing, and management from three to 52 weeks of hen age. Briefly, Lohmann LSL Classic (LW, white eggshell color) and Lohmann Sandy (LS, cream eggshell color) strains were under the same housing conditions regarding stocking densities, photoperiod, number of drinkers and feeders, etc. The study followed the vaccination program as required in the region.

There were a total of 26 replicate pens at the same poultry house, each with 10 hens. The birds were designated for the outdoor plant-based housing environment (18 replicate pens), with free access to the respective outdoor pens cultivated with either *Mentha piperita* (*M. piperita*), *Petroselinum crispum* (*P. crispum*), or *Medicago sativa* (*M. sativa*). For range accessibility, the pop holes were opened every day between 8:30 a.m. and 3:30 p.m. from 12 weeks of hen age. The other eight replicate pens were for completely indoor (deep litter, DL) housed birds. Specifically, during the egg-laying period, the birds were fed standard feed *ad libitum* composed of 17 % CP; 2700 Kcal ME/kg; 3.9 % Ca, and 0.4 % P).

Data collection

One hundred and fifty-six eggs (78 eggs per strain; 6 eggs per replicate pen) were used to assess the eggshell color and yolk fatty acid profiles at 25 weeks of hen age.

Eggshell color determination: In the laboratory, all the eggs were first weighed (0.01 g precision weighing scale) and their shell color was determined as follows. Color differences (shell color, ΔE^*) were calculated using the L^* , a^* , and b^* . $\Delta E^* = (L^{*2} + a^{*2} + b^{*2})^{1/2}$. The lightness (L^*), redness (a^*), and yellowness (b^*) of the shell were determined with a Minolta CR400 chromameter (Konica Minolta Sensing Inc., Osaka, Japan). ΔE^* was determined as the average of three L^* , a^* , and b^* measurements that were recorded at the center, blunt edge, and pointed edge of the egg.

Assessment of fatty acid profiles: To determine the egg yolk fatty acid compositions, Folch et al. (1957) and Samman et al. (2009) procedures were followed. The yolk fatty acid profiles were expressed as a percentage of total fatty acids.

Statistical analysis: During data analysis, the normality assumptions of the data were examined using the Kolmogorov-Smirnov test, and tests for homogeneity of variance were conducted using the Levene test, confirming that the assumptions were met. Accordingly, an analysis of variance was applied to the data. Intra-group multiple comparisons utilized Duncan's multiple comparison test at $P < 0.05$. The statistical software package SPSS 21 was used for data analysis. The following statistical model was used for the analysis of the data:

$$Y_{ijk} = \mu + \alpha_i + \beta_j + \alpha\beta_{ij} + e_{ijk}$$

In the model, Y_{ijk} : observation value, μ : population mean, α_i : the effect of the i . housing environment, β_j : the effect of the j . strain, $\alpha\beta_{ij}$: the effect of interaction and e_{ijk} : the effect of random error $e \sim N(0, \sigma^2)$.



Results

The results for eggshell color are indicated in Table 1. As expected, shell color differed between strains. Also, there was a significant variation regarding the shell color: redness (a^*) and yellowness (b^*) at the broad end, lightness (L^*), a^* , b^* , and shell color (ΔE^*) at the center and pointed end ($P < 0.01$; $P < 0.05$) among the housing environments. It was identified that the overall ΔE^* was significantly highest in eggs collected from *M. sativa* and *P. crispum* hens and lowest in eggs from *M. piperita* hens.

Table 1. Effect of strain and housing environment on shell color in laying hens at 25 weeks of age.

Broad end					Center					Sharp end					
F	EW	L*	a*	b*	ΔE*	L*	a*	b*	ΔE*	L*	a*	b*	ΔE*	A	
F1	DL	55.36	84.45	4.56 ^b	13.14 ^b	86.43	84.90 ^{ab}	4.42 ^b	13.23 ^b	86.87 ^b	84.45 ^a	5.05 ^b	13.63 ^b	84.92 ^a	86.07 ^{ab}
	Pc	55.47	85.78	3.42 ^a	11.50 ^a	87.23	86.04 ^b	3.26 ^a	11.36 ^a	87.41 ^b	86.35 ^c	3.68 ^a	11.72 ^a	86.63 ^c	87.09 ^b
	Mp	55.24	84.78	4.01 ^{ab}	11.62 ^a	86.41	83.75 ^a	3.77 ^a	11.44 ^a	85.30 ^a	84.98 ^{ab}	4.31 ^a	12.02 ^a	85.35 ^{ab}	85.69 ^a
	Ms	55.86	85.74	3.55 ^a	11.31 ^a	87.25	85.78 ^b	3.45 ^a	11.37 ^a	87.29 ^b	86.12 ^{bc}	3.96 ^a	11.71 ^a	86.46 ^{bc}	87.00 ^b
	P	0.741	0.066	<0.001	<0.000	0.186	<0.005	<0.001	<0.000	<0.002	<0.006	<0.000	<0.000	<0.007	<0.010
F2	LS	55.90	76.89	8.41	20.63	80.16	87.32	8.09	20.42	80.50	87.15	9.15	21.31	77.88	79.51
	LW	55.05	93.37	-0.54	3.34	93.44	92.88	-0.54	3.49	92.96	93.64	-0.53	3.44	93.66	93.35
	P	<0.049	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000	<0.000
SEM	0.20	0.70	0.38	0.72	0.57	0.67	0.37	0.71	0.55	0.70	0.41	0.74	0.67	0.58	
HE × HS	0.628	<0.036	<0.001	0.102	0.113	<0.039	<0.002	<0.031	0.102	<0.018	0<.001	<0.036	<0.021	<0.028	

Abbreviations: F: Factor; F1: Housing environment (HE); F2: Hen strain (HS); DL: deep litter, Pc: *Petroselinum crispum*, Mp: *Mentha piperita*, Ms: *Medicago sativa*, P: P value; A: Average ΔE^* ; LS: Lohmann Sandy, LW: Lohmann LSL Classic, SEM: standard error of mean, ΔE^* : shell color, L^* : lightness, a^* : redness, b^* : yellowness, ×: interactions between different factors. EW: Egg weight, g; Means within the same column with different letter superscript significantly differ ($P < 0.05$).

The data for the yolk fatty acid compositions are shown in Table 2. There was no significant effect of hen strain on yolk fatty acid profiles ($P > 0.05$). However, housing environment affected the yolk fatty acid compositions: DL and *P. crispum* eggs had significantly lower palmitic (C16:0), stearic (C18:0), oleic (C18:1n9c), linoleic (C18:2n6), and alpha-linolenic (C18:3n3) acids than *M. piperita* and *M. sativa* eggs ($P < 0.01$). On the other hand, myristic (C14:0) and arachidonic (C20:4 n-6) fatty acid compositions were not different among the housing environments ($P > 0.05$). The housing environment significantly influenced the total saturated fatty acids (SFA) and total unsaturated fatty acids (UFA) ($P < 0.05$): while the *M. sativa* eggs had the highest and lowest total SFA and total UFA, the *P. crispum* eggs had the lowest and highest total SFA and total UFA. There was a significant housing environment × hen strain interaction effect on palmitic (C16:0), stearic (C18:0), oleic (C18:1n9c), linoleic (C18:2n6), and alpha-linolenic (C18:3n3) acids.

Table 2. Effect of strain and housing environment on yolk fatty acid composition (%) in laying hens at 25 weeks of age.

Factor		Palmitic (C16:0)	Stearic (C18:0)	Myristic acid (C14:0)	Arachidonic acid (C20:4 n-6)	Oleic acid (C18:1n9c)	Linoleic acid (C18:2n6)	Alpha linolenic acid (C18:3n3)	Total saturated fatty acids	Total unsaturated fatty acids
F1	DL	18.62 ^a	5.57 ^a	2.53	1.44	38.18 ^a	14.63 ^a	1.42 ^a	32.39 ^{ab}	67.61 ^{bc}
	Pc	18.27 ^a	5.63 ^a	2.66	1.40	39.23 ^a	14.10 ^a	1.39 ^a	32.12 ^a	67.88 ^c
	Mp	21.19 ^b	6.05 ^b	2.62	1.39	42.26 ^b	15.74 ^b	1.53 ^b	32.86 ^{bc}	67.14 ^{ab}
	Ms	21.23 ^b	6.00 ^b	2.58	1.39	41.42 ^b	15.55 ^b	1.54 ^b	33.18 ^c	66.82 ^a
	P	<0.000	<0.001	0.218	0.701	<0.000	<0.000	<0.000	<0.015	<0.015
F2	LS	19.89	5.77	2.61	1.40	40.23	15.02	1.47	32.68	67.32
	LW	19.58	5.82	2.58	1.42	39.99	14.94	1.46	32.56	67.44
	P	0.893	0.319	0.564	0.613	0.776	0.718	0.902	0.957	0.957
	SEM	0.259	0.054	0.024	0.016	0.365	0.151	0.015	0.129	0.129
	HE × HS	<0.000	<0.001	0.866	0.211	<0.000	<0.000	<0.000	<0.008	<0.008

Abbreviations: F: Factor; F1: Housing environment (HE); F2: Hen strain (HS); DL: deep litter, Pc: *Petroselinum crispum*, Mp: *Mentha piperita*, Ms: *Medicago sativa*, P: P value; LS: Lohmann Sandy, LW: Lohmann LSL Classic, SEM: standard error of the mean, ×: interactions between different factors, Means within the same column with different letter superscript significantly differ ($P < 0.05$).

Discussion

The results for the strain differences regarding shell color were expected because the LS strain lays cream-shell eggs, and the LW strain lays white-shell eggs, which aligns with the genetic influence on the coloration of shell (Samiullah et al. 2015). Furthermore, Lordelo et al. (2020) reported shell color differences among Amarela, Branca, Pedres, and Preta breeds and Tetra brown commercial hybrid laying hen.



In the present study, the effect of housing environment on shell color would reveal that the specific ingested bioactive compounds obtained from intake of specific outdoor plants can modify the physiological and biochemical characteristics of various pigments in laying hens differently and consequently, the extent of shell pigment deposition (Samiullah et al. 2015). Additionally, the present results confirmed that the extent of pigment deposition across the egg is not uniform and might be modulated by the bird's responsiveness to dietary manipulation with free access to different outdoor vegetated areas. Moreover, in the present study, the housing system and strain interaction effect on shell color highlights the pattern of changes in the coloration of eggshells between hybrids under different housing systems.

In this study, the major fatty acids in egg yolks were oleic (C18:1n9c), linoleic (C18:2n6), and palmitic (C16:0), which is similar to results reported by some authors (Lopez-Bote et al., 1998; Sarica et al., 2009; Lordelo et al., 2020).

The variation in palmitic (C16:0), stearic (C18:0), oleic (C18:1n9c), linoleic (C18:2n6), and alpha-linolenic (C18:3n3) fatty acids would indicate that these fatty acids were receptive to dietary manipulation with free access to different outdoor forage plants. However, the responsiveness was much higher with access to *M. sativa* and *M. piperita* than with *P. crispum*. These results would suggest that (i) the intake of *M. sativa* and *M. piperita* was higher than *P. crispum* and consequently, a higher intake of bioactive compounds that modified the above fatty acids and (ii) *M. sativa* and *M. piperita* might be associated with a higher concentration of specific bioactive components that would modulate the above yolk fatty acids (Mugnai et al., 2014; Dal Bosco et al., 2016).

Indeed, some authors have reported variability in fatty acid compositions based on the differences in outdoor plant species (Karsten et al., 2010; Lopez-Bote et al., 1998; Popova et al., 2020; Mierliță, 2020; Islam et al., 2021). Anderson (2011) also found more unsaturated fatty acids and higher levels of n-3 fatty acids in free-range eggs than in cage eggs. On the contrary, the lack of differences in myristic (C14:0) and arachidonic (C20:4 n-6) fatty acids would suggest that these specific fatty acids did not respond to dietary manipulation with free access to different plant compositions.

Several authors have also reported changes in total SFA and total UFA due to the housing environment (Popova et al., 2020; Mierliță, 2020; Islam et al., 2021).

In the present study, the lack of strain differences in the fatty acid compositions would agree with Lordelo et al (2020), who found similar fatty acid profiles in eggs obtained from Amarela, Branca, Pedres, and Preta breeds and tetra brown commercial hybrid laying hen. In contrast, several authors reported genetic influence on some fatty acid compositions. For instance, Sarica et al. (2009) identified significant differences in some fatty acids in two local Turkish breeds and a commercial laying hen strain. Sözcü et al. (2021) found that the yolk saturated fatty acids profile, except C15:0, the total yolk SFAs, and yolk UFAs, except C18:1c, C18:2c, and C20:3n6 differed between Atabey and Atak-S genotypes. The contradiction in results is associated with different factors including strains, feeding, housing system and environment, study region, age of hens at which fatty acid analysis was conducted, etc.

In the present study, the significant housing environment $\times$ strain interaction effect on some yolk fatty acids would indicate a pattern of changes in these fatty acid compositions as laying hens react to the different housing environmental circumstances.

Conclusions

This study demonstrated that eggs may be enriched with the major fatty acids with free access to outdoor areas vegetated with *M. piperita* and *M. sativa* plant species. In addition, *M. sativa* and *P. crispum* plant species seem to have the potential to modify the shell color intensity.

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Physio-Biochemical Responses of Maize Genotypes to Salinity Stress

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Abstract

Global crop productivity, especially that of maize (*Zea mays* L.) is severely impacted by salinity, a significant abiotic stressor. Various physio-biochemical reactions are involved in how salinity affects maize genotypes. With an emphasis on some physiological and biochemical features, this study attempts to assess how salinity affects three genotypes of maize. This study examined the physio-biochemical characteristics of three maize varieties (BARI Hybrid Maize-9, BARI Hybrid Maize-12 and BARI Hybrid Maize-13) grown in the first phase of salinity in the grill house next to the Department of Crop Botany at BAU. NaCl was used to simulate the salinity stress (12ds/m), while no NaCl was applied to the control group. The pot experiment, which included four replications and 20L pots with 17kg of air-dried soil each, was conducted using the CRD method. On day 20, the plants were fully salted, and on day 30, they were harvested following ten days of intense stress. Different physiological (viz. stomatal conductance and photosynthesis rate) and biochemical (viz. carotenoids content, phenolics content and chlorophyll-b content) parameters were studied. From the study, it was found that the changes in stomatal conductance and photosynthesis rate were not that much significant but carotenoids, phenolics, and chlorophyll-b content were altered greatly by salinity stress. Based on a comprehensive analysis of all the parameters and overall performance, BARI Hybrid Maize-13 seems to be the most resistant variety to salinity stress because of its significant increase in chlorophyll-b and phenolics content, which are essential for photosynthetic effectiveness and adaptation to stress.

Key Words: Salinity, Maize, Physio-Biochemical, Crop production, Stress





ID: 352

Genome Wide Identification of NPR-1 like Gene Family in *Theobroma Cacao* (Cacao) in Response to Biotic Stress

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Abstract

Cacao (*Theobroma cacao*), the source of chocolate, faces critical production challenges due to the harmful Cacao swollen shoot virus (CSSV). This virus causes substantial yield losses, threatening the global chocolate supply chain. Salicylic acid (SA) is a crucial plant defense signal molecule that triggers immune responses via the NPR1 protein. Upon SA activation, the cellular environment changes, leading to the reduction of disulfide bonds within the NPR1 complex. This releases NPR1 monomers, allowing them to activate defense genes in the nucleus. This study employed in-silico methods to identify and characterize NPR-1 like genes within the cocoa (*Theobroma cacao*) genome. Using computational methods, three NPR1-like genes (*TcNPR1*, *TcNPR2*, and *TcNPR3*) are discovered. Phylogenetic analysis revealed that *TcNPR1* and *TcNPR2* cluster with known SA signaling genes in *Arabidopsis*, suggesting they may play similar roles in cacao's defense pathways. Interestingly, *TcNPR3* formed a distinct evolutionary group, hinting at possible unique functions. Further analysis revealed the presence of conserved motifs essential TGACG motif for NPR1 function in all *TcNPRs* proteins. Transcriptomic analysis showed increased expression of *TcNPR2* in response to *Phytophthora megakarya* infection, highlighting a potential role in defense activation. The identification of miRNAs targeting *TcNPR3* raises the possibility of CSSV suppressing cacao's immune response by downregulating this critical gene. Our study helped to elucidate the understanding of NPR1-like genes in cacao and provides crucial insights into their potential roles in defense against. These findings lay the foundation for developing strategies to enhance disease resistance in cacao, ensuring the sustainable production of this economically vital crop.

Keywords: *Cacao, Badnavirus, NPR1, Salicylic Acid, Disease Resistance*





ID: 353

In-silico investigation of the potential role of PBS3 gene in salicylic production in Cacao

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Abstract

Badnaviruses, especially Cacao swollen shoot virus (CSSV), is a major threat to cacao plants. Dispersed by insects, these DNA viruses cause swollen shoots, stunted growth, resulting in reduced yields, negatively impacting chocolate production worldwide. Salicylic Acid, A Plant's Built-in Alarm System Against Viruses, activate PR-genes in plants. Homology analysis with *Arabidopsis thaliana* suggests the potential involvement of PBS3 (avr-PphB Susceptible 3) gene family in salicylic acid (SA) biosynthesis. PBS3 protein attaches Glutamate to Isochorismic acid (ICA) to produce Isochorismate-9-Glutamate, then which produces salicylic acid. This study employed in-silico methods to identify and characterize PBS3 genes within the cocoa (*Theobroma cacao*) genome. This study analyzes gene structure, chromosomal location, protein motifs, phylogeny, synteny, transcriptome expression, and potential microRNA targets to elucidate the structural and functional characteristics of the PBS3 family in *T. cocoa*. Our findings revealed 24 *PBS3 genes* distributed across three chromosomes in *T. cocoa*. The abundance of *PBS3 genes* suggests extensive dispersion through segmental duplications (paralogous events) compared to tandem duplications (orthologous events). Transcriptomic analysis indicated high expression of *PBS3 genes* in response to *Phytophthora megakarya* inoculation, a fungal pathogen of *T. cocoa*. Additionally, Phylogenetic analysis with *Arabidopsis thaliana* identified five subfamilies within the GH3 family, encompassing both *T. cocoa* and *Arabidopsis* genes, sharing functional characteristics Further exploratory investigation of *PBS3 gene* and its underline mechanisms involved in SA production will enhance scientific knowledge of researchers in development of disease tolerance in cacao cultivars. However, further investigation is needed to validate the present results and to further understand the mechanisms controlling upregulation and downregulation of PBS3 and associated genes in plant stress tolerance.

Keywords: *Theobroma cacao*, Disease resistance, Badnavirus, Salicylic acid, PBS3 gene family,





ID: 356

Usage of Eastern Black Sea Region Plants in The World Ornamental Plants Sector and Ongoing Studies Towards Their Utilization in Our National Sector

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Abstract

Consumer demands are constantly changing in the world ornamental plants sector. Hundreds of ornamental plant varieties are grown and marketed every year. While more attractive flowers were preferred in the past, natural flowers have started to be preferred in recent years. Turkey is one of the countries with the richest biodiversity in the world and the ornamental plants sector has a high development potential. However, due to the insufficient number of domestic varieties in the sector, it is dependent on foreign production inputs, especially plant materials. The Black Sea Region is one of the regions with the highest genetic resources of plants used as ornamental plants in the world. In this study, information about the subcategory of the world ornamental plants sector in which some natural ornamental plant species in the Eastern Black Sea region are evaluated and the studies carried out for the evaluation of these plants in the ornamental plants sector of our country are given. Turkey is one of the countries with the richest biodiversity in the world and the ornamental plants sector has a high development potential due to its climate where production can be made all year round. However, due to the inadequacy of the number of domestic varieties in the sector, it is foreign-dependent for production inputs, especially plant materials. Consumer demands in the world ornamental plants sector are constantly changing. Hundreds of ornamental plant varieties are grown and marketed each year. While more attractive flowers were preferred in the past, natural flowers have started to be preferred in recent years. The region with the highest concentration of genetic resources that can be considered as ornamental plants is the Black Sea region. In this study, there is information about which subcategory of the sector can be evaluated for some natural ornamental plant species in the Eastern Black Sea region, which includes Artvin, Rize and Trabzon provinces.

Key words: Ornamental Plants, Commercial Value, Artvin, Rize, Trabzon, Natural Plants



ID: 357

Determination of Biogas Production Potential of Aegean Region from Animal Waste

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Abstract

Greenhouse gases resulting from the intensive burning of fossil fuels bring serious environmental problems. These anthropogenic impacts cause environmental concerns such as air pollution and global warming. Moreover, the fact that fossil fuels are expensive and will be depleted in the near future has led researchers to seek economic and renewable energy alternatives. In this respect, biogas, one of the renewable energy alternatives, is obtained anaerobically from almost any kind of organic waste or residue according to the operating parameters. Biogas is one of the most popular biofuels, typically produced using animal waste as feedstock. This study determined the daily manure amounts according to animal class by obtaining the number of cattle, ovine, and poultry in the Aegean Region from the Turkish Statistical Institute. Accordingly, dry fertilizer amounts were determined and biogas production potential was calculated. Finally, the energy obtained based on the biogas production potential was determined. In the study, it was determined that the cattle class has a biogas production potential of 1199862 m³ per day, the ovine class 83264.1 m³ per day, and the poultry class 478279.1 m³ per day. Annual energy in the Aegean Region was calculated as 552699.4 TOE.

Key Words: Biogas potential, Animal waste, Aegean Region

Ege Bölgesi'nin Hayvansal Atık Kaynaklı Biyogaz Üretim Potansiyelinin Belirlenmesi

Özet

Fosil yakıtların yoğun şekilde yakılması sonucu oluşan sera gazları, önemli çevresel sorunları beraberinde getirmektedir. Bu antropojenik etkiler, hava kirliliği ve küresel ısınma gibi çevresel sorunlara neden olmaktadır. Ayrıca, fosil yakıtların maliyetli olması ve yakın gelecekte tükenecek olması, araştırmacıları ekonomik ve yenilenebilir enerji alternatifleri aramaya yöneltmiştir. Bu kapsamda, yenilenebilir enerji alternatiflerinden biri olan biyogaz, hemen hemen her türlü organik atık veya kalıntıdan anaerobik olarak işletim parametrelerine göre elde edilmektedir. Biyogaz, genelde ham madde olarak hayvansal atıklar kullanılarak elde edilen en popüler biyoyakıtlardan biridir. Bu çalışmada, Ege Bölgesi'nin büyükbaş, küçükbaş ve kümes hayvan sayıları Türkiye İstatistik Kurumu'ndan temin edilerek, hayvan sınıfına göre günlük gübre miktarları saptanmıştır. Buna göre, kuru gübre miktarları belirlenerek, biyogaz üretim potansiyeli hesaplanmıştır. Son olarak, biyogaz üretim potansiyeline bağlı olarak elde edilen enerji tespit edilmiştir. Çalışmada, büyükbaş hayvan sınıfının günlük 1199862 m³, küçükbaş hayvan sınıfının günlük 83264.1 m³ ve kümes hayvan sınıfının günlük 478279.1 m³ biyogaz üretim potansiyeli olduğu belirlenmiştir. Ege Bölgesi'nde yıllık enerji 552699.4 TEP olarak hesaplanmıştır.

Anahtar Kelimeler: Biyogaz potansiyeli, Hayvansal atık, Ege Bölgesi

Giriş

İnsan konforu ve gündelik hayattaki temel ihtiyaçlar için enerjiye gereksinim duyulmaktadır. Ülkelerin çoğunda, özellikle de gelişmekte olan ülkelerde yenilenemez fosil yakıtlara bağımlılık enerji krizlerine neden olmaktadır. Küresel ölçekte ülkelerin ulusal enerji itici güçleri enerji güvenliği, ekonomik büyüme ve çevre korumadır. Yenilenebilir olmayan kömür ve petrol gibi yakıtların yakın gelecekte tükeneceği, dolayısıyla fosil yakıtlara alternatif olabilecek enerji kaynaklarına ihtiyaç duyulacağı bildirilmiştir (Kabeyi & Olanrewaju, 2022). Dünyada, atıktan enerjiye temalı uygulamalar kapsamında, sürdürülebilir enerji sağlamaya yönelik farkındalık artmaktadır. Bu kapsamda popüler yaklaşım, organik içeriği zengin olan atık ve kalıntıların anaerobik olarak yenilenebilir ürünlere dönüştürülmesidir (Kasinath vd., 2021). Hayvansal atık, tarımsal atık ve kalıntılar gibi çeşitli tipte organik atıklar biyogaz üretimi için ham madde olarak kullanılmaktadır. Bu atıklardan, özellikle hayvansal atıklar, biyogaz üretiminde yaygın kullanılmaktadır.

Atıkların, biyogaz üretiminde ham madde olarak kullanımı, ekonomik ve çevre dostudur. Biyogazın içeriğinin ham madde tipi başta olmak üzere işletim parametrelerine göre genel olarak CH₄ ve CO₂ sırasıyla %55-65 ve %35-45 oranlarında olduğu rapor edilmiştir. Buna ilaveten, çok sınırlı oranda da azot içeriğine sahip olabileceği



bildirilmiştir (Forssberg, 2010; Balat & Balat, 2009). Türkiye’deki bölgelerin genelinde hayvancılık faaliyeti yapılmaktadır. Bu bölgelerden Ege Bölgesinde, diğer bölgelere göre hayvan sayısı daha az olup sınırlı sayıda çalışma yapıldığı saptanmıştır. Bu çalışmada, Ege Bölgesi’nin hayvan sınıfına göre hayvansal atık miktarı belirlenerek, biyogaz üretim potansiyelinin belirlenmesi amaçlanmıştır.

Materyal ve Yöntem

Araştırmada, Ege Bölgesi illerine ilişkin 2023 yılı hayvansal atık kaynaklı biyogaz üretim potansiyelini belirlemek için Türkiye İstatistik Kurumu’nun (TÜİK, 2024) hayvan sayısı verileri kullanılmıştır. Büyükbaş ve küçükbaş hayvan sayıları, TÜİK tarafından yaş ve cinslerine göre nitelendirilmiştir. Bu araştırma kapsamında, 12 ay ve üzeri yaş grubu, büyükbaş hayvan (saf kültür sığırları, süt sığırları, melez sığırlar, yerli sığırlar, manda) ve küçükbaş hayvan (keçi, koyun) sayıları değerlendirmeye alınmıştır. Hayvan sınıflarından kümes hayvanlarda ise, yumurta tavuğu, kaz, hindi, ördek ve beç tavuğu sayıları değerlendirmeye alınmıştır. Buna göre, Ege Bölgesi illerine ilişkin 2023 yılı hayvan sayısı verileri Tablo 1’de sunulmuştur. Hayvan sınıfına göre biyogaz üretim potansiyeli belirlenmesinde, Kaykıoğlu & Cantekin (2023) tarafından yapılan çalışma ve LIFE 03 TCY proje sonuç raporu kabulleri kullanılmıştır (Tablo 2). Bu kabuller dikkate alınarak yapılan hesaplarda gübre miktarı, kullanılabilir gübre miktarı, biyogaz ve enerji potansiyeli hesaplanmıştır.

Tablo 1. Ege Bölgesinin illere göre hayvan sayısı

İl	Hayvan Sayısı			
	Büyükbaş	Küçükbaş	Kümes	Toplam
Afyonkarahisar	279171	735653	14693931	15708755
Aydın	366138	301369	869708	1537215
Denizli	194642	555689	2032481	2782812
İzmir	623157	658300	5448489	6729946
Kütahya	141269	359160	1324998	1825427
Manisa	164177	674715	13158676	13997568
Muğla	188224	371052	505021	1064297
Uşak	94863	211603	313610	620076
Toplam	2051641	3867541	38346914	44266096

Tablo 2. Biyogaz üretim potansiyeli hesabı kabulleri

	Hayvan Sayısı		
	Büyükbaş	Küçükbaş	Kümes
Birim hayvan için gübre üretimi (kg/hayvan.gün)	43.00	2.40	0.18
Kullanılabilirlik (%)	65	13	99
KM (kuru madde, % gübre miktarı)	13.95	27.50	25.88
UKM (uçucu kuru madde, %KM)	83.33	83.64	77.27
Metan üretim oranı (m ³ CH ₄ /kg UKM)	0.18	0.30	0.35

Bulgular ve Tartışma

Ege Bölgesi’nde toplam hayvan sayısının TÜİK (2024) verilerine göre, 44266096 olduğu belirlenmiştir. Tablo 3’e göre büyükbaş hayvan sayısının en yüksek olduğu İzmir ilini, Aydın ilinin takip ettiği görülmektedir. Ege Bölgesi’ndeki büyükbaş hayvan sayısı toplamı 2051641’dir. Tablo 3’e göre, bu sayının %30.4’ünü İzmir, %17.8’ini Aydın ili takip etmektedir. Bölgenin en düşük hayvan sayısının %4.6 oranla Uşak ili olduğu saptanmıştır. Araştırmada, Tablo 3’de sunulduğu üzere, illere göre hayvan sayısı verileri kullanılarak sırasıyla gübre miktarı, kullanılabilir gübre miktarı, kuru madde, uçucu katı madde miktarı ve üretilebilecek metan miktarı günlük olarak hesaplanmıştır. Buna göre, 2023 yılında, Afyonkarahisar ilinin günlük 163267.7 m³, Aydın ilinin günlük 214128.6 m³, Denizli ilinin günlük 113832.6 m³, İzmir ilinin günlük 364441.1 m³, Kütahya ilinin günlük 82618.4 m³, Manisa ilinin günlük 96015.7 m³, Muğla ilinin günlük 110079.1 m³ ve Uşak ilinin günlük 55478.8 m³ biyogaz üretim potansiyeline sahip olduğu tespit edilmiştir (Tablo 3).

Araştırmada, Tablo 4’de sunulduğu üzere, büyükbaş hayvan sınıfından elde edilebilecek biyogazın yıllık TEP cinsinden enerji değerleri belirlenmiştir. Tablo 4’e göre, İzmir ilinin yıllık 114355.5 TEP, Aydın ilinin yıllık 67190.0 TEP, Afyonkarahisar ilinin yıllık 51230.7 TEP, Denizli ilinin yıllık 35718.7 TEP, Muğla ilinin yıllık 34541.0 TEP, Manisa ilinin yıllık 30128.1 TEP, Kütahya ilinin yıllık 25924.3 TEP ve Uşak ilinin yıllık 17408.3 TEP enerji potansiyeli olduğu tespit edilmiştir.

Tablo 5 incelendiğinde, küçükbaş hayvan sayısı en yüksek olan ilin Afyonkarahisar ili olduğu bunu da Manisa ilinin takip ettiği tespit edilmiştir. Ege Bölgesi’nde küçükbaş hayvan sayısı 3867541 olarak belirlenmiştir. Bu sayının %19.0’unu Afyonkarahisar, %17.4’ünü Manisa, %17.0’ını İzmir ilinin takip ettiği ve en düşük oranın ise



%5.5 oran ile Uşak ili olduğu saptanmıştır (Tablo 5). Araştırmada, Tablo 5’de sunulduğu üzere, illere göre hayvan sayısı verileri kullanılarak sırasıyla gübre miktarı, kullanılabilir gübre miktarı, kuru madde, uçucu katı madde miktarı ve üretilebilecek metan miktarı günlük olarak hesaplanmıştır. Buna göre, 2023 yılında, Afyonkarahisar ili günlük 15837.8 m³, Manisa ili günlük 14525.9 m³, İzmir ili günlük 14172.5 m³, Denizli ili günlük 11963.4 m³, Muğla ili günlük 7988.4 m³, Kütahya ili günlük 7732.3 m³, Aydın ili günlük 6488.2 m³ ve Uşak ili günlük 4555.6 m³ biyogaz üretim potansiyeline sahiptir (Tablo 5).

Tablo 3. Büyükbaş hayvan sınıfının illere göre biyogaz üretim potansiyeli

İl	Hayvan sayısı (hayvan)	Gübre miktarı (kg/gün)	Kullanılabilir gübre (kg/gün)	KM (kg/gün)	UKM (kg/gün)	CH ₄ (m ³ /gün)
Afyonkarahisar	279171	12004353	7802829	1088495	907042.6	163267.7
Aydın	366138	15743934	10233557	1427581	1189603.0	214128.6
Denizli	194642	8369606	5440244	758914	632403.1	113832.6
İzmir	623157	26795751	17417238	2429705	2024673.0	364441.1
Kütahya	141269	6074567	3948469	550811.4	458991.1	82618.4
Manisa	164177	7059611	4588747	640130.2	533420.5	96015.7
Muğla	188224	8093632	5260861	733890.1	611550.6	110079.1
Uşak	94863	4079109	2651421	369873.2	308215.3	55478.8

Tablo 4. Büyükbaş hayvan sınıfının illere göre biyogaz üretim potansiyeli ve enerji potansiyeli

İl	CH ₄ (m ³ /gün)	Enerji (MJ/gün)	Enerji (MJ/yıl)	Enerji (TJ/yıl)	Enerji (TEP/yıl)
Afyonkarahisar	163267.7	5877636	2145337253	2145.3	51230.7
Aydın	214128.6	7708630	2813650025	2813.7	67190.0
Denizli	113832.6	4097972	1495759709	1495.8	35718.7
İzmir	364441.1	13119881	4788756449	4788.8	114355.5
Kütahya	82618.4	2974262	1085605770	1085.6	25924.3
Manisa	96015.7	3456565	1261646210	1261.6	30128.1
Muğla	110079.1	3962848	1446439491	1446.4	34541.0
Uşak	55478.8	1997235	728990933	729.0	17408.3

Tablo 5. Küçükbaş hayvan sınıfının illere göre biyogaz üretim potansiyeli

İl	Hayvan sayısı (hayvan)	Gübre miktarı (kg/gün)	Kullanılabilir gübre (kg/gün)	KM (kg/gün)	UKM (kg/gün)	CH ₄ (m ³ /gün)
Afyonkarahisar	735653	1765567.0	229523.7	63119.0	52792.8	15837.8
Aydın	301369	723285.6	94027.1	25857.5	21627.2	6488.2
Denizli	555689	1333654.0	173375	47678.1	39878.0	11963.4
İzmir	658300	1579920.0	205389.6	56482.1	47241.7	14172.5
Kütahya	359160	861984.0	112057.9	30815.9	25774.4	7732.3
Manisa	674715	1619316.0	210511.1	57890.6	48419.7	14525.9
Muğla	371052	890524.8	115768.2	31836.3	26627.9	7988.4
Uşak	211603	507847.2	66020.1	18155.5	15185.3	4555.6

Küçükbaş hayvan sınıfından illere göre elde edilebilecek biyogazın yıllık TEP cinsinden enerji değerleri Tablo 6’da verilmiştir. Buna göre, Afyonkarahisar ilinin yıllık 4969.6 TEP, Manisa ilinin yıllık 4558.0 TEP, İzmir ilinin yıllık 4447.0 TEP, Denizli ilinin yıllık 3753.9 TEP, Muğla ilinin yıllık 2506.6 TEP, Kütahya ilinin yıllık 2426.3 TEP, Aydın ilinin yıllık 2035.9 TEP ve Uşak ilinin yıllık 1429.5 TEP enerji potansiyeli olduğu saptanmıştır.

Tablo 7’de, illere göre kümes hayvanı sayısının en yüksek Afyonkarahisar ilinde olduğu, bu ili de Manisa ilinin takip ettiği tespit edilmiştir. Ege Bölgesi, kümes hayvanı sayısı toplamı 38346914 olarak belirlenmiştir. Tablo 7’ye göre, bu sayının %38.3’ünü Afyonkarahisar, %34.3’ünü Manisa ilinin takip ettiği görülmektedir. Bölgenin en düşük hayvan sayısının %0.8 oran ile Uşak ili olduğu saptanmıştır. Araştırmada, Tablo 7’de sunulduğu üzere, illere göre hayvan sayısı verileri kullanılarak sırasıyla gübre miktarı, kullanılabilir gübre miktarı, kuru madde, uçucu katı madde miktarı ve üretilebilecek metan miktarı günlük olarak hesaplanmıştır. Buna göre, 2023 yılında, Afyonkarahisar ili günlük 183269.0 m³, Aydın ili günlük 10847.4 m³, Denizli ili günlük 25350.0 m³, İzmir ili günlük 67955.9 m³, Kütahya ili günlük 16525.9 m³, Manisa ili günlük 164120.6 m³, Muğla ili günlük 6298.8 m³ ve Uşak ili günlük 3911.5 m³ biyogaz üretim potansiyeline sahiptir (Tablo 7).



Tablo 6. Küçükbaş hayvan sınıfının illere göre biyogaz üretim potansiyeli ve enerji potansiyeli

İl	CH ₄ (m ³ /gün)	Enerji (MJ/gün)	Enerji (MJ/yıl)	Enerji (TJ/yıl)	Enerji (TEP/yıl)
Afyonkarahisar	15837.8	570161.7	208109038	208.1	4969.6
Aydın	6488.2	233573.5	85254342	85.3	2035.9
Denizli	11963.4	430682.1	157198983	157.2	3753.9
İzmir	14172.5	510210.0	186226631	186.2	4447.0
Kütahya	7732.3	278364.0	101602851	101.6	2426.3
Manisa	14525.9	522932.3	190870274	190.9	4558.0
Muğla	7988.4	287580.8	104966982	105.0	2506.6
Uşak	4555.6	164001.1	59860419	59.9	1429.5

Tablo 7. Kümes hayvanı sınıfının illere göre biyogaz üretim potansiyeli

İl	Hayvan sayısı (hayvan)	Gübre miktarı (kg/gün)	Kullanılabilir gübre (kg/gün)	KM (kg/gün)	UKM (kg/gün)	CH ₄ (m ³ /gün)
Afyonkarahisar	14693931	2644908.0	2618459	677657.1	523625.6	183269.0
Aydın	869708	156547.4	154982	40109.3	30992.5	10847.4
Denizli	2032481	365846.6	362188.1	93734.3	72428.5	25350.0
İzmir	5448489	980728.0	970920.7	251274.3	194159.6	67955.9
Kütahya	1324998	238500.0	236114.6	61106.5	47217.0	16525.9
Manisa	13158676	2368562.0	2344876.0	606853.9	468916.0	164120.6
Muğla	505021	90903.8	89994.7	23290.6	17996.7	6298.8
Uşak	313610	56450.0	55885.3	14463.1	11175.7	3911.5

Tablo 8. Kümes hayvanı sınıfının illere göre biyogaz üretim potansiyeli ve enerji potansiyeli

İl	CH ₄ (m ³ /gün)	Enerji (MJ/gün)	Enerji (MJ/yıl)	Enerji (TJ/yıl)	Enerji (TEP/yıl)
Afyonkarahisar	183269.0	6597683.0	2408154185	2408.2	57506.7
Aydın	10847.4	390505.3	142534422	142.5	3403.7
Denizli	25350.0	912598.9	333098585	333.1	7954.4
İzmir	67955.9	2446411.0	892940193	892.9	21323.4
Kütahya	16525.9	594933.8	217150841	217.2	5185.6
Manisa	164120.6	5908342.0	2156544813	2156.5	51498.3
Muğla	6298.8	226758.1	82766717	82.8	1976.5
Uşak	3911.5	140813.2	51396814	51.4	1227.4

Araştırmada, kümes hayvanı sınıfından illere göre elde edilebilecek biyogazın yıllık TEP cinsinden enerji değerleri Tablo 8’de sunulmuştur. Tablo 8’e göre, Afyonkarahisar ilinin yıllık 57506.7 TEP, Manisa ilinin yıllık 51498.3 TEP, İzmir ilinin yıllık 21323.4 TEP, Denizli ilinin yıllık 7954.4 TEP, Kütahya ilinin yıllık 5185.6 TEP, Aydın ilinin yıllık 3403.7 TEP, Muğla ilinin yıllık 1976.5 TEP ve Uşak ilinin yıllık 1227.4 TEP enerji potansiyeli olduğu belirlenmiştir.

Ege Bölgesi illerinden Denizli ilinde Doruk & Bozdeveci (2017) tarafından yapılan bir çalışmada, TÜİK 2014 yılı verileri kullanılmıştır. Buna göre 4370129 toplam hayvan sayısından oluşan günlük yaş gübre miktarı 4578889 kg olarak saptanmıştır. Çalışmada, Denizli ili hayvansal atık kaynaklı biyogazın 70.16 m³/yıl olduğu hesaplanmıştır. Başka bir çalışmada da, Türkiye tavuk atıklarının biyogaz potansiyeli Avcıoğlu vd. (2013) tarafından, TÜİK 2009 yılı et tavuğu ve yumurta tavuğu verileri dikkate alınarak incelenmiştir. Çalışmada, Manisa ilinin 29038 bin m³/yıl, Afyonkarahisar ilinin 24356 bin m³/yıl, İzmir ilinin 22913 bin m³/yıl, Denizli ilinin 5600 bin m³/yıl, Muğla ilinin 4163 bin m³/yıl, Aydın ilinin 3986 bin m³/yıl ve Uşak ilinin 3907 bin m³/yıl biyogaz potansiyeline sahip olduğu belirlenmiştir. Ertop vd. (2022) tarafından yapılan araştırmada, TÜİK 2020 yılı büyükbaş hayvan (süt sığırtı ve et sığırtı) sayısı verileri değerlendirmeye alınmıştır. Araştırmaya göre, Ege Bölgesi araştırma alanında elde edilebilecek biyogaz potansiyeli Afyonkarahisar ilinde 55438618.40 MJ, Aydın ilinde 56179397.51 MJ, Denizli ilinde 37981047.12 MJ, İzmir ilinde 100488906.60 MJ, Kütahya ilinde 23846922.85 MJ, Manisa ilinde 30990885.16 MJ, Muğla ilinde 36553104.36 MJ ve Uşak ilinde 18319480.54 MJ olarak tespit edilmiştir. Aydın ilinin hayvansal atık kaynaklı biyogaz potansiyelini belirlemek amacıyla Aydın Tarım İl Müdürlüğü ve TÜİK verilerinin kullanıldığı Öztürk (2019) tarafından yapılan bir çalışmada da, yıllık 5611710 ton büyükbaş, 227550 ton küçükbaş ve 183784 ton kanatlı hayvan atığı olduğu rapor edilmiştir. Bu atıkların kullanılabilir kuru madde miktarının 493432 ton olduğuna bağlı olarak, 2.24 PJ enerji eşdeğeri olduğu saptanmıştır. Ege Bölgesi kapsamında, hayvansal atık kaynaklı biyogaz potansiyelinin il bazında belirlenmesine yönelik araştırmalar ve bu



araştırma, biyogaz potansiyelinin enerji eldesine önemli oranlarda katkısı olacağını göstermektedir. Bu potansiyel katkı göz önünde bulundurularak, bölgede biyogaz tesisi sayısının gelecek yıllarda artacağı öngörülmektedir.

Sonuç

Çalışmada, TÜİK hayvan sayısı verileri dikkate alınarak Ege Bölgesi'nin yıllık biyogaz üretim potansiyeli saptanmıştır. Bu verilere göre, büyükbaş hayvan sınıfının günlük 1199862 m³, küçükbaş hayvan sınıfının günlük 83264.1 m³ ve kümes hayvan sınıfının günlük 478279.1 m³ biyogaz üretim potansiyeli olduğu belirlenmiştir. İl bazında toplam enerji, Afyonkarahisar ilinde 113707 TEP/yıl, Aydın ilinde 72629.6 TEP/yıl, Denizli ilinde 47427 TEP/yıl, İzmir ilinde 140125.9 TEP/yıl, Kütahya ilinde 33536.2 TEP/yıl, Manisa ilinde 86184.4 TEP/yıl, Muğla ilinde 39024.1 TEP/yıl ve Uşak ilinde 20065.2 TEP/yıl olarak hesaplanmıştır.

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Changes in Quality Parameters During The Shelf Life of Honey and Non-Honey Bee Products

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Abstract

From past to present, beekeeping products have taken their place among the most used natural products due to their strong antioxidant, anti-inflammatory, antibacterial, antiviral and antitumor properties. Chemical composition of bee products; It may vary depending on geographical conditions. The bee product that is most difficult to standardize in this regard is propolis. Bee products have a chemical composition rich in proteins, carbohydrates, vitamins, minerals and phenolic substances. Bee products rich in bioactive components are honey, propolis, royal jelly, bee pollen and bee bread. It is important to maintain the quality and ensure stability of these products throughout their shelf life. It is stated by the Turkish Food Codex that propolis should be used in its extracted form, not its raw form. There are no studies on the changes and differences in the structure of propolis during its shelf life. The formation and increase of HMF and the decrease of diastasis in the shelf life of honey is an important quality problem. HMF and Diastase are two important parameters in controlling the quality of honey. Proline, the main amino acid of honey, is a parameter that indicates the maturity of honey. It has been stated that with correct storage conditions, the shelf life of honey can be determined as 3 years on average. Although it is possible to consume bee pollen fresh, it is more common and recommended to consume it after drying in order to prevent fermentation, maintain stability and prevent microbial spoilage. 10-HDA fatty acid, which is an important compound in the high water content capacity and structure of royal jelly, is an important quality parameter in its shelf life. It has been observed that 10-HDA concentration decreases throughout shelf life. Bee bread (perga) should be stored in a cool environment and consumed quickly. While honey should be kept dry and protected from direct sunlight at a temperature not exceeding 25 °C, royal jelly, bee pollen and bee bread should be stored in raw form at +8 °C and below.

Key Words: Honey, Propolis, Bee bread, Royal jelly, Pollen,

Bal ve Bal Dışı Arı Ürünlerinde Raf Örü Süresince Kalite Parametrelerindeki Değişmeler

Özet

Geçmişten günümüze kadar arıcılık ürünleri güçlü antioksidan, antiinflamatuvar, antibakteriyel, antiviral ve antitümör özellikleri sebebi ile en çok kullanılmakta olan doğal ürünler arasında yerlerini almışlardır. Arı ürünlerinin kimyasal bileşimi; coğrafi koşullara göre değişiklik gösterebilmektedir. Bu konuda standardizasyonu en zor olan arı ürünü ise propolistir. Arı ürünleri proteinler, karbonhidratlar, vitaminler, mineraller ve fenolik maddelerce zengin kimyasal kompozisyona sahiptirler. Biyoaktif bileşence zengin arı ürünleri ise bal, propolis, arı sütü, arı poleni ve arı ekmeğidir. Raf ömrü boyunca bu ürünlerin kalitesini koruyabilmek, stabiliteyi sağlayabilmek önemli bir durumdur. Propolisin Türk Gıda Kodeksi tarafından ham halinin değil ekstrakte edilmiş formunun kullanılması gerektiği belirtilmiştir. Propolisin raf ömrü süresince yapısında meydana gelen değişiklikler, farklılıklar ile ilgili çalışmalar bulunmamaktadır. Bal için raf ömründe HMF'nin oluşması ve artması diastazın ise azalması önemli bir kalite sorunudur. HMF ve Diastaz balın kalitesinin kontrolünde önemli iki parametredir. Balın ana amino asiti olan prolin, balın olgunluğunu belirten bir parametredir. Doğru muhafaza koşullarıyla beraber balın raf ömrünün ortalama 3 yıl olarak belirlenebileceği belirtilmiştir. Arı poleninin taze tüketiminin mümkün olmasıyla beraber fermentasyonun engellenmesi, stabilitenin korunması ve mikrobiyal bozulmanın engellenebilmesi için kurutulduktan sonra tüketimi daha yaygın ve önerilen bir husustur. Arı sütünün yüksek su içeriği kapasitesi ve yapısındaki önemli bir bileşik olan 10-HDA yağ asiti raf ömründe önemli kalite parametresidir. 10-HDA konsantrasyonunun raf ömrü boyunca azaldığı görülmüştür. Arı ekmeğinin (perga) ise serin ortamda muhafazası sağlanarak hızlıca tüketilmelidir. Ballar, kuru, doğrudan gelen güneş ışınlarından korunacak biçimde 25 °C'yi geçmeyecek şekilde muhafaza edilirken, arı sütü, arı poleni ve arı ekmeği ham şekilde +8 °C ve altı sıcaklıklarda muhafaza edilmelidir.

Anahtar Kelimeler: Bal, Propolis, Arı ekmeği, Arı sütü, Polen



The Sanitization of Wastewater with Active Carbon by Sodium Hypochlorite

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Abstract

In a world facing growing challenges in water management and preservation of the environment, the efficient treatment of wastewater has become a priority indisputable. Innovative and sustainable techniques are sought to respond to this growing demand (treatment wastewater) may involve physical (settling, flotation, etc.), biological (anaerobic digestion, activated sludge, trickling bed, etc.) or physico-chemical/chemical (precipitation, disinfection, adsorption, etc.) processes. Among these, adsorption is one of the most used processes around the world with a view to eliminating various pollutants in wastewater networks. That's why our study focuses on this method. Where our works present a double environmental aspect, on the one hand a valuation of natural products in case the agricultural residue (Palm leaves) and secondly study the effectiveness of activated carbon adsorbent from these residues. We have developed a material rich in carbon from the carbonization of homogenate obtained from agriculture residue at 700 °C for a residence time of 60 minutes, were used as adsorbents for Sewage. To improve the adsorption capacity of carbons from agriculture residue has undergone a chemical treatment with sodium hypochlorite at a concentration of 5 N for a one day. Indeed, the effectiveness is evaluated through the following factors: contact time 24 hours, ratio (Solid mass/ volume of liquid) (1/10), stirring speed (200 tour/min), and ambient temperature. Once the optimum conditions are determined, this activated carbon (AC) is used for the purification of wastewater in the main purification treatment, while its adsorption capacity for chemical compounds is high. The results concerning the biological oxygen demand (BOD₅) lesser with 68% and chemical oxygen demand (COD) reduce by 63% and the concentration of NH₄⁺ decrease by 20%, compared to the initial concentrations of these ingredients BOD₅, COD and NH₄⁺ are satisfactory and encouraging to make other applications, the purifying of wastewater using activated carbon will allow us not only to reduce the cost of purification but also to contribute to the preservation of the environment.

Key Words: Agriculture Residue, Active Carbon, Sodium Hypochlorite, Wastewater.



Detection of Somaclonal Variation in Tissue-Cultured Turkish Tea Genotypes Using SSR Markers

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Abstract

Somaclonal variation is defined as genetic or epigenetic changes that occur in vitro between clonal regenerants and their corresponding donor plants. Genetic alterations involve cytogenetic abnormalities and changes in specific DNA sequences. Epigenetic changes refer to alterations in gene expression without modifying DNA sequences. Regardless of the mechanisms involved, somaclonal variation has been reported in several plant species. While the emergence of somaclonal variation in tissue culture negatively impacts the rapid production of clonal plants from elite varieties, it may also stimulate the creation of new horticultural plant genotypes. In the study presented here, the presence of somaclonal variation was evaluated in subculture explants of 12 new variety candidate tea genotypes obtained through selection and propagated via tissue culture. SSR-PCR reactions were conducted using 8 selected SSR markers previously constructed by Ma et al. (2014). Among these markers, TM586 (an SSR marker associated with EC, ECG, and EGCG groups) and TM560 (an ECG group SSR marker) exhibited high polymorphism. Notably, genotype 53KA10 (a white tea variety candidate) showed the highest number of somaclonal variations at the SSR locus. In the somaclonal variation analyses conducted on subculture explants of the 61HA52 genotype, varying degrees of polymorphism were observed in all markers except TM412 (an ECG group marker) and TM399 (an ECG group marker). Interestingly, among all the genotypes analyzed for somaclonal variation, only the 53ÇE184 genotype (a green tea variety candidate) exhibited genetic stability across all markers, with no somaclonal variation detected. Notably, the SSR marker TM399 (associated with Epicatechin gallate, or ECG) showed the lowest level of somaclonal variation in the regenerated explants. Based on the study data, it was suggested that tissue cultures should prioritize genotypes resistant to genetic alterations and stress conditions.

Key Words: *Camellia sinensis*, Tea variety candidate, Genotyping, Molecular characterization, SSR, Turkish tea.

Doku Kültürüyle Üretilen Türk Çay Genotiplerinde Somaklonal Varyasyonun SSR Merkörleri Kullanılarak Tespiti

Özet

Somaklonal varyasyon, klonal rejenerantlar ve bunlara karşılık gelen donör bitkiler arasında in vitro olarak ortaya çıkan genetik veya epigenetik değişiklikler olarak tanımlanmaktadır. Genetik değişiklikler sitogenetik anormallikler ve spesifik DNA dizilerindeki değişikliklerdir. Epigenetik değişiklikler, DNA dizilerinde değişiklik olmaksızın gen ifadesindeki değişiklikler olarak tanımlanmaktadır. İlgili mekanizmalardan bağımsız olarak bir kaç bitki türü için somaklonal varyasyon rapor edilmiştir. Doku kültüründe somaklonal varyasyonun ortaya çıkması, elit çeşitlerin klonal bitkilerinin hızlı üretimi üzerinde olumsuz bir etkiye sahip olmakla beraber yeni bahçe bitki genotiplerinin üretimini teşvik edebilir. Sunulan bu çalışmada, ebeveyn bitkileri seleksiyonla seçilen, tescillenmeye uygun ve doku kültürü ile çoğaltılmış 12 yeni çeşit aday çay genotipinin alt kültür eksplantlarında somaklonal varyasyon varlığı değerlendirildi. Literatürde daha önce Ma. vd., (2014) tarafından oluşturulmuş olan ve EC (epikateşin), ECG (epikateşingallat), EGC (epigallokateşin) ve EGCG (epigallokateşingallat) kantitatif karakter lokuslarına yakın bulunan ve polimorfik oldukları tespit edilen 8 SSR markörü kullanılarak gerçekleştirilen SSR-PCR reaksiyonları sonucunda elde edilen fargament analizleri verilerine göre EC (epikateşin), ECG (epikateşingallat) ve EGCG (epigallokateşingallat) grubu SSR markörlerinden TM586 ve ECG ECG (epikateşingallat) grubu SSR markörlerinden TM560 ile gerçekleştirilen analizlerde bu markörlerin yüksek oranda polimorfizm gösterdiği tespit edildi. Tüm genotipler içinde en çok sayıda SSR lokusunda (markörde) somaklonal varyasyon tespit edildiği genotip 53KA10 (beyaz çay çeşit aday) genotipi oldu. 61HA52 genotipinin alt kültür eksplantlarında gerçekleştirilen somaklonal varyasyon analizlerinde EGC (epigallokateşin) grubu markörlerden TM412 ve ECG (epikateşingallat) grubu markörlerden TM399 dışında ki tüm markörlerde çeşitli derecelerde polimorfizm tespit edildi. Somaklonal varyasyon analizi yapılan tüm genotipler içerisinde sadece 53ÇE184 (yeşil çay çeşit aday) genotipinde ise analizi yapılan tüm markörlerde genetik stabilite tespit edildi ve somaklonal varyasyona rastlanmadı. Somaklonal varyasyonun en az rejenerantta tespit edildiği markör SSR markörlerinden TM399 (Epikateşingallat (ECG) ile ilişkili) oldu. Çalışmadan elde edilen veriler göz önüne alındığında, doku kültürü üretiminin genetik değişimlere ve stres koşullarına dayanıklı genotipler seçilerek gerçekleştirilmesinin daha uygun olacağı yönünde değerlendirildi.

Anahtar Kelimeler: *Camellia sinensis*, Doku kültürü, Genotiplendirme, SSR, Somaklonal varyasyon, Türk çayı



ID: 361

Determination of Important Park Features that Encourage Physical Activity and Social Interaction of Park Usage Purposes of Elderly Individuals: Ihlamur Park Example

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Abstract

Parks and public open green spaces are open spaces for all segments of the society. These places, which are important recreation areas, enable the elderly to renew themselves, to breathe a little in the open air, to be alone with nature even in the city. These opportunities provided by parks are utilised by elderly users. Today, the population of elderly individuals is increasing day by day due to the slowdown in population growth rate. In this study, it is aimed to determine the park usage purposes of the elderly and important park features that encourage physical activity and social interaction. Within the scope of the research, 96 elderly individuals were interviewed with 96 elderly individuals within the scope of face-to-face survey study by going to the park at random times on weekdays and weekends on a voluntary basis by using the questionnaire form prepared for revealing the user profile of individuals aged 40 and over in Ihlamur Park in Selçuklu District, determining the preference times of the park, determining the duration and times of park use, determining the reasons for park preference and selection, and evaluating park user satisfaction and expectations. The findings showed that parks are an important social space for elderly people and therefore require careful planning and implementation in the design, management and use of parks. With the landscape designs to be made in line with the findings, it will be possible for elderly individuals to benefit more from the parks and have a more enjoyable time.

Key Words: Physical Activity, Elderly, Landscape design, Urban parks, Ihlamur park

Yaşlı Bireylerin Park Kullanım Amaçlarının Fiziksel Aktiviteyi ve Sosyal Etkileşimi Teşvik Eden Önemli Park Özelliklerinin Tespit Edilmesi: Ihlamur Parkı Örneği

Özet

Parklar ve kamusal açık yeşil alanlar toplumun her kesimi için açık mekanlardır. Önemli rekreasyon alanı olan bu mekanlar, yaşlıların; kendini yenileyebilmeleri, açık havada biraz nefes alabilmeleri, kent içinde bile olsa doğayla baş başa kalabilmeleri, parklarla mümkündür. Parkların sağladığı bu fırsatlar yaşlı kullanıcılar tarafından değerlendirilmektedir. Günümüzde nüfus artış hızının yavaşlamasından kaynaklı, yaşlı bireylerin nüfusu gün geçtikçe artmaktadır. Bu çalışmada da yaşlıların park kullanım amaçlarının fiziksel aktiviteyi ve sosyal etkileşimi teşvik eden önemli park özelliklerinin tespit edilmesi amaçlanmıştır. Araştırma kapsamında Selçuklu İlçesinde yer alan Ihlamur Parkı'nda 40 yaş ve üzeri bireylerin kullanıcı profilinin ortaya konulması, parkın tercih zamanlarının belirlenmesi, park alanı kullanım süre ve zamanlarının belirlenmesi, park tercih ve seçim nedenlerinin belirlenmesi ve park alanı kullanıcı memnuniyeti ve beklentilerinin değerlendirilmesi için hazırlanan anket formu kullanılarak gönüllülük esasına göre hafta içi ve hafta sonu rastgele zamanlarda parke gidilerek yüz yüze anket çalışması kapsamında 96 yaşlı birey ile görüşülmüştür. Tespit edilen bulgular, parkların yaşlı bireyler için önemli bir sosyal alan olduğunu ve bu nedenle parkların tasarımı, yönetimi ve kullanımı konusunda dikkatli bir planlama ve uygulama gerektirdiğini göstermiştir. Tespitler doğrultusunda yapılacak peyzaj tasarımları ile yaşlı bireylerin parklardan daha fazla faydalanmaları ve daha keyifli zaman geçirmeleri sağlanabilecektir.

Anahtar Kelimeler: Fiziksel aktivite, Yaşlılar, Peyzaj Tasarımı, Kent parkları, Ihlamur parkı





Prediction of Liver Cancer Using *Tp53* Polymorphisms: A Comparison of Advanced Machine Learning Models

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Abstract

Globally, liver cancer ranks second in terms of cancer-related deaths and is the sixth most common type of cancer diagnosed. Most initial liver malignancies (70%–90%) are hepatocellular carcinomas. The early detection of HCC can be challenging, as it tends to develop without obvious symptoms. Liver cancer has several risk factors like other cancer forms, both preventable and unavoidable. The risk factors for liver cancer may be demographic, environmental, clinical, and genetic.

We investigated single nucleotide polymorphism (SNP) in the *Tp53* gene with liver cancer in the southern Punjab population of Pakistan. Two SNPs of *Tp53*, rs9895829 and rs9891744 were selected to investigate their impact on liver cancer development. We additionally investigated several clinical and demographic factors, such as age, diabetes, BMI, cancer family history, smoking, HCV, HBsAg, and haplotypes affected by liver cancer. We recruited 100 individuals for this study including cases and controls. Tetra-Arms PCR polymerase chain reaction technique was used for genotyping. The impact of genetic and non-genetic factors on the development of liver cancer was predicted by using artificial neural networks (ANNs) machine learning models, the multilayer perceptron model, and the radial basis function neural network model. Further, factor importance is also predicted by using the classification regression tree (CRT) model. Our results indicated that age, smoking, BMI, and SNP of *Tp53* rs9891744 (C/T) may be the most contributing risk factors for causing liver cancer in the population of Southern Punjab, Pakistan. This information may help the medical practitioner to predict the development of liver cancer and help for the generation of personalized medicine.

Key Words: Liver cancer, Single nucleotide Polymorphism, Artificial neural network, Classification regression method, TP53



Effect of Hydropriming Treatment On Seed Germination Parameters, Growth and Yield Components of *Corchorus olitorius* (Jute Mallow)

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Abstract

A field experiment was conducted during the 2023 cropping season in Biology Department Botanical Garden, Ibrahim Badamasi Babangida University, Lapai, Niger state, to investigate the effect of hydropriming treatment on seed Germination parameters, Growth and Yield Components of *Corchorus olitorius*. The Objectives are to determine the effect of hydropriming treatment on seed Germination parameters, Growth and Yield Components of jute seed and to know which gives the highest germination percentage at intervals of 0,12,24,36 and 48 hours duration. The treatments were arranged in a Complete Randomized design (CRD) in five replications. Data collected were, Germination percentage (%), Germination index, Plant height (cm), Number of leaves per plant, Number of branches per plant, Number of flowers per plant, Number of fruits per plant and fruit length (mm). Germination index was significantly highest when seeds were primed for 36 hours when compared with 0, 12, 24 and 48 hours priming duration with the lowest germination index recorded in the control were seeds were not primed. A similar trend was observed for number of leaves per plant and number of branches per plant. Hydro primed seeds for a duration of 36 hours resulted to better germination percentage, germination index, growth and yield than untreated (unprimed seeds). Hydropriming *Corchorus olitorius* seed for a duration of 36 hours is recommended for optimum germination, growth and yield of the crop.

Keywords: *Corchorus olitorius*, Germination index, Growth, hydropriming, yield

Introduction

Jute mallow (*Corchorus olitorius* L.) is one of the popular tropical leafy vegetable in Africa, Asia and some parts of the Middle East and Latin America (Odojin, *et al.*, 2018). It is a leading leafy vegetable in Cote d'Ivoire, Benin, Nigeria, Cameroon, Sudan, Kenya, Uganda and Zimbabwe (Fondo and Grubben, 2016). The mucilaginous leaves are consumed along with other staples. It is extremely consumed as a health vegetable, because it contains abundant β -carotene and other carotenoids, vitamins B1, B2, C and E, and minerals. The vegetable also has varying proportion of dietary fibre and protein required for health (Schippers, 2019). Nutritionally, Jute mallow on the average contain 85-87g H₂O, 5.6 g protein, 0.7 g oil, 5g carbohydrate, 1.5 g fiber 250-266 mg Ca, 4.8 mgFe, 1.5 mg vitamin A, 0.1 mg thiamine, 0.3 mg riboflavin, 1.5 mg nicotinamide, and 53-100 mg ascorbic acid per 100 g (Ndiovu and Afolavan, 2008). The leaves have been variously used in folk medicines for ascites, pain, piles, tumors, cystitis, dysuria, fever, and gonorrhea while the cold infusion is said to restore appetite and strength. Jute mallow is also a stem fibre of international importance. It is the world most important bagging and wrapping textile crop (Adesina *et al.*, 2017).

In spite of these enormous benefits associated with this vegetable crop, a lot of factors have limited its production. Poor and delayed germination orchestrated by seed dormancy has been one of the major challenges limiting production of this crop. Several methods have been employed by many researchers (Schippers, 2019; Fondo and Grubben, 2016; Oladiran, 2017) to break dormancy of the seed before planting to enhance totality and speedy germination. Dormancy poses a serious problem to successful seed germination and seedling establishment in jute mallow and different methods have been employed to alleviate the problem. Hydropriming is a very simple, economic and environmental friendly type of seed priming. Odojin, *et al.*, (2018) reported the effectiveness of hydro priming in this respect which has been confirmed by other reports (Schippers, 2019; Fondo and Grubben, 2016). Nkomo and Kambizi, (2019) recorded best germination when seeds of *Corchorus olitorius* L. were hydroprimed for 48 hours before they were planted. Exposure of the seed of this crop to dry heat at 90°C for 5 or ten minutes has also been reported to break dormancy by (Denton *et al.*, 2013). According to (Halford, 2017), the temperature required to break seed dormancy in *C. cunninghamii* in Australia ranged between 80-100°C. It was therefore concluded that soil heating from bush fire would promote the germination of seeds of this species. (Emongo *et al.*, 2018; Chauhan and Johnson, 2020) reported the effectiveness of sulphuric acid and seed coat scarification respectively. Earthworm cast leachate has also been found effective in dormancy breaking in *C. olitorius* L. seeds (Oladiran, 2017). Of all the methods stated above, though not an exhaustive list, the use of hot water appears to be the most favoured as water is cheaply available and can be more safely handled by all users. Germination failure may lead to reduction in yield or even total crop failure. In seeds with prolonged dormancy period, like *Corchorus olitorius* L. (Halford, 2017), it is necessary to shorten the dormancy period for better germination. In view of the foregoing, it is imperative to determine the effect of hydropriming treatment on seed germination parameters, growth and yield components of *Corchorus olitorius*



Materials and Method

Experimental Location

This experiment was conducted at the Biology Department Botanical Garden, Faculty of Natural Sciences, Ibrahim Badamasi Babangida University main campus, Lapai, Niger State, Nigeria which lies between the latitude of 9.0674°N and longitude 6.5618°E.

Experimental Materials and Collection

Materials needed for the experiment were samples of *Corchorus olitorius* . seeds of cultivars Oniyaya□ which were harvested in November, 2022, and soaking was done before planting (Elouaer, and Hannachi,2019).

Experimental Design and Procedure

Harvested *Corchorus olitorius* L. Seeds were divided into five (5) parts and soaked in water for a duration of 30min. watering was done to the boxes to provide moisture needed for germination (Tolorunse *et al.*,2015). Germination count was taken daily for 50 days. The treatments were arranged in complete randomized design (CRD) in three replications. Duration of sow seeds were at 0,12,24,36 and 48 hours respectively.

Data Collection: Data collected were:

Germination percentage

Germination percentage is an estimation of the viability of seeds within a population which was also taken and recorded.

Germination index

Germination index was taken by counting the number of seeds that germinated in each bag which was also recorded.

Plant height

The plant height was taken by measuring, using tape rule to measure the plant height (mm) from top to bottom which was also recorded.

Number of leaves per plant

The number of leaves per plant was taken by counting the number of leaves on the tagged plants and the average also taken and recorded.

Number of branches per plant

The branches per plant on the tagged plants were counted and the average taken represent number of branches per plant.

Number of flowers per plant

The number of flowers per plant was taken by counting the number of flowers on the tagged plants and the average also taken and recorded.

Number of fruits per plant

The number of fruits on the tagged plants were counted and the average taken represent fruits number per plant.

Fruit Length The fruit length was measured in (cm) using tape rule which was recorded.

Data Analysis

Data collected on all the mentioned parameters were subjected to Analysis of Variance (ANOVA) using Minitab statistical software and significant means will be separated using Tukey Pair wise Comparison at 95% probability level.

Results

Mean Squares from Analysis of Variance for Growth Attributes of Jute

The mean square from analysis of variance for growth attributes of jute is shown in Table 1. The result of the table indicated a highly significant ($P \leq 0.01$) effect of priming duration on germination percentage, germination index, number of leaves per plant and number of branches per plant.

Mean Squares from Analysis of Variance for Yield Attributes of Jute

Table 2 showed the mean squares from ANOVA for yield attributes of jute. The table showed that priming duration was highly significant for ($P \leq 0.01$) for number of flowers per plant, number of fruits per plant and fruit length.



Table 1. Mean Squares from Analysis of Variance for Growth Attributes Jute

SOV	DF	Germination %	Germination Index	Plant Height (cm)	Number of Leaves/Plant	Number of Branches/Plant
Replication	2	32.11	11.34	14.45	312.12	431.67
Priming Duration	4	0.321**	52.456**	112.32NS	0.871**	52.841**
Error	12	36.87	32.12	6.56	15.67	31.54
Total	18					

KEY: SOV = Source of Variation; DF = Degree of Freedom; ** = Highly Significant at ($P \leq 0.01$); G% = Germination Percentage; GI = Germination Index pLT HT= Plant Height NOL = Number of Leaves per Plant NOB\PLT = Number of Branches per Plant

Table 2. Mean Squares from Analysis of Variance for Yield Attributes of Jute

SOV	DF	Number of Flowers/Plant	Number of Fruits/Plant	Fruit Length (mm)
Replication	2	63.00	301.35	51.67
Priming Duration	4	1.342**	23.45**	54.89**
Error	12	11.05	61.74	9.36
Total	18			

KEY: SOV = Source of variation; DF = degree of freedom; ** = highly significant at ($P \leq 0.01$); NOFL\PLT= Number of Flowers per Plant; NFR\PLT =Number of Fruit per Plant; FL= Fruit Length

Mean Effect of Seed Priming Duration on Growth Attributes of Jute

The mean effect of seed priming duration on growth attributes of jute is presented in Table 3. The table showed that priming for 36 hours duration recorded significantly the highest germination percentage compared to 0, 12, 24 and 48 hours duration. The lowest germination percentage was observed in the control (0 hours priming). Similarly, germination index was also significantly highest when seeds were primed for 36 hours compared 0, 12, 24 and 48 hours priming duration with the lowest germination index recorded in the control where seeds were not primed at all. A similar trend was observed for number of leaves per plant and number of branches per plant.

Table 3. Mean Effect of Seed Priming Duration on Growth Attributes of Jute

Priming Duration (Hours)	Germination %	Germination Index	Plant Height (cm)	Number of Leaves/Plant	Number of Branches/Plant
0	34.12d	3.11d	53.21a	43.56b	3.14b
12	32.78d	3.54d	52.72a	42.76b	2.89b
24	45.67c	5.45c	52.56a	40.32b	3.19b
36	78.67a	9.67a	51.03a	54.89a	6.37a
48	52.45b	6.23b	49.76a	41.34b	3.11b

* Means with the same letter within a column are not significantly different; G% = germination percentage; GI = germination index; PLT HT= Plant Height; NOL\PLT= Number of Leaves per Plant; NOB\PLT= Number of Branches per Plant

Mean Effect of Seed Priming Duration on Yield Attributes of Jute

Mean effect of seed priming duration on yield attributes of Jute is shown in Table 4. The Table showed that number of flowers per plant was highest in seeds primed for 36 hours relative to seeds primed for 0, 12, 24 and 48 hours. The control (with 0 hours priming) recorded the least number of flowers. More so, number of fruits plant was highest in seeds primed for 36 hours duration relative to 0, 12, 24 and 48 hours priming duration. The control (0 hours priming) produced the least number of fruits per plant even though it was not significantly different from 12 hours priming duration statistically, it was however numerically lowest in the number of fruits produced per plant. A similar trend was observed in fruit diameter.

Table 4. Mean Effect of Seed Priming Duration on Yield Attributes of Jute

Priming Duration (Hours)	Number of Flowers/Plant	Number of Fruits/Plant	Fruit Length (mm)
0	45.31c	21.47d	4.27c
12	44.67c	24.76d	5.61bc
24	67.89bc	50.21c	7.69a
36	97.67a	78.67a	6.51ab
48	75.41b	63.73b	8.54b

* Means with the same letter within a column are not significantly different; NOFL\PLT= Number of Flowers per Plant; NFR\PLT= Number of Fruits per Plant; FL= Fruit Length



Discussion

The variations in germination percentage, germination index, number of leaves per plant, number of branches per plant, number of flowers per plant, number of fruits per plant and fruit length is an indication that hydro-priming had effect on germination, growth and yield of jute. Germination is an important prerequisite for continuation of further growth and other physiological process including production or yield.

In this study, hydro primed seeds for a duration of 36 hours resulted to better germination percentage and germination index than untreated (unprimed seeds). This might be due to hydration of seeds enough for it to enable metabolic events before germination to take place. This observation was similar to the reports by (Farooq *et al.*, 2009) who reported superior germination percentage and index in *Amaranthus* seeds when hydro primed for 36 hours. Harris *et al.*, (2018) reported that each crop cultivar requires a critical soaking duration and it should be for sowing.

Having thick seed coat sometimes makes proper absorption of water becomes difficult. This results in late germination and also dormancy of seed. Soaking of seeds before sowing may be beneficial in this aspect. Soaking helps to absorb water easily and also remove some surface pathogen of seeds. Seed priming, the controlled hydration and dehydration of seeds, is used extensively to increase the rate and uniformity of seedling establishment of commercial vegetable and flower seeds (Bradford, 1986; Khan, 1992). Jute showed faster germination, early emergence and vigorous seedlings achieved by soaking seeds in water for same time followed by surface drying before sowing, which may result in higher crop yield (Harris *et al.*, 2018).

In this study, hydro primed seeds gave healthy vigorous seedlings which ultimately ensured more number of branches and number of leaves than that of untreated seeds. This is in line with the findings of Murungu *et al.*, (2004) who reported higher number of branches, number of leaves per plant and some yield traits of garden egg when as a result of hydro priming. Higher numbers of flowers were produced which led to higher number of fruits per plant for seeds primed for 36 hours. This is similar to the report of Jamil *et al.*, (2016) who reported higher fruit number and fruit length when seeds were hydro primed for certain durations.

Conclusion

In this study, the result showed that *Corchorus olitorius* L. seeds were influenced by hydro priming duration. Hydro priming of jute *Cochorus olitorius* seeds for a duration of 36 hours produced superior germination percentage, germination index as well as growth and yield. The control (0 hours priming) recorded the most inferior germination, growth and yield attributes of *Cochorus olitorius*.

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ID: 365

Valorization of *Pardoglossum Cheirifolium* (L.) E. Barbier & Mathez. (Boraginaceae) as a Source of Bioactive Molecules Within a Circular and Sustainable Bioeconomy

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Abstract

Pardoglossum cheirifolium is an Algerian medicinal herb used to treat acne, diarrhea and ulcer (Boussalah, 2020), yet there is little information available concerning its bioactive composition and its potential economic value has not been explored. The aim of this research was to study, the extract composition of whole plant of *P. cheirifolium* and its coherence with antioxidant and antiacetylcholinesterase activities in order to prove its possible use as potential natural source for human health. Phenolic compounds were distinctively profiled in the different extracts using TLC and standard phenolics. The antioxidant activity was evaluated by the DPPH, ABTS, DMPD, nitric, hydroxyl, superoxide and singlet oxygen radicals, β -carotene bleaching, CUPRAC, ferric reducing, and metal chelating activity methods. Maceration in ethyl acetate and methanol allowed recovering the highest flavonol (9.52 and 4.04 mg QE/g DE, respectively) contents. The phytochemical analysis led to the identification of several phenolic compounds that were dominated by chrysophanol, emodin, caffeic acid, chlorogenic acid and quercetin-3-O-sophoroside. The ethyl acetate and methanol extracts showed potential antioxidant activity in the different assays and this could be attributed to their polyphenol, tannin, and flavonoid contents. The ethyl acetate and methanol extracts exhibited also acetylcholinesterase inhibitory activity (IC_{50} values of 1.94 and 0.58 mg/mL, respectively). Owing to its phenolic profile and biological activities, *P. cheirifolium* could be considered as potential functional ingredient for pharmaceutical applications.

Key Words: Antioxidant Molecules, Flavonoids, Neuroprotective Natural Molecules, Sustainable Life

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Investigation of Important Park Features that Encourage Park Visiting, Physical Activity and Social Interaction Among Teenagers with the Case of Ihlamur Park

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Abstract

Today, the rapid increase in urbanisation and the concentration of population density in urban centres have increased the need for individuals to be in touch with nature. In this context, urban use areas such as urban parks play an important role in meeting the physical and social needs of teenagers. Parks are not only spaces that encourage physical activity, but also spaces that increase social interaction, strengthen community ties and support physical activities. Ihlamur Park in Konya is an important living space where teenagers show great interest, offering various activities and social opportunities. However, detailed information on the purposes for which teenagers use the park and which features of the park encourage this use has not been fully identified. The aim of this study is to examine the purposes of use of Ihlamur Park by teenagers and to identify the features of the park that encourage physical activity and social interaction. For the research, 116 teenagers were surveyed face-to-face on the basis of the law on the protection of personal data and voluntary participation of park users by visiting the area on random days on weekdays and weekends. The survey was carried out with the approval of the Ethics Committee of Selçuk University, Faculty of Architecture and Design. By determining the level of use of teenagers, it is the preparation of a resource that park users can reach. The research also provides a comprehensive evaluation to understand the park usage habits and motivations of teenagers, and in this context, it has contributed to the development of recommendations for the design and management of parks. Thus, the importance of park features that allow teenagers to lead a more active life and increase their social interactions is emphasised.

Key Words: Teenagers, Urban park, Physical activity, Social Interaction, Ihlamur park

Gençler Arasında Park Ziyaretini, Fiziksel Aktiviteyi ve Sosyal Etkileşimi Teşvik Eden Önemli Park Özelliklerinin Ihlamur Parkı Örneğinde İncelenmesi

Özet

Günümüzde kentleşmenin hızla artması ve nüfus yoğunluğunun kent merkezlerinde yoğunlaşması, bireylerin doğayla iç içe olma ihtiyacını artırmıştır. Bu bağlamda kent parkları, gibi kentsel kullanım alanları özellikle gençlerin fiziksel ve sosyal ihtiyaçlarını karşılamada önemli rol oynamaktadır. Parklar, fiziksel aktiviteyi teşvik eden alanlar olmanın ötesinde, aynı zamanda sosyal etkileşimi arttıran, topluluk bağlarını güçlendiren, fiziksel aktiviteleri destekleyen mekânlar olarak da karşımıza çıkmaktadır. Konya'daki Ihlamur Parkı, gençlerin yoğun ilgi gösterdiği, çeşitli aktiviteler ve sosyal olanaklar sunan önemli bir yaşam alanıdır. Ancak, gençlerin parkı hangi amaçlarla kullandıkları ve parkın hangi özelliklerinin bu kullanımı teşvik ettiği konusunda detaylı bilgiler tam olarak tespit edilememiştir. Bu çalışmanın amacı, Ihlamur Parkı'nın gençler tarafından kullanım amaçlarını incelemek ve parkın fiziksel aktiviteyi ve sosyal etkileşimi teşvik eden özelliklerini tespit etmektir. Araştırma için hafta içi ve hafta sonu rastgele günlerde alana gidilerek, park kullanıcılarıyla kişisel verilerin korunması kanunu ve gönüllülük esasına dayanarak 116 genç bireyle yüz yüze anket yapılmıştır. Yapılan anket, Selçuk Üniversitesi, Mimarlık ve Tasarım Fakültesi Etik Kurul onayı ile gerçekleştirilmiştir. Gençlerin kullanım düzeyini belirleyerek, park kullanıcılarının ulaşabileceği bir kaynağın hazırlanmasıdır. Araştırma aynı zamanda gençlerin park kullanım alışkanlıklarını ve motivasyonlarını anlamaya yönelik kapsamlı bir değerlendirme sunmaktadır, bu bağlamda parkların tasarım ve yönetimi için öneriler geliştirilmesine katkı sağlanmıştır. Böylece, gençlerin daha aktif bir yaşam sürdürmelerine ve sosyal etkileşimlerini artırmalarına olanak tanıyan park özelliklerinin önemi vurgulanmıştır.

Anahtar Kelimeler: Gençler, Kent Parkı, Fiziksel Aktivite, Sosyal etkileşim, Ihlamur parkı



The impact of polyphenols on nutrition and health

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Abstract

Polyphenols are plant-sourced compounds that exhibit important dietary features on human health. They have been defined and used either as a food source or as a raw material in the food industry to enhance functional properties and nutritional quality. They have significant positive bioactivities as; antioxidant, anti-inflammatory, anti-carcinogenic, cardiovascular health protection, immune supporter, and also benefits on digestion and brain functioning. The effects and bioactivity ranges were studied in the literature which has been discussed in the review to emphasize the importance of these natural compounds to provide insight into health and well-being.

Key Words: Polyphenol, Dietary Polyphenol, Antioxidant, Anti-Carcinogenic, Anti-Inflammatory

Polifenollerin beslenme ve sağlık üzerindeki etkisi

Özet

Polifenoller, insan sağlığı üzerinde önemli beslenme özellikleri sergileyen bitki kaynaklı bileşiklerdir. Fonksiyonel özellikleri ve beslenme kalitesini artırıcı özellikleri sayesinde hem primer gıda kaynağı hem de gıda endüstrisinde hammadde olarak kullanılmaktadır. Önemli pozitif biyoaktiviteleri bulunmaktadır ve bunlardan bazıları; antioksidan, anti-inflamatuar, anti kanserojen, kalp ve damar sağlığını koruyucu, bağışıklığı destekleyici, sindirim ve beyin fonksiyonlarına fayda sağlayıcı özellikler olarak sıralanabilir. Bu çalışmada bu tür doğal bileşiklerin sağlık üzerine etkileri ve biyoaktivite fayda sağlayıcı konsantrasyonları irdelenmiş ve sağlıklı yaşam için literatür kaynakları ile polifenollerin önemi vurgulanmıştır.

Anahtar Kelimeler: Polifenol, Diyet Kaynaklı Polifenol, Antioksidan, Anti-Kanserojen, Anti-Inflamatuar

Introduction

Polyphenols: definition, history

Polyphenols are defined as plant-sourced metabolites which exhibits antioxidant characteristic (Galanakis, 2018). Even though polyphenol does not emphasize a strict chemical term it refers to a big class of dietary beneficial chemical groups that include flavonoids, phenolic acids, or tannins and their derivatives (Williamson, 2017). Polyphenols are mentioned to be the most abundant antioxidants in the diet which could be as high as 1 gram in a day. This level of intake is related to an important health outcome. Moreover, these plant-sourced chemicals provide prevention of diseases with those related to oxidative stress (Scalbert et al., 2005).

In the literature, the initial addressing of polyphenol chemicals goes back to the 20th century, especially with the terms like “plant polyphenols” and “vegetable tannins”. After the mid-1900s paper chromatography was discovered with various analytical methods to measure numerous chemicals polyphenol-related research shifted gears (Cheynier et al., 2015; Quideau et al., 2011). In 1957 “Plant Phenolic Group” was founded by E. C. Bate-Smith and Tony Swain who later defined plant polyphenols as “water-soluble phenolic compounds having molecular weights between 500 and 3000 (Da) and, besides giving the usual phenolic reactions, they have special properties such as the ability to precipitate alkaloids, gelatin and other proteins from solution” (Bate-Smith, 1962; Cheynier et al., 2015). This was later updated to the term polyphenol as a descriptor and the molecular mass was altered to be up to 4000 Da (Haslam & Cai, 1994). Later with the efforts of the scientists involved in the field, the polyphenols were defined as plant secondary metabolites which are produced by the shikimate-derived phenylpropanoid and/or the polyketide pathway(s) with at least two phenolic rings and being devoid of any nitrogen-based functional group in the basic structure (Quideau et al., 2011).



Classification of polyphenols

In light of the mostly accepted definition done by Quideau et. al. (2011), polyphenols are the largest and most broadly distributed group of secondary metabolites (Scalbert & Williamson, 2000). This large classification is mostly the result of the acceptance of the hydroxyl groups on aromatic rings, phenol rings, phenolic acids, or phenolic alcohols in the chemical structure to be categorized as polyphenolic chemicals (Galanakis, 2018). The aforementioned mechanism of secondary metabolite production leads to the formation of phenylpropanoids and simple phenols by the shikimic acid pathway and polyketide pathway, respectively (Sánchez-Moreno, 2002). Generally, plant polyphenols are produced with the shikimic acid pathway while the combination of the shikimic acid pathway and polyketide pathway leads to the production of flavonoids (Galanakis, 2018). Therefore, due to the diversity and wide distribution due to the source of origin, distribution, biological function, and chemical structures, polyphenols are categorized. Figure 1 illustrates the main classification methods based on the categorizes.

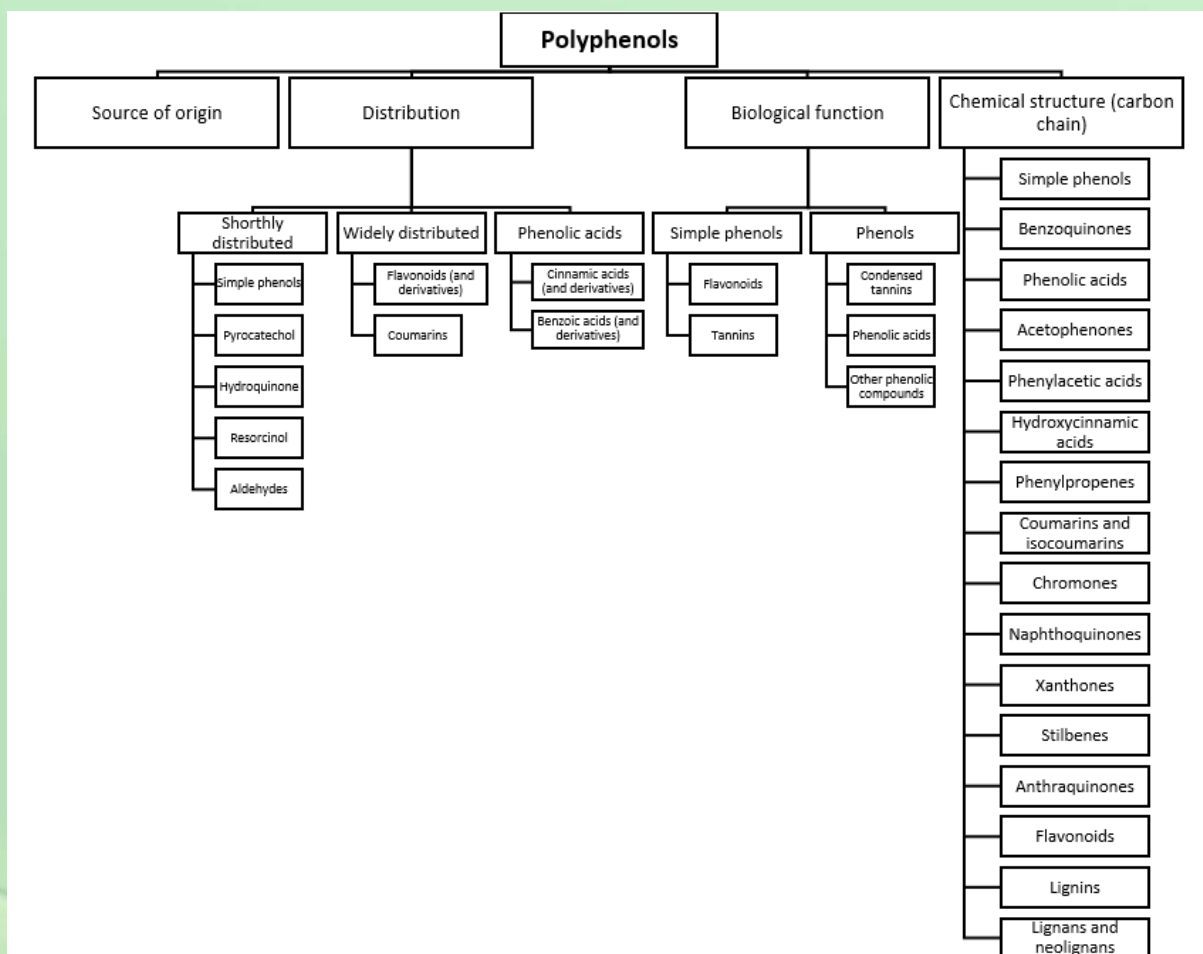


Figure 1. Classes of polyphenols based on various factors (Bravo, 1998; Harborne, 1989; Sánchez-Moreno, 2002)

Even though the literature involves several factors to classify those polyphenol groups of chemicals the main classes of polyphenols are flavonoids, phenolic acids, lignans, stilbenes, and others (Galanakis, 2018). Flavonoids refer to a typical chemical structure that involves two benzene rings with phenolic hydroxyl that are connected by three central carbon chains to form the C₆-C₃-C₆ series as a basic chemical skeleton (Chen et al., 2022). The oxidation level of C₃ leads to different structures which are named accordingly as; flavonoids, flavonols, isoflavones, anthocyanins, chalcone, nerone, flavane, etc. (Yildiz, 2010). Moreover, flavonoids act as a natural pigment with loads of physiological duties as well as benefits for human and animal health. This important class of polyphenols possesses antioxidant anti-inflammatory, antiviral, anticancer and antibacterial activity (Chen et al., 2020, 2022; He et al., 2006). Phenolic acids are the main plant phenolic compound group that has one carboxylic acid group in the chemical structure (Kumar & Goel, 2019). These compounds have two sub-groups hydroxybenzoic and hydroxycinnamic acid and all provide very high antioxidant activity (Clifford, 1999; Tsao & Deng,



2004). The former sub-group is derived from cinnamic acid and is found in the form of ferulic, caffeic, p-coumaric, and sinapic acids whereas the latter hydroxybenzoic acid is derived from benzoic acid and found in the form of p-hydroxybenzoic, protocatechuic, vanillic, and syringic acids (Kumar & Goel, 2019). Lignans on the other hand, are derived from the shikimic acid biosynthetic pathway and they contain a basic scaffold of at least two phenylpropanoid units which are formed monomers of cinnamic acid, cinnamyl alcohol, propenyl benzene, and allyl benzene (Ayres & Loike, 1990; Cui et al., 2020; Teponno et al., 2016). These plant polyphenols exhibit important features as antitumor, antioxidant, antibacterial, immunosuppressive, and antiasthmatic (Cui et al., 2020). Lastly, stilbenes suppress a smaller portion intake compared to the rest in the mammal diet. Despite the smaller intake, they exhibit important physiological effects such as the anticarcinogenic effect of resveratrol (Galanakis, 2018).

Food Sources of Polyphenols

A wide variety of fruits and vegetables, such as berries, whole-grain cereals, and cacao, as well as beverages, such as coffee, tea, and wine, have been shown to contain around 800 distinct types of polyphenols. Phenolic compounds are not only widespread in plants that are edible but also in plants that are not edible. These compounds have been shown to have numerous biological impacts, one of which is the ability to act as an antioxidant. The food industry is becoming increasingly interested in the crude extracts of fruits, herbs, vegetables, grains, and other plant materials that are rich in phenolics (Table 1). This is due to the fact that these extracts retard the oxidative destruction of lipids and, as a result, increase the quality of food as well as its nutritional content (El Gharra, 2009).

Table 1. Polyphenols in Foods

Polyphenols	Food Sources	References
Flavonoids, Catechins	Green, Black Tea, Grapes, Cocoa, Lentils, Berries	(Dias et al., 2021)
Flavanones	Orange, Grapefruit, Lemon, Tangerine, Olive, Olive Oil	(Yang et al., 2022)
Flavanols	Green vegetables, Apples, Onions, Berries, Olive oil	(Luo et al., 2022)
Anthocyanins	Strawberry, Colorful fruits, Black grapes, Wine, Pink olives	(Qi et al., 2022)
Non-flavonoid polyphenols		
Resveratrol	Grape skin, Red wine, Nuts (almonds, walnuts, etc.)	(Tian & Liu, 2020)
Curcumin	Turmeric, Mustard	(Jiang et al., 2021)
Coumarin	Strawberry, Blueberry, Apricot, Cherry, Cinnamon, Licorice root	(Lončar et al., 2020)
Phenolic Acids		
Ellagic acid	Walnut, Strawberry, Blueberry, Pomegranate, Grape	(Lorenzo et al., 2019)
Tannic acid	Nettle, Tea, Berry fruits, Olive, Olive oil	(Dai et al., 2022)
Gallic acid	Tea, Mango, Strawberry, Soy, Olive, Olive oil	(Parveen et al., 2019)
Caffeic acid	Blueberry, Kiwi, Plum, Cherry, Apple	(Maity et al., 2022)

Biological Activities and health effects of Polyphenols

Nutrition today seeks the attention of many researchers from diverse fields such as epidemiology, biochemistry, health sciences, chemistry, psychology, food engineering, pharmacology, biology, chemistry, etc. As a well-known fact food is essential for energy yet modern-era human societies replaced food to be something more than this. Food is expected to promote energy as well as have a positive impact on health (functional foods) or also promote potentially healthier aging and well-being. Amongst these beneficial expectations, one can advise to include or increase the intake of polyphenols because of their popular effects on health. This benefit is a fact but still, the biochemical interactions, metabolic pathways, enzyme actions, and cellular regulations are being investigated to confirm the potential effect of polyphenols on human health (Williamson, 2017).



Polyphenols are micronutrients that are essential for facilitating biochemical operations in the body. These plant-based foods may have been used reversibly instead as plant secondary metabolites, phytochemicals, phytonutrients, antioxidants, bioactive chemicals, etc. (Hertog et al., 1995). Polyphenols' bioactivities will be outlined in this book chapter as their properties of; antioxidant, anti-inflammatory, anti-carcinogenic, and cardiovascular health.

Antioxidant activity

Polyphenols are the secondary metabolites of plants that are secreted to protect the plant against environmental stress such as UV light, climate, pests, and insects. Until the 1990s they were classified as general antioxidants due to their biological activities in plants and potentially in humans with the diet (Serafini et al., 1994). So far the researchers made loads of contributions with the investigations according to food type, health condition, age/gender/status-related alterations in-vivo and in vitro.

Generally, antioxidant activity is related to the phenolic chemical structure with the catechol-like moieties and delocalized unpaired electrons in the structure (Croft, 2016). Dietary polyphenols show reasonable antioxidant activities either in vitro or in vivo. The literature presents numerous studies in the antioxidant activities including, scavenging of free radicals, lipid oxidation, hydroperoxide formation process, etc. Not only in the plants to protect them against natural stress sources but also in dietary usage polyphenols' antioxidant character has an impact on plasma, membrane, transcription factors, and enzyme activities. Moreover, other beneficial features such as anti-inflammatory, anti-carcinogenic, neuroprotective, cardiovascular health, and anti-diabetic are somehow related to the antioxidant characteristics either directly or indirectly.

Antioxidant polyphenols are a common food preservation compound in the industry. They are used for three main purposes;

- Food additives, as an antioxidant compound, provide longer shelf life,
- As a packaging material, designed packaging materials with supported antioxidant behavior to provide better protection,
- Processing aid is used to provide an easier process that makes it less susceptible to environmental effects.

Some typical examples of literature studies can be listed as; lipid oxidation blockers in; fish oil (Luther et al., 2007), in fish (Ramanathan & Das, 1992), meat (Chamorro et al., 2015), muscle food (Wu et al., 2022); polyphenol supported packaging (Cheng et al., 2022; Liu et al., 2019; Roman et al., 2016), processing aids (Aguilar et al., 2008; Aliakbarian et al., 2008; Ranalli & De Mattia, 1997).

Anti-inflammatory activity

Inflammation is a biological response to some agents like pathogens, irritants, or damaged cells which are associated with diseases and certain health issues like rheumatoid arthritis, atherosclerosis, asthma, obesity, diabetes, coronary heart diseases, and aging (de Cássia da Silveira e Sá et al., 2013; A.-N. Li et al., 2014). Human biology tries to suppress the inflammation to “treat” the disorders to become “healthier” status. Polyphenols show significant activity in terms of inflammation suppression as an anti-inflammatory in vivo and in vitro (Yahfoufi et al., 2018).

Literature provides a good insight into polyphenols' anti-inflammatory effects. Some examples are; olive polyphenols (Bucciantini et al., 2021), fruit polyphenols (Joseph et al., 2016), p-coumaric acid (Pragasam et al., 2013), black seeds (Ghannadi et al., 2005), green tea (Cavet et al., 2011; Lambert et al., 2010; Tipoe et al., 2007).

Anti-inflammatory activity is triggered by the antioxidant capacity. Hence, it will be clear to see these effects at once in the polyphenols (Kulkarni et al., 2008; Zhang & Tsao, 2016). Good evidence for such a synergistic effect is curcumin which has a great advantage for the bioactivity of polyphenols especially as an anti-inflammatory and antioxidant (Arshad et al., 2017; Menon & Sudheer, 2007; Motterlini et al., 2000).

Anti-carcinogenic activity

Cancer is one of the top death-causing diseases globally and most of the nutritional and epidemiological research focuses on the effect of consumed foods on cancer metabolism. The literature is clear that polyphenols play a significant role in the prevention of cancer which has been proven especially in, skin cancer (Sajadimajd et al., 2020), gastric and stomach cancer (Vitelli-Storelli et al., 2020), colorectal cancer (Ding et al., 2020; Yammine et al., 2021), prostate cancer (G. Li et al., 2013), liver cancer (S. Li et al., 2023; Loa et al., 2009), and lung cancer (Sadava et al., 2007; Wang et al., 2011).



Some specific polyphenols have been previously listed by Li et al. (2014) as proanthocyanidins, flavonoids, resveratrol, tannins, epigallocatechin-3-gallate, gallic acid, and anthocyanin. These compounds are considered not as a treatment aid only but also a dietary source to prevent cancer as well. Yet, we have to mention that cancer is still one of the diseases that are hard to treat, especially with complex mechanisms of cellular production (e.g. metastases) that are affected by many factors in the body including genetic factors. Polyphenols were found to affect the enzyme biology that could be showing an anti-carcinogenic effect with the carcinogen bounding capability as well as avoiding excessive cell damage during the cancer metabolism. The polyphenols still have to be tested in vivo and in vitro to be used for teuropathic purposes.

Cardiovascular health

Polyphenols show a great advantage in cardiovascular health thanks to their antioxidant activities. In the literature, this effect was associated with postprandial hyperlipidemia and oxidative stress which could be reduced by polyphenols (A.-N. Li et al., 2014). Polyphenols were found to have a significant effect on; atherosclerosis, myocardial infarction, and unstable angina which have very high case reporting globally yet significantly lower in the Mediterranean region due to higher intake of polyphenols (Nadtochiy & Redman, 2011). Moreover, antioxidant and anti-inflammatory effects help to protect heart health in the long term.

Polyphenols were also found to reduce blood pressure which directly reduces the risk factor for the heart and helps the enlargement of the blood veins (Marunaka et al., 2017; Medina-Reimon et al., 2013). Additionally, polyphenol-rich diets were found to be associated with the lowering of low-density lipoprotein (LDL) which is linked with high blood pressure (Davalos et al., 2006; Hernez et al., 2015).

Dietary Intake of Polyphenols

The average consumption of polyphenols through diet is about 1 g/day, ranging from 800-900 mg/day in Finland to 800-1100 mg/day in Spain, depending on diet, gender, and other socioeconomic factors. This intake is 100 times more than that of vitamin E and -carotenes and 10 times greater than that of vitamin C. Polyphenols may be the primary bioactive dietary components involved in redox homeostasis due to their stronger anti-oxidant effects than vitamin E (Tresserra-Rimbau et al. 2018; Landete 2013).

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ID: 369

Behavioral Toxicity Assessment of Cypermethrin on *Drosophila melanogaster*

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Abstract

Pyrethroids are widely used insecticides due to their high insecticidal activities. Nowadays, there are growing concerns about the toxic effects of insecticides on non-target organisms. The aim of this study was to evaluate the behavioral toxicity of cypermethrin, an insecticide from the pyrethroid group, on *Drosophila melanogaster*. To assess behavioral toxicity, pupal formation success, pupal emergence success, adult weight, and negative geotaxis experiments were carried out. As a result of experiments conducted in the 0.01-30 ppm dose range on 72±4 hour-old larvae obtained from individuals belonging to the Oregon R+ wild strain, the LD₅₀ value was determined to be 0.31 ppm by probit analysis. Behavioral toxicity studies were performed with four different cypermethrin doses (0.01, 0.05, 0.1, and 0.3 ppm) determined according to the LD₅₀ value. The results obtained from the applications showed that 0.1 ppm and 0.3 ppm doses of cypermethrin caused statistically significant changes in the success of pupal formation and pupal emergence. The results obtained from the negative geotaxis assay showed that the 0.3 ppm dose of cypermethrin caused a statistically significant decrease in the flying abilities of individuals. Adult weight measurement test results showed that cypermethrin did not cause any statistically significant change in the weight of individuals.

Key Words: Cypermethrin, insecticide, behavioral toxicity, *Drosophila melanogaster*

Cypermethrin'in *Drosophila melanogaster* Üzerindeki Davranışsal Toksisitesinin Değerlendirilmesi

Özet

Piretroidler yüksek insektisidal aktiviteleri nedeniyle yaygın olarak kullanılan insektisitlerdir. Günümüzde insektisitlerin hedef dışı organizmalar üzerindeki toksik etkilerine ilişkin artan endişeler bulunmaktadır. Bu çalışmanın amacı piretroid grubundan bir insektisit olan cypermethrin'in *Drosophila melanogaster* üzerindeki davranışsal toksisitesinin değerlendirilmesidir. Davranışsal toksisiteyi değerlendirmek için pupa oluşturma başarısı, pupadan çıkış başarısı, ergin birey ağırlığı ve negatif jeotaksis deneyleri gerçekleştirilmiştir. Oregon R+ yabancıl soyuna ait bireylerden elde edilen 72±4 saatlik larvalar üzerinde 0.01-30 ppm doz aralığında yapılan deneyler sonucunda probit analizi ile LD₅₀ değeri 0.31 ppm olarak tespit edilmiştir. Davranışsal toksisite çalışmaları LD₅₀ değerine göre belirlenen dört farklı cypermethrin dozu (0.01, 0.05, 0.1, ve 0.3 ppm) ile gerçekleştirilmiştir. Uygulamalardan elde edilen sonuçlar cypermethrin'in 0.1 ppm ve 0.3 ppm dozlarının pupa oluşturma ve pupadan çıkış başarısı üzerinde istatistiksel olarak anlamlı değişikliklere neden olduklarını göstermiştir. Negatif jeotaksis deneyinden elde edilen sonuçlar 0.3 ppm cypermethrin dozunun bireylerin uçuş kabiliyetlerinde istatistiksel olarak anlamlı azalmaya neden olduğunu göstermiştir. Ergin birey ağırlığı deney sonuçları cypermethrin'in bireylerin ağırlıklarında istatistiksel olarak anlamlı değişikliğe neden olmadığını göstermiştir.

Anahtar Kelimeler: Cypermethrin, insektisit, davranışsal toksisite, *Drosophila melanogaster*





ID: 371

Valorization of Low Value Dates as a Commodity for Nutritional and Natural Products.

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Abstract

This work focuses on the development of nutritionally balanced treats, covering the energy needs of the human body. The food formulation is based on local products from phoeniculture which are Algerian dates of low commodity value. where these common dates are in most date-producing countries thrown away or partially incorporated into animal feed, their use in human food remains very little explored outside of a few traditional applications. With many food technology processes meeting global food and nutritional standards that make this product possible. Where this product can enter the food markets through its open door as an alternative product to some sweets that are contain chemical ingredients such as adjuvants and colorings, which are considered carcinogenic foods. Concerns the preparation of treats based on dry date flour whatever the variety. Given its richness in sugar, which can replace marketed white sugar (icing or crystallized) and their valorization could represent strong added value on the socio-economic impact. For these reasons, the incorporation of this date flour into a food formulation which is candy. The high sugar content of the powder, notably fructose, makes it an excellent partial or total substitute for the sugar usually added in the food industry to which the negative effects are attributed. The good exploitation of the excessively high energy of this date flour is closely linked to the supplementation and the nutritional balance by three sources. The first is the supplementation with sesame seeds where sesame has antioxidant properties and is rich in several micronutrients that appear to have interesting effects on human health, the second is made with sunflower oil and lemon zest to adjust the taste of this candy. This integration will be evaluated by physicochemical, microbiological and sensory analyzes in order to verify its effect on the properties of the formation developed. Finally, these date candies are intended for everyone, and should be a good snack for children.

Key Words: Dry Dates, Dats Flour, Candy Dates, Physicochemical Analyses, Microbiological Analyzes.



Effect of Egg Weight and Genotype on Egg Quality Traits in Brown and White-Egg Layer Pure Lines Housed in Enriched Cage System

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Abstract

This study investigated the effect of egg weight and genotype on egg quality traits in brown-egg (Line-54, RIR 1, RIR 2, COL, BAR 1, and BAR 2) and white-egg (D-229, Brown, Blue, Black, and Maroon) layer pure lines reared in enriched cage system. 20 eggs from each pure line were collected on the same day at 33 weeks of hen age and classified into four different weight groups: small (S: ≤ 52 g), medium (M: 53-63 g), large (L: 63-72 g), and extra-large (XL: ≥ 73 g) according to Turkish Food Codex Communiqué on Eggs and Egg Products before the analysis of physical egg quality traits. It was identified that brown-egg pure lines differed regarding the shell-breaking strength, shell thickness, albumen index, and Haugh unit, all greatest in RIR 2 eggs and yolk color score, highest in BAR 2 eggs ($P<0.05$; $P<0.01$). White-egg layer pure lines only varied regarding yolk color score, highest in Blue pure line eggs ($P<0.05$), and the genotype effect on meat-blood inclusions in the yolk approached a significant level ($P=0.065$), the highest number of eggs with inclusions in D229 pure lines. For egg weight, while only the Haugh unit ($P<0.05$) varied among egg weight groups in brown-egg pure lines; highest in M and L eggs, the shape index, shell breaking strength, shell thickness, and yolk index differed greatly among the egg weight groups in white-egg layer pure lines ($P<0.05$; $P<0.01$). The egg weight did not significantly affect meat and blood inclusion in the yolk and albumen in both pure line groups ($P>0.05$). In conclusion, while brown-egg pure lines differed in several egg quality traits, the white-egg pure lines varied in only the yolk color score. The effect of egg weight on egg quality traits was very noticeable in white compared to brown-egg layer pure lines.

Key Words: Egg quality traits, Egg weight, Genotype, Enriched cage system

Introduction

The poultry industry continues to grow, owing to increasing population growth and rapid changes in sociodemographic patterns worldwide, which increases demand for cheap animal-origin foods, such as eggs. Indeed, eggs play an important role because aside from being the most affordable, they are a natural food that contains high-value protein, vitamins, minerals, and essential fatty acids among animal products (Altan, 2015). Apart from the importance of eggs in nutrition, the quality of eggs, which is examined by analyzing their internal and external traits, is critical for the layer chicken industry. External quality traits include egg weight, shell thickness, shell breaking strength, and shape index, while internal quality traits comprise albumen and yolk index, Haugh unit, yolk color score, and meat-blood inclusions (Altan, 2015).

Egg quality traits can vary based on egg weight, for instance, the yolk index and yolk color increased with an increase in egg weight, and the highest and lowest shell thickness were in medium and extra-large eggs, respectively (Şekeroğlu and Altuntaş, 2009). The same authors reported a positive correlation between egg weight and yolk color and yolk index and a negative correlation between egg weight and shell thickness. Shi et al. (2009) found an increase in shape index and shell thickness with the increasing egg weight, and the highest and lowest Haugh unit in small and medium eggs, respectively. Egg quality traits are related to genetic structure (Durmuş et al., 2010; Hanusova et al., 2015; Rakonjac et al., 2021). Thus, breeding programs are important in the modification of egg quality traits, in particular, egg weight and shell color show a significant genotypic variation. In addition, the preference for these traits varies significantly among consumers (Kurşun et al., 2024a). As a consequence of breeding programs to meet the different consumer preferences in the world, brown and white egg layers dominate the egg industry. For instance, in Türkiye at Ankara Poultry Research Institute, the successful progress in the breeding program of layers was reported in 1995, with the importation of six and four brown and white egg pure lines as starting materials from Canada. After the introduction of pure lines, they were first multiplied and later, the beginning of selection with the aim of developing important traits. With the crossings among the pure lines, high-yielding hybrid groups were obtained, including the first two brown (ATAK and ATAK-S) and one white (ATABEY) egg layers (Sarica et al., 2014) and currently, a new white layer hybrid known as the AKBAY that



was obtained in 2019 (Kursun et al., 2024b). Furthermore, other genotypes are under development, with various breeding programs. This study was therefore conducted to determine the effect of egg weight and genotype on egg quality traits in six brown and five white-egg layer pure lines developed in Türkiye.

Materials and Methods

Study location and ethical approval

The Local Ethics Committee for Animal Experiments approval was not applicable because the study did not involve the direct handling of birds. Egg samples were collected from the genotypes that were housed at the laying hen commercial unit of Niğde Ömer Halisdemir University, Ayhan Şahenk Agricultural Application and Research Center.

Animal materials and housing

Briefly, eggs were collected from 33-week-old Line-54, Rhode Island Red-I (RIR1), Rhode Island Red-II (RIR2), Barred Rock 1 (BAR-I), Barred Rock 2 (BAR-II), and Colombian (COL.) brown-egg layer pure line and D-229, Brown, Blue, Black, and Maron white-egg layer pure lines.

Hens were raised in enriched cages: 3 tiers with 40 cage units each (cage dimensions: 240 cm × 63.5 cm × 60 cm (length, width, and height). Each cage unit had a stainless-steel nipple and two parallel perches, each measuring 180 cm. The perches were equipped with nail clippers. Additionally, each cage cell had a nest area surrounded by a dark blue curtain, measuring 40 cm, 33.5 cm and 30 cm (length, width, height). There was also a scratch pad and wire mesh floor.

The birds were subjected to a photoperiod of 16 hours of light and 8 hours of darkness between 06:00 and 22:00. During this period, birds were offered standard concentrate feed (2nd phase layer feed, Table 1) purchased from a commercial company. Feed and water were provided without restriction.

Table 1. Nutrient content of the feed used in the study

Analytical Components		Additives	
Crude Protein	16.26%	Vitamin A	12.000 IU
Crude Fiber	4.70%	Vitamin D3	2.400 IU
Ash	12%	Vitamin E	30 Mg/KG
Crude Fat	4.0%	Manganese	80 mg
Calcium	3.58%	Zinc	60 mg
Phosphorus	0.37%	Copper	5 mg
Sodium	0.16%	Iron	60 mg
Lysine	0.78%	Iodine	2 mg
Methionine	0.38%	Selenium	0.15 mg
Metabolizable Energy	2720 Kcal/kg	Cobalt	0.5 mg

Egg weight classification and selection of egg samples

Egg weight groups were determined as Small. S (≤ 52 g); Medium. M (53-62 g); Large. L (63-72 g); Extra Large. XL (≥ 73 g) according to the egg weight classes specified in the Turkish Food Codex Communiqué on Eggs and Egg Products. In the study, 20 eggs were randomly collected from each of the six brown and five white-egg layer pure lines, and classified according to the above 4 different weight groups, each with five egg samples. The eggs were collected on the same day, and stored at room temperature for 24 hours in the laboratory, and thereafter, their physical quality characteristics were analysed.

Egg quality analysis

A scale with a precision of 0.001 g was used to measure egg weights and the width and length of eggs were measured using a digital caliper with a precision of 0.001 mm. Shell breaking strength in Kg. force was then determined with an Egg Force Reader (Orka food tech. FGV-10XY (5.000 kg) EFO493/2013). The egg was then broken on a glass table and shells were put aside for shell thickness determination. A digital caliper with a precision of ± 0.001 mm was used to determine the albumen length and width, and yolk width and diameter. A tripod micrometer was used to measure albumen and yolk height. DSM yolk color fan was used to score the yolk color. The albumen and yolk were checked for meat and blood inclusions by visual observation. After measuring the albumen and yolk dimensions, the albumen was then separately collected into a container. The pH meter was inserted in the containing with the collected albumen to record the albumen pH. Lastly, shell samples were taken from the broad, center, and pointed regions of the egg, and their shell thickness without the membrane was



determined in mm using a tripod micrometer. Shell thickness (mm) was later determined as the average of the three measurements from the different regions of the egg. In addition, the criteria and equations used in the determination of other egg quality traits (shape index, albumen index, yolk index, and Haugh unit) are shown in Table 2. Furthermore, egg quality analysis was carried out according to Altan (2015) and Şekeroğlu et al. (2024).

Table 2. Equations for some egg quality traits

No	Trait	Symbol	Equation and criteria
1	Shape Index, %	SI	$SI = (\text{Egg width/egg length}) \times 100$
2	Yolk Index, %	YI	$YI = (\text{Yolk height/ yolk diameter}) \times 100$
3	Albumin Index, %	AI	$AI = (\text{Albumen height/ ((albumen length + albumen width)/2)}) \times 100.$
4	Haugh Unit	HU	$HU = 100 \log (\text{albumen height} - 1.7 W^{0.37} + 7.57).$ W; egg weight (g).

Statistical analysis

The normality assumption of the data was examined with the Kolmogorov-Smirnov test and the homogeneity of variances with the Levene test. Logarithmic transformation was performed on variables that did not meet the above assumptions. Analysis of variance and Duncan's multiple comparison test were used. In addition, Chi-Square analysis was used in the analysis of egg meat-to-blood ratios. SPSS package program was used in statistical analysis.

Results

Table 3 indicated that there was greater variability among brown-egg pure lines regarding shell breaking strength, shell thickness, albumen index, and Haugh unit, all highest in the RIR2 pure line eggs and yolk color score, highest in the BAB2 pure line eggs ($P < 0.01$; $P < 0.05$). On the other hand, there was no significant difference in the egg weight, shape index, yolk index, and albumen pH among the brown genotypes ($P > 0.05$). It was observed that while egg weight had a significant effect on Haugh unit ($P < 0.05$), highest in M and L eggs and lowest in XL eggs, the other egg quality traits were not influenced by the egg weight ($P > 0.05$). In addition, a significant genotype $\times$ egg weight interaction effect was observed on Haugh unit and albumen pH ($P < 0.05$).

Table 6 indicated that white-egg pure lines differed only in yolk color score, highest and lowest in Blue and Brown pure line eggs, respectively ($P < 0.05$). In addition, there was a significant difference among egg weight groups regarding the shape index, highest in L and lowest in XL eggs; shell breaking strength, highest in XL and lowest in M and L eggs; shell thickness, highest in XL and lowest in M eggs; yolk index, highest in M and L and lowest in S and XL eggs; and yolk color score, highest in XL and lowest in S eggs ($P < 0.01$; $P < 0.05$). On the other hand, egg weight did not significantly affect albumen index, Haugh unit, and albumen pH ($P > 0.05$).

There was no significant effect of egg weight and genotype on the presence of meat and blood inclusions in the albumen ($P > 0.05$; Table 7). However, the effect of genotype on meat-blood inclusion in the yolk approached a significant level, with D229 pure line eggs having the highest number of eggs with meat-blood inclusions, followed by Black and no inclusions in Brown, Blue, and Moron pure line eggs ($P = 0.065$; Table 8). Furthermore, egg weight did not affect the presence of inclusions in the yolk ($P > 0.05$).

Table 3. Effect of genotype and egg weight on egg quality traits of brown-egg layer pure lines

Factor		Egg weight (g)	Shape index (%)	Shell breaking strength (kg. force)	Shell thickness (mm)	Albumen index (%)	Haugh unit	Yolk index (%)	Yolk color score (DSM)	pH
Genotype (G)	L54	62.60	76.26	2.90 ^a	0.212 ^{ab}	8.11 ^{ab}	80.27 ^{ab}	43.48	12.85 ^{cd}	9.67
	RIR2	62.20	76.03	3.67 ^c	0.249 ^c	10.81 ^d	91.40 ^c	43.77	12.75 ^{bcd}	9.74
	COL	61.10	78.84	2.98 ^{ab}	0.210 ^a	9.89 ^{cd}	86.29 ^{bc}	44.06	12.35 ^b	9.62
	RIR1	62.25	76.57	3.58 ^{bc}	0.232 ^{bc}	9.30 ^{bc}	85.79 ^{bc}	43.39	12.45 ^{bc}	9.68
	BAR1	62.21	75.76	3.36 ^{abc}	0.215 ^{ab}	7.97 ^a	78.70 ^a	42.97	11.84 ^a	9.70
	BAR2	61.85	78.78	3.36 ^{abc}	0.233 ^{bc}	9.84 ^{cd}	85.40 ^{bc}	45.88	13.05 ^d	9.66
Egg weight (EW, g)	S	51.33 ^a	79.01	3.30	0.226	8.99	83.54 ^{ab}	42.94	12.43	9.70
	M	58.00 ^b	76.39	3.37	0.223	9.82	87.33 ^b	44.48	12.40	9.71
	L	64.73 ^c	77.02	3.17	0.220	9.60	86.75 ^b	44.03	12.70	9.62
	XL	74.48 ^d	75.74	3.40	0.232	8.90	81.02 ^a	44.29	12.69	9.68
SEM		0.821	0.514	0.082	0.003	0.201	1.001	0.301	0.070	0.013
P value	G	0.312	0.282	<0.036	<0.000	<0.000	<0.000	0.066	<0.000	0.172
	EW	<0.000	0.126	0.772	0.574	0.136	<0.022	0.259	0.162	0.056
	G × EW	0.269	0.753	0.503	0.388	0.157	<0.032	0.280	0.138	<0.028

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL: extra-large, ≥ 73 g. SEM: standard of mean, $\times$: interaction. Means with different superscripts significantly differ ($P < 0.05$); Tables 4 and 5 indicated that there was no significant effect of genotype and egg weight on meat-blood inclusions in the albumen and the yolk ($P > 0.05$).



Table 4. Effect of genotype and egg weight on meat-blood inclusions in the albumen in brown-egg layer pure lines

		Number of eggs (%)				Total	χ^2	P
Factor		Normal (eggs without inclusions)	Eggs with meat inclusions	Eggs with blood inclusion	Eggs with both meat-blood inclusions			
Genotype	L54	18 (90)	2 (10)	0 (0)	0 (0)	20 (100)	17.146	0.310
	RIR2	13 (65)	4 (20)	2 (10)	1 (5)	20 (100)		
	COL	18 (90)	2 (10)	0 (0)	0 (0)	20 (100)		
	RIR1	15 (75)	5 (25)	0 (0)	0 (0)	20 (100)		
	BAR1	13 (68.4)	5 (26.3)	1 (5.3)	0 (0)	19 (100)		
	BAR2	14 (70)	6 (30)	0 (0)	0 (0)	20 (100)		
Egg Weight, g	S	20 (66.7)	10 (33.3)	0 (0)	0 (0)	30 (100)	8.587	0.476
	M	22 (73.3)	6 (20)	1 (3.3)	1 (3.3)	30 (100)		
	L	25 (83.3)	4 (13.3)	1 (3.3)	0 (0)	30 (100)		
	XL	24 (82.8)	4 (13.8)	1 (3.4)	0 (0)	29 (100)		
Total		91 (76.5)	24 (20.2)	3 (2.5)	1 (0.8)	119 (100)		

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL, extra-large, ≥ 73 g, χ^2 : chi-square. The first value, in front of the bracket, is the absolute number of eggs and the value in the bracket is the percentage.

Table 5. Effect of genotype and egg weight on meat-blood inclusions in the yolk in brown-egg layer pure lines

		Number of eggs (%)				Total	χ^2	p
Factor		Normal (eggs without inclusions)	Eggs with meat inclusion	Eggs with blood inclusions	Eggs with both meat-blood inclusions			
Genotype	L54	11 (55)	3 (15)	5 (25)	1 (5)	20 (100)	18.472	0.239
	RIR2	17 (85)	0 (0)	3 (15)	0 (0)	20 (100)		
	COL	13 (65)	2 (10)	5 (25)	0 (0)	20 (100)		
	RIR1	15 (75)	0 (0)	5 (25)	0 (0)	20 (100)		
	BAR1	14 (73.7)	0 (0)	4 (21.1)	1 (5.3)	19 (100)		
	BAR2	10 (50)	1 (5)	9 (45)	0 (0)	20 (100)		
Egg Weight, g	S	25 (83.3)	2 (6.7)	3 (10)	0 (0)	30 (100)	10.084	0.344
	M	17 (56.7)	2 (6.7)	10 (33.3)	1 (3.3)	30 (100)		
	L	18 (60)	2 (6.7)	10 (33.3)	0 (0)	30 (100)		
	XL	20 (69)	0 (0)	8 (27.6)	1 (3.4)	29 (100)		
Total		80 (67.2)	6 (5.0)	31 (26.1)	2 (1.7)	119 (100)		

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL, extra-large, ≥ 73 g, χ^2 : chi-square. The first value, in front of the bracket, is the absolute number of eggs and the value in the bracket is the percentage.

Table 6. Effect of genotype and egg weight on egg quality traits in white-egg layer pure lines

		Shell								
Factor		Egg weight (g)	Shape index (%)	breaking strength (kg. force)	Shell thickness (mm)	Albumen index (%)	Haugh unit	Yolk index (%)	Yolk color score (DSM)	pH
Genotype (G)	D229	61.95	75.93	4.31	0.251	11.95	94.21	43.39	11.50 ^a	9.40
	Brown	62.20	75.97	3.88	0.228	11.86	92.47	43.11	11.35 ^a	9.47
	Blue	62.60	76.67	3.76	0.243	10.49	89.49	44.11	11.90 ^b	9.50
	Black	62.10	76.08	4.12	0.247	11.79	93.46	44.08	11.60 ^{ab}	9.48
	Moron	61.95	77.17	3.58	0.248	12.36	94.18	43.59	11.70 ^{ab}	9.46
Egg weight (EW, g)	S	50.36 ^a	76.27 ^{ab}	4.07 ^{ab}	0.244 ^{ab}	11.69	92.71	42.96 ^a	11.44 ^a	9.51
	M	58.60 ^b	76.19 ^{ab}	3.63 ^a	0.228 ^a	12.08	94.01	44.74 ^b	11.64 ^{ab}	9.47
	L	65.04 ^c	77.39 ^b	3.74 ^a	0.243 ^{ab}	11.99	94.37	45.34 ^b	11.52 ^{ab}	9.47
	XL	74.64 ^d	74.82 ^a	4.29 ^b	0.257 ^b	11.00	89.96	41.58 ^a	11.84 ^b	9.40
SEM		0.929	0.324	0.098	0.003	0.213	0.629	0.326	0.060	0.016
P value	G	0.922	0.268	0.067	0.104	0.063	0.095	0.774	<0.028	0.281
	EW	<0.000	<0.049	<0.029	<0.005	0.242	0.053	<0.000	0.064	<0.070
	G × EW	0.077	0.710	<0.006	0.252	0.444	0.750	0.183	0.085	0.406

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL, extra-large, ≥ 73 g; SEM: standard of mean, $\times$: interaction. Means with different superscripts significantly differ ($P < 0.05$).



Table 7. Effect of genotype and egg weight on meat-blood inclusions in the albumen in white-egg layer pure lines

		Number of eggs (%)			χ^2	P
Factor		Normal (eggs with inclusions)	Eggs with meat-blood inclusions	Total		
Genotype	D229	19 (95)	1 (5)	20 (100)	3.061	0.548
	Brown	20 (100)	0 (0)	20 (100)		
	Blue	20 (100)	0 (0)	20 (100)		
	Black	20 (100)	0 (0)	20 (100)		
	Maron	19 (95)	1 (5)	20 (100)		
Egg weight, g	S	24 (96)	1 (4)	25 (100)	2.041	0.564
	M	24 (96)	1 (4)	25 (100)		
	L	25 (100)	0 (0)	25 (100)		
	XL	25 (100)	0 (0)	25 (100)		
Total		98 (98.0)	2 (2.0)	100 (100.0)		

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL, extra-large, ≥ 73 g, χ^2 : chi-square. The first value, in front of the bracket, is the absolute number of eggs and the value in the bracket is the percentage.

Table 8. Effect of genotype and egg weight on meat-blood inclusions in the yolk in white-egg layer pure lines

		Number of eggs (%)			χ^2	P
Factor		Normal (eggs with inclusions)	Eggs with meat-blood inclusions	Total		
Genotype	D229	17 (85)	3 (15)	20 (100)	8.854	0.065
	Brown	20 (100)	0 (0)	20 (100)		
	Blue	20 (100)	0 (0)	20 (100)		
	Black	19 (95)	1 (5)	20 (100)		
	Maron	20 (100)	0 (0)	20 (100)		
Egg weight, g	S	24 (96)	1 (4)	25 (100)	6.250	0.100
	M	22 (88)	3 (12)	25 (100)		
	L	25 (100)	0 (0)	25 (100)		
	XL	25 (100)	0 (0)	25 (100)		
Total		96 (96.0)	4 (4.0)	100 (100.0)		

Abbreviations: S: small, ≤ 52 g; M: medium, 53-62 g; L: large, 63-72 g; XL, extra-large, ≥ 73 g, χ^2 : chi-square. The first value, in front of the bracket, is the absolute number of eggs and the value in the bracket is the percentage.

Discussion

In the present study, there was no significant effect of genotype, both in brown and white-egg layer pure lines on egg shape index, which is in contrast with the study of Calik and Obrzut (2023) who identified significant variations among genotypes: Rhode Island Red/RIR (R-11 and K-22) and Rhode Island White (A-33) regarding the egg shape index. Kraus et al. (2019) reported a genetic influence on shell-breaking strength in a study conducted using eggs from Hy-Line Brown and ISA Brown hens at 36-64 weeks of age, which is in agreement with our study, with brown-egg layer pure lines. Durmuş et al. (2010) reported that shell thickness, Haugh unit, albumen index, and yolk index values of BAR 1, RIR 2, and Colombian breeds at 37 weeks of age were statistically significant.

In this study, shell thickness, albumen index, and Haugh unit were found statistically significant, but the yolk index was found statistically insignificant in particular to brown layer pure lines. Hanusova et al. (2015) stated that yolk color was affected by breed in a study conducted in 47-week-old Oravka and Rhode Island Red laying hens and emphasized that the yolk color of the Rhode Island Red breed was significantly darker than Oravka breed. Similarly, in the current study, yolk color differed among the genotypes, in both the brown and white-egg layer pure lines that were used. Aygün et al. (2017) reported that the minimum and maximum pH values of brown eggs were 7.96 and 8.78, respectively. In this study, the minimum and maximum values were found to be 9.62 and 9.74 for the brown-egg pure lines, respectively, which is higher than the above report. In a study involving Black, Blue, Brown, and Maroon genotypes, Durmuş and Türkoğlu (2007) found a genetic influence on shell-breaking strength, shell thickness, and albumen index, which is contrary to our findings of the white-egg pure lines. However, Durmuş and Türkoğlu (2007) identified that there was no genetic influence on shape index, yolk index, and Haugh unit, which is in line with the findings of the current study, with the white-egg pure lines. Kamanlı and Türkoğlu (2018) determined that D229, Black, Blue, Brown, and Maroon genotypes differed regarding shape index, shell-breaking



strength, shell thickness, albumen index, yolk index, Haugh unit, and meat-blood inclusions in eggs, which is in contrast to the findings of the present study. Mızrak et al. (2010) found a significantly higher shape index of Blue compared to Maroon pure line eggs, and this variability in genotypes is contrary to the present findings. Nevertheless, some authors reported a genetic influence on the percentage of eggs of blood and meat spots (Şekeroğlu and Sarıca, 2005; Hammershoj et al., 2021), which is not in line with the present data of the individual pure line groups.

In the current study, the egg weight effect was observed only on Haugh unit in brown-egg pure lines and on shape index, shell breaking strength, shell thickness, yolk index, and yolk color score in white-egg pure lines. In line with the present findings, Şekeroğlu and Altuntaş (2009) found egg weight effect on yolk index, yolk color score, and shell thickness. Also, Shi et al. (2009) identified egg weight effect on shape index and Haugh unit. It is worth noting that there was an increase in yolk index and yolk color (Şekeroğlu and Altuntaş, 2009), and shape index and shell thickness (Shi et al., 2009) with increasing egg weight. Such clear trends were not determined in the present study, and the possible explanation might be associated with the differences in egg samples that were analysed, genotypes that were used in studies, study region, age of hens during egg analysis, etc.

Conclusions

In this study, RIR2 and BAR2 pure lines can be selected for the production of hybrids that lay brown-shell eggs with superior shell and albumen quality traits and yolk color, respectively. Blue pure lines can be preferred for the development of hybrids that lay white-shell eggs with a darker yolk. The results regarding the egg weight effect on egg quality traits indicated no clear trend, warranting further studies. However, in brown-egg pure lines, M and L eggs had higher Haugh unit and in white-egg pure lines, L eggs are more oval, XL eggs are higher in terms of shell-breaking strength and shell thickness, and M and L eggs are higher in terms of yolk index.

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ID: 373

Some Medicinal and Aromatic Plants at Kastamonu

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Abstract

Medicinal and aromatic plants have been a treatment method frequently used by human beings for a long time. These plants are still taken as food supplements and/or medicines today. In this context, raspberry, hawthorn, aronia, bearberry, honeyberry, blackberry, wild strawberry, tamarind, mulberry, currant, giraburu, jujube, kumquat, black elderberry, buckthorn, black berry, cranberry, goji berry, bird apple, rose hip, licapa. Biochemical properties, usage areas and growing conditions of medicinal and aromatic plants such as , medlar, mountain ash, sloe and wild buckthorn ... are examined. These plants, which grow widely in the Black Sea region, are considered a source of healing. The place where these plants grow, geographical conditions and climatic conditions are discussed. It is thought that new research conducted in the light of this information will contribute to the literature.

Key Words: *Plants, Medicinal and Aromatic Plants, Biochemical Activity*





ID: 374

Navigating the Manure Maze: Sustainable Livestock Management for Future

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Abstract

Livestock production is increasing significantly because the demand for livestock food to meet the requirements is also growing. Livestock are essential components of the global nutrition chain, producing dairy products, eggs, and meat while contributing to gender equity, sustainable income, and meeting the SDG goals. However, contrary to sustainability, they generate a substantial quantity of waste. From livestock operations, billions of tons of trash are generated annually. Poor waste management contaminates water, air, and soil, which is hazardous for the environment and public health. The article aims to create a balanced future where manure is valued as a resource rather than a waste product. This paper investigates strategies that convert manure into nutrient-rich fertilizer and pure biogas. By converting animal waste into valuable resources, we can advance toward a sustainable future free of pollution.

Key Words: Livestock Management, livestock, Sustainable future, Manure management



ID: 375

The Biopotential of Bacterial Bioagents Isolated from Compost in Suppressing *Botrytis cinerea* and *Sclerotinia sclerotiorum*

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Abstract

To address the waste issues in our country, it is crucial to recycle plant residues through various processes, as it contributes to the protection of the environment and ecosystems. Composting is one of the most important recycling methods for plant residues. Composts are not only natural and enhance soil fertility, but they also exhibit fungitoxic properties on the mycelial and spore germination of fungi. This study was conducted to isolate bacterial bioagents from compost derived from various agricultural and household organic wastes, and to assess their antagonistic potential against important plant pathogens *Botrytis cinerea* and *Sclerotinia sclerotiorum* under *in vitro* conditions. A total of 8 bacterial isolates were obtained, which were identified as belonging to *Bacillus* spp. Dual culture tests were used to evaluate the potential of these bacterial candidates to inhibit the mycelial growth of phytopathogenic fungi. *In vitro* trials revealed that 6 bacterial isolates exhibited varying degrees of antagonistic effects (23.3% - 63.3%) on the mycelial growth of *B. cinerea*. Among the tested bacteria, two isolates were effective against *S. sclerotiorum*, demonstrating antifungal activity ranging from 80% to 83.3%. The results indicate that composts provide a favorable environment for microorganisms with antagonistic potential, suggesting that such cultivation environments could play a significant role in the biological control of fungal pathogens in agriculture. In conclusion, this study contributes to the development of sustainable agricultural practices by ensuring more efficient utilization of organic waste.

Key Words: Compost, *Botrytis*, *Sclerotinia*, Dual Culture, *Bacillus*

Komposttan izole edilen bakteriyel biyoajanların *Botrytis cinerae* ve *Sclerotinia sclerotiorum* ‘un baskılanmasındaki biyopotansiyelleri

Özet

Ülkemizde yaşanan atık problemlerinin önüne geçmek için bitkisel atıkların çeşitli işlemlerden geçirilerek geri dönüşüme kazandırılması çevre ve ekosistemin korunması açısından önemlidir. Bitkisel atıkların en önemli geri dönüşüm yöntemi kompostlaştırmadır. Kompostlar tamamen doğal, toprağın verimini artırıcı olmalarının yanı sıra fungusların misel gelişimi ve spor çimlenmesi üzerine fungitoksik özellik gösterirler. Bu çalışma tarımsal ve evsel organik atıkların çeşitli işlemlerden geçirilip, farklı katkı maddelerinin de eklenmesiyle oluşturulan komposttan bakteriyel izolatların elde edilmesi ve bu izolatların önemli bitki patojenleri olan *Botrytis cinerea* ve *Sclerotinia sclerotiorum*’a karşı antagonistik etkinliklerinin *in vitro* koşullarda belirlenmesi amacıyla yapılmıştır. Çalışmada toplam 8 bakteriyel izolat elde edilmiş ve bunların *Bacillus* spp.’e ait olduğu belirlenmiştir. İkili kültür testleri kullanılarak, aday bakterilerin fitopatojen fungusların misel gelişimini engelleme potansiyelleri değerlendirilmiştir. *In vitro* denemelerinde 6 bakteri izolatı, *B. cinerea*’nın misel gelişimini engellemede farklı oranlarda (%23,3-63,3) antagonistik etki göstermiştir. Test edilen bakteriler arasında iki izolat *S. sclerotiorum*’un gelişimi üzerine etkili olmuş ve %80-83,3 oranında antifungal etki göstermiştir. Elde edilen sonuçlar kompostların antagonistik potansiyele sahip mikroorganizmalar için elverişli bir ortam olduğunu ve bu tür yetiştirme ortamlarının tarımda kullanımının fungal patojenlerin biyolojik mücadelesinde etkin bir rol oynayabileceğini göstermektedir. Sonuç olarak organik atıkların daha verimli kullanılmasını sağlanarak sürdürülebilir tarım uygulamalarının geliştirilmesine katkı sağlayacaktır.

Anahtar Kelimeler: Kompost, *Botrytis*, *Sclerotinia*, ikili kültür, *Bacillus*



The Effect of Feather Condition on Blood Parameters and Egg Quality Traits in Brown Commercial Laying Hens Housed in Enriched Cages

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Abstract

The study's objective was to investigate the effect of feather condition on blood and egg quality traits of laying hens. A total of 45 Lohmann brown laying hens were randomly selected at 60 weeks of age and grouped based on total feather scores obtained from scoring 6 different body regions of the birds: the head, neck, breast, back, wings, and tail. According to the total feather score, the experimental groups consisted of low (6 - 12, L), moderate (13 - 17, M), and high (18 - 24, H). The number of lymphocytes, monocytes, heterophils, eosinophils, basophil cells, and heterophil/lymphocyte (H/L) ratio were determined at 61 weeks of hen age. Quality traits of eggs were analyzed at 68 weeks of hen age. The results indicated that feather condition significantly influenced monocytes, and heterophils ($P < 0.01$). However, the impact on H/L ratio, lymphocytes, and eosinophils was not significant ($P > 0.05$). There were differences in the egg weight, redness of eggshell, shape index, and shell thickness among the feathering groups ($P < 0.01$; $P < 0.05$). Shell-breaking strength, albumen index, Haugh unit, yolk index, and yolk color score were similar among the feathering groups ($P > 0.05$). In conclusion, the findings of this study revealed that moderate feathering was not negatively associated with a stress response in the birds. Furthermore, while the feather condition can modulate some external egg traits, it does not lead to variations in any internal egg quality traits. However, further studies over a longer duration are required to refine these findings.

Keywords: Laying hen, Feather score, Blood parameters, Stress response, Egg quality traits

Introduction

The enriched or furnished were developed to enhance the well-being of laying hens in cages. This happened after the criticism of the conventional cages concerning the quality of life of hens in the later system (Lay et al., 2011; Tainika and Şekeroğlu, 2020). However, Lay et al. (2011) emphasized that every system has its limitations in ensuring a perfect welfare-friendly environment for the birds. To this day, several protocols and approaches have been developed and validated to assess the welfare of hens (EFSA, 2023). Among them, blood parameters, for instance, the heterophil/lymphocyte (H/L) ratio is a significant physiological indicator for stress response in birds and is increased with several stressors (Gross and Siegel, 1983; Scanes, 2016). The H/L ratio has a genetic basis and varies among genotypes reared in cages (Singh et al., 2009). Additionally, Cotter (2015) indicated differences in the H/L ratio among cage types, which variations might be linked to the environmental changes in the different cage types.

The other approach is the utilization of plumage or feather condition scores (FCS) which are usually determined by a 4-point scoring scale (Tauson et al., 1984). The 4-point feather scoring is based on feather density and a total of scores obtained from scoring the 6 body regions of the bird: neck, breast, cloaca, back, wing, and tail. FCS is a significant physical indicator of hen health and the behaviors expressed within a flock, especially associated with feather pecking (Campe et al., 2018; Janczak & Riber, 2015). FCS is expected to differ with the internal stimuli such as aging and genotype of hens (Albentosa et al., 2003; Tok et al., 2022; Sokołowicz et al., 2023; Tainika et al., 2024). Additionally, FCS can reflect the effect of environmental factors on the birds. For example, Erensoy et al. (2021) and Tok et al. (2022) reported greater feather loss with increasing cage stocking density.

Furthermore, consumer preferences for eggs focus on the traits related to the shell (external egg quality variables) and those linked to the albumen and yolk (internal egg quality variables). Multiple factors influence the quality variables of eggs (Rakonjac et al., 2015; da Silva Pires et al., 2021). Also, cage system properties such as cage tier and direction can influence some egg quality traits in hens (Akkuş and Yıldırım, 2018; Şekeroğlu et al., 2024). While the influence of internal and external stimuli on the H/L ratio and egg quality of hens in cages is fully



established, the relationship between feather score, and stress response and egg quality in hens has not been fully investigated.

It is argued that the differences in feather condition would result in variations in the bird's response to the environment. This would consequently impact the bird's physiological mechanisms, leading to differences in the H/L ratio and egg quality traits. Therefore, this study examined the effect of feather condition on blood parameters and egg quality in the Lohmann brown genotype.

Materials and methods

Animal materials and housing

This research was carried out at the laying unit of Niğde Ömer Halisdemir University Ayhan Şahenk Agricultural Research Application and Research Center. This study was approved by the Animal Experiments Local Ethics Committee of Niğde Ömer Halisdemir University, Ayhan Şahenk Agricultural Research Application and Research Center (Decision no: 2023/08).

In this study, animal materials comprised Lohmann Brown laying hen hybrids. Feather condition was evaluated at 61 weeks of age, using a 4-point scoring scale as described by Tauson et al. (1984). While score 1 is for a lack of feathers and score 4 shows perfect feathering. The score of the 6 different body regions was determined and thereafter, the total feather score of each hen was calculated, with a total score of 24 as the maximum. A total of 45 birds were sampled, 15 birds for each group. Group 1 involved poor feathering birds, with a score of less than 12 (L). Group 2 consisted of moderate feathering, with a score between 13- 18 (M). Group 3 comprised high feathering, with a score of >18 (H), as shown in Table 1. The hens in each group had been previously raised in pens comprising 20 birds/ cage unit, raised in the commercial unit from 16 weeks of age.

Based on the feather score groups, the birds were then housed in the first three cage units of the second cage tier. There was an egg conveyor belt and a feeder in front of the cage tier. The cages were made from galvanized wires. Each cage unit size measured 240 cm in length, 63.5 cm in width, and 60 cm in height, and was furnished with a stainless-steel nipple drinking system, and two parallel perches, each measuring 180 cm. The perches were equipped with a claw-shortening device. Additionally, each cage unit was enriched with a dark blue curtained nesting area, measuring 40 cm in length, 33.5 cm in width, and 30 cm in height, a scratch pad, and a wire floor.

The photoperiod of 16 hours light:8 hours darkness was offered to the birds, between 06:00 - 22:00. 24-W led bulbs (20 lux -3.2w/m²) were the light sources. Standard concentrate feed (2. period layer feed) purchased from a commercial firm was offered to the birds during this period. The nutrient content of the feed used in the study is shown in Table 1. Feed and water were provided without restriction, *ad libitum*.

Before the blood samples were collected at 61 weeks of hen age, the plumage condition of birds in their respective were again scored using a 4-point scale (Tauson et al., 1984), and the data is indicated in Table 2. During the second scoring, both the feather score groups were recorded, and the accuracy of the group distribution was checked. On both occasions, scoring was done by the same observer, thus, avoiding significant differences in the scores.

Table 1. The nutrient composition of feed provided to the hens

Ingredients	%
Crude Protein	15.6
Crude Cellulose	4.4
Ash	12.4
Crude oil	3.8
Calcium	3.83
Phosphorus	0.35
Sodium	0.16
Lysine	0.76
Methionine	0.37
Metabolic Energy	2720 Kcal/Kg

Table 2. Feather score of different body regions laying hens 7 days after grouping based on feather density.

Group	Neck	Back	Tail	Cloaca	Breast	Wing	Total
LFS (6-12)	1.33 ^a	2.13 ^a	1.40 ^a	1.47 ^a	1.67 ^a	2.00 ^a	10.0 ^a
MFS (13-17)	2.07 ^b	3.07 ^b	2.67 ^b	2.53 ^b	2.33 ^b	2.73 ^b	15.40 ^b
HFS (18-24)	2.40 ^b	3.60 ^c	3.33 ^c	3.80 ^c	2.73 ^c	3.00 ^b	18.87 ^c
SEM	0.079	0.081	0.074	0.072	0.078	0.069	0.186
p-value	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***

Abbreviations; LFS: lower feather score, MFS: medium feather score, HFS: high feather score, SEM; standard error of mean; Means within the same column with different letter superscripts significantly differ (***) p < 0.001).



Blood sample collection and Blood cell count

Blood was collected from the wing vein and 2 cc sterile syringes were used for this purpose. separately for each subject. Approximately 1 drop of blood was taken and dropped on the base or smear slide to ensure a thin blood smear was drawn. This was obtained by running the drop of blood on the smear slide thinly using another slide, which is called a spreader slide. The process started by ensuring that the drop of blood on the smear slide was run to form a thin line between the smear slide at an angle of 30 - 45 ° C with the spreader slide as presented.

Afterward, the blood samples, labeled with a pencil were taken to Niğde Ömer Halisdemir University, Faculty of Medicine for staining and blood cell counting. The staining process was carried out using May-Grunwald and Giemsa (Lukas 1961). Briefly, during the staining process:

- Blood smear slides were kept in methyl alcohol for 2 minutes and 45 seconds.
- The smear slides were removed from methyl alcohol and allowed to dry.
- Dried smear slides were then kept in May Grunwald for 3 minutes.
- The smear slides were then dipped in distilled water or tap water 3-4 times and removed.
- The smear slides were then kept in Giemsa solution (1ml of Giemsa 9ml of water) for 16 minutes.
- Lastly, the smear slides taken out of Giemsa were again immersed 3-4 times in water, removed, and left to dry.

In the mounting process, 1-3 drops of balm or entellan mounting media were added to the smear slide using an entellan injector depending on the slide size to be mounted on the blood smear slide. The mounting was done slowly so that an air gap was not left, or the adhesive did not form a layer on the slide and dry.

After the staining process, blood cell counting was done in the same place. In this procedure, lymphocytes, monocytes, heterophiles, eosinophils, and basophils were counted as blood parameters. First, the blood smear slides were examined under the microscope at a 40x setting, and the areas where blood cells were found were determined. Then, the microscope was adjusted to 100x, and blood cells were counted starting from the far right or left most of the blood smear, and again from the top or bottom, depending on preference. The counted cells were recorded in order. The counting of blood cells was completed when a total of 100 cells was reached. The H/L ratio was determined according to Gross and Siegel (1983).

Egg quality analyses

Analysis of egg quality was carried out at 68 weeks of hen age. All the egg samples were analyzed on the same day as described by Altan (2015) and Şekeroğlu et al. (2024).

Egg weight (EW, g): a scale with an accuracy of 0.1 grams was used to measure the weight of eggs.

Shape index (SI, %): Egg width (EW, mm) and egg length (EL, mm) were measured using a digital caliper. The shape index was calculated with the formula; $SI = (EW/EL) \times 100$.

Shell color: was based on the average of three measurements obtained from blunt, center, and pointed egg regions. Each region was determined for lightness (L^*), redness (a^*), and yellowness (b^*) for each region was taken with a Minolta CR400 chromameter (Konica Minolta Sensing Inc., Osaka, Japan). Color differences (ΔE^*) were determined by the L^* , a^* , b^* , and indicated as the color of an egg (Ingram et al., 2008).

Shell-breaking strength (Kg. f): was taken by an Egg force reader (orka food tech. FGV-10XY (5.000 kg) EFO493/2013).

Shell thickness (mm): was determined as the average of shell thickness values obtained from three different regions of an egg, using a metrica manual micrometer (0.01mm). The shell thickness values at the blunt, center, and pointed portions of eggs were measured on shells without the shell membrane.

Thereafter, egg samples were broken on a special glass table to measure internal egg quality variables. Here, after waiting for 10 minutes, the albumen height (AH) and yolk height (YH) were measured with a tripod 0.01 mm sensitivity manual micrometer. The albumen length (AL), albumen width (AW), and yolk diameter (YD) values were taken by a digital caliper (0 – 150 mm). The following formulas were used to calculate the albumen and yolk index, AI and YI, respectively, and the Haugh unit.

AI, % = $((AH \text{ (mm)}) / ((AL \text{ (mm)}) + AW \text{ (mm)})/2)) \times 100$.

YI, % = $(YH \text{ (mm)}) / YD \text{ (mm)}) \times 100$.

HU = $100 \times \log (AH \text{ (mm)} + 7.57 - 1.7 EW^{0.37})$ H: observed albumen height (mm) (Haugh, 1973).

Yolk color: was scored by DSM yolk color fan.

Statistical analysis

The normality assumption of the data was found to provide the normality assumption of the data, except for the feather score, which was examined with the Kolmogorov Smirnov test ($p > 0.05$). According to these conditions, it was determined that the data other than the feather score were suitable for analysis of variance, and statistical analyses were performed according to one-way analysis of variance (One-way ANOVA). Differences between groups were determined by Duncan's multiple comparison test. The Mann-Whitney U test was used to analyze the data of the feather score. However, since there was no difference, no multiple comparison test was used. SPSS package program was used in the analysis of the data. The difference was accepted as statistically significant at $P < 0.05$.



Results and discussion

Recently, the increased public concern for the welfare of hens has influenced the laying hen housing systems in many developed countries. Welfare issues such as stress and fear responses and feather damage are still critical to the poultry industry. The H/L ratio is widely used as a physiological indicator of stress responses in birds (Dinçer et al, 2011; Scanes, 2016; Scanes et al., 2019). The results in Table 3 indicated that feather condition had a significant influence on monocytes and heterophils ($P < 0.009$).

Table 3. Blood parameters of laying hens based on feather score

Group	Lymphocyte	Monocyte	Heterophil	Eosinophil	Basophil	H/L ratio
LFS (6-12)	50.73	18.87 ^a	25.20 ^b	2.67	0.33	0.51
MFS (13-17)	55.33	21.07 ^a	22.73 ^b	2.27	0.80	0.43
HFS (18-24)	53.27	26.93 ^b	16.53 ^a	3.00	0.27	0.33
SEM	1.047	0.727	1.121	0.404	0.114	0.029
P-value	0.211	0.000***	0.009***	0.761	0.128	0.060

Abbreviation: SEM; standard error of mean, LFS: lower feather score, MFS: medium feather score, HFS: high feather score. Means within the same column with different letter superscripts significantly differ (*** $P < 0.001$).

The monocytes and heterophils increased and decreased, respectively with the increase in feathering of birds. However, the impact of feather condition on H/L ratio, lymphocyte, and eosinophil was not significant ($P > 0.05$). This study is not in agreement with Campo et al. (2001), who reported a higher H/L ratio for poor feathering compared to perfect feathering hens. It can be argued that the variations in results might be connected to the differences in age when blood samples were taken, genotypes, handling of birds, study places, housing system, etc.

Furthermore, Gross and Siegel (1983) reported that stress is considered low when the H/L ratio is about 0.2, moderate when it is 0.5, and high when it is 0.8. In the present study, it was determined that the H/L ratio of the high feathering group was 0.33. Thus, the stress response of the high feathering group was low (value close to 0.2) compared to the H/L ratio of the low feathering group with the highest value of 0.51, showing moderate stress. Generally, the findings of this study would highlight that poor feathering birds might indeed be more stressed than high-feathering hens.

Notably, the mechanisms underlying the effect of feather condition on some blood parameters need to be fully investigated. Furthermore, the birds that originated from different cage tiers of the enriched were mixed to form the different feathering groups. Therefore, the results of this study might speculate the potential of hens to cope with the new environment and flock mates after the separation.

Studies have found an inverse relationship between feather condition and performance or egg production traits (Bentsen, 1983; Hagger et al., 1989; Glatz, 1998; Yamak and Sarica, 2012; Taşkın et al., 2015). Feather damage is of economic importance in chicken production especially due to its influence on feed intake which in turn impacts egg quality. Meanwhile, the association between feather condition and egg quality traits is not fully investigated. In the present study (Table 4), egg weight ($P < 0.05$), redness of eggshell ($P < 0.05$), shape index ($P < 0.01$), and shell thickness ($P < 0.05$) were significantly affected by feather condition.

Table 4. Effect of feather score on egg quality traits in laying hens based on feather score

Feather score	Egg weight (g)	L*	a*	b*	L*-a*-b*	Shape index (%)	Shell breakin	Shell thickness (mm)	Albumen index	Haugh unit	Yolk index	Yolk color	Albumen pH
n	40	40	40	40	40	40	40	40	40	40	40	40	40
L	69.48 ^b	59.18	17.52 ^a	31.64	10.03	77.53 ^{ab}	4.13	0.2440 ^a	1.96	78.09	41.48	13.13	9.00
M	66.95 ^{ab}	59.27	19.03 ^b	31.85	9.06	79.10 ^b	4.17	0.26 ^{ab}	2.17	80.33	43.28	12.87	8.97
H	63.59 ^a	59.70	18.86 ^b	32.11	8.72	76.17 ^a	4.55	0.27 ^b	1.96	79.12	41.94	13.00	9.11
SEM	0.944	0.561	0.270	0.254	0.988	0.379	0.167	0.004	0.078	1.590	0.498	0.080	0.030
P	0.05*	0.936	0.030*	0.777	0.863	0.007**	0.604	0.020*	0.435	0.837	0.279	0.363	0.166

Abbreviations: n; number of eggs; L; low, M; medium, H; high, SEM; standard error of mean, L*; brightness, a*; redness, b*; yellowness; The difference between the means indicated with different Letters in the same column is statistically significant (*; $P < 0.05$, **; $P < 0.01$)

Egg weight decreased with an increase in feather condition, higher in the poor feathering compared to the moderate and high feathering groups, whose values were statistically similar. The redness of the shell color was higher in the moderate feathering group compared to the poor and high feathering groups. The egg shape index was higher in the moderate feathering group compared to the poor and high feathering groups. Shell thickness increased with the increase in feather condition scores.



The influence of feather condition on some egg quality traits is probably linked to the individual variability in the ability of hens to cope with the challenges of feather scores. These variabilities can be related to the association between feed intake and feather condition. However, the lack of significant differences in the shell-breaking strength and internal egg quality parameters among feathering groups shows that individual differences within a strain in coping with the challenges of feather loss seem insignificant for these traits.

The feather scores obtained after the second phase of feather scoring are indicated in Table 2. However, this data was not discussed because it was taken to ensure the accuracy of the different feathering groups before blood collection.

Conclusions

This study was able to reveal that feather condition does not influence stress response in birds. However, external egg quality traits may differ due to feather condition. It is suggested that further studies are warranted to explore the association between feather loss and stress response and egg quality traits.

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Evaluation of Exposure to Essential Oils in Terms of Potential Health Risks

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Abstract

The protection and sustainable use of natural resources is essential to ensure the ecological integrity of all living species. Essential oils are considered one of nature's oldest and most valuable natural resources. Hundreds of species of essential oils or essential oil blends have been used for healing purposes since ancient times and should not be ignored when considering how, how often and at what concentration to use them. The aim of this review is to examine the current data on the possible health risks of essential oils, which can be absorbed into the body by different methods and for different purposes and can reach all body tissues through the bloodstream.

Key Words: Essential oils, aromatherapy, toxicity

Esansiyel Yağlara Maruz Kalma Şeklinin Olası Sağlık Riskleri Açısından Değerlendirilmesi

Özet

Ekolojik bütünlüğün sağlanmasında, doğal kaynakların korunması ve sürdürülebilir kullanımı her canlı için ayrı önem taşımaktadır. Esansiyel yağlar, doğanın bize sunduğu en eski ve değerli doğal kaynaklardan birisi olarak kabul edilmektedir. Antik çağlardan bu yana şifa amaçlı kullanılan yüzlerce çeşit esansiyel yağın veya esansiyel yağ karışımlarının hangi uygulama metoduyla, ne sıklıkta ve ne düzeyde kullanılması gerektiğine yönelik endişelerde göz ardı edilmemelidir. Bu derlemede, farklı uygulama yollarıyla ve amaçlarla vücuda alınarak kan dolaşımıyla tüm vücut dokularına erişebilen esansiyel yağların olası sağlık risklerine ilişkin güncel verilerin gözden geçirilmesi amaçlanmaktadır.

Anahtar Kelimeler: Esansiyel yağar, aromaterapi, toksisite

Giriş

Risk, bir ürün tarafından üretilen tehlike ile insanların bu ürüne maruz kalmasının kombinasyonu olarak tanımlanmaktadır (Maes ve ark., 2021). Bir molekülün doğada kendiğilinden var olması yada tamamen doğal kökenli olması, herhangi bir risk taşımadığı anlamına gelmemektedir. Özellikle kompleks yapıdaki doğal materyaller için çok daha riskli durumlar söz konusu olabilir.

Terpenoidler, fenol türevleri, aromatik ve alifatik bileşenlerin kompleks bir karışımı olarak kabul edilen ve bitkilerin tohum, meyve, yaprak, dal, çiçek gibi kısımlarında doğal olarak bulunan esansiyel yağlar orta çağlardan bu yana bilinmekte ve kullanılmaktadır. Esansiyel yağların bakterisidal, virüsidal, fungusidal, antiparazitik, insektisidal ve analjezik, sedatif, anti-inflamatuar, spazmolitik vb. etkileri klinik olarak kanıtlanmış olsa da, içerdikleri uçucu bileşenlerin toksik, mutajenik ve alerjenik etkilerinin ortaya koyulduğu çalışmaların sayısı da gün geçtikçe artmaktadır (Bilia ve ark., 2014; de Oliveira ve ark., 2022; Shirole ve ark., 2015).

İlk olarak 1928 yılında Rene Maurice Gattefossé tarafından kullanılan "aromaterapi" terimi, canlının fiziksel, zihinsel ve duygusal refahını iyileştirmek amacıyla bitkilerden elde edilen uçucu yağların ve konsantrelerinin kullanıldığı tamamlayıcı bir sağlık terapisi. Aromaterapinin tıbbi bir uzmanlık alanı olarak kabul edilmesi ilk olarak Fransa'da başlamış ve bunu takiben İngiltere'de Bütünleştirici ve Tamamlayıcı Uygulamalar (ICP) kapsamında tanımlanmıştır (Walters, 1998; Bakkali ve ark., 2008).

Günümüzde geleneksel noktada dünyanın hemen her uygarlığında kültürel ve tamamlayıcı tedavilerde sıklıkla tercih edilmektedir. Fakat aromaterapinin olası risklerine yönelik soru işaretleri de açıklığa kavuşmuş değildir.

Aromaterapide Esansiyel Yağların Kullanımı

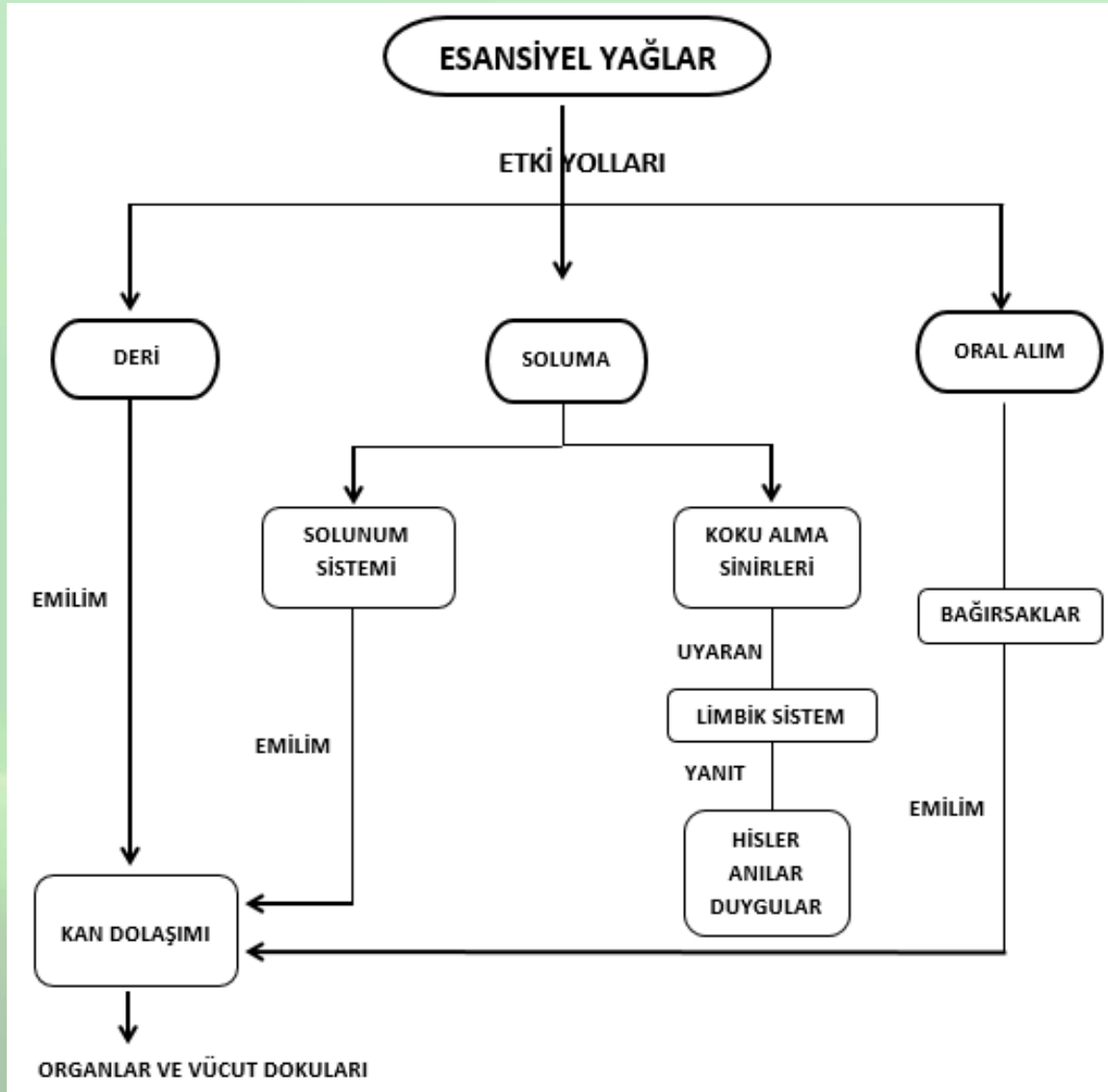
Esansiyel yağların aromaterapi amaçlarıyla kullanımında sadece verilen doz değil, aynı zamanda yağın nasıl uygulandığı da dikkate alınmalıdır. Çünkü farklı uygulama türlerinin, farklı emilim seviyelerine ve toksisiteye (Tablo 1) sahip olduğu bilinmektedir (Guba, 2000).



Tablo 1. Esansiyel yağların uygulama metodlarına bağlı toksisite (Guba, 2000).

Uygulama şekli	Toksisite
Oral	+++++
Rektal	++
Vajinal	+ +
Topikal (deri)	+
Solunum	0

Esansiyel yağların uygulanmasında üç farklı yöntem tercih edilebilmektedir: soluma yoluyla, deri yoluyla (topikal uygulama) ve oral alım (Şekil 1). Her üç yönteminde kan dolaşımına karıştığını gösteren çalışmalar mevcuttur. Tisserand (2004), solunan esansiyel yağların üst solunum yolunu geçerek alt solunum yollarına kadar ulaşabildiğini ve burada pulmoner kan damarları tarafından emilerek kan dolaşımına katıldığını belirtmektedir. Solunuma benzer şekilde deriyle temas eden esansiyel yağların epitel dokular tarafından emilerek, oral yolla alınan esansiyel yağların ise bağırsak mukozasına nüfuz ederek, kan dolaşımına katıldığı ve böylece diğer organlara ve dokulara ulaşabildiği bildirilmiştir.



Şekil 1. Farklı uygulama metodlarının esansiyel yağların vücuttaki dağılımına etkisi (Gnatta, 2016)

Uluslararası Aromaterapistler Federasyonu (IFA, International Federation of Aromatherapists) tarafından yayınlanan listede mısır, anason, tarçın kabuğu, sinameki, karanfil, kekik ve geyik otu esansiyel yağlarının cilt üzerinde doğrudan kullanılmaması gerektiği bildirilmiştir. Bu kararın alınmasındaki en önemli etken, bu yağların dermokostik veya cildi tahriş edici niteliğe sahip birer fenol veya aromatik aldehit içermesi olarak ifade edilmektedir (Battaglia, 2003).



Alanında uzman, eğitilmiş aromaterapistlerin bu tür yağları kullanması federasyon kararıyla yasaklanmasına rağmen, ne yazık ki ciddi miktarda (% 60 konsantrasyonda) sinameki, karanfil ve kafur gibi esansiyel yağların karışımı olarak satışa sunulan "Tiger Balm" gibi ürünlerin halk arasındaki popüleritesi giderek artmaktadır (Guba, 2000).

Esansiyel yağların yan etkilerinden sorumlu tutulan bileşenler uçucu bileşenler olarak kabul edilmektedir. Özellikle ultraviyole ışınları emme ve depolama yeteneğinde olan furanokumarinlerce zengin bergamot, misket limonu, acı portakal, greylift ve kimyon esansiyel yağlarının cilt yüzeyine uygulanması sonrasında gün ışığına maruz kalındığında, ciddi güneş yanıklarının oluştuğu bildirilmiştir (Guba, 2000)

Yüksek 5-methoxypsoralen (bergapten) içeriğiyle bilinen bergamot yağıyla muamele edilen fare derisinin UV ışığına tekrar tekrar maruz kalmasının, cilt kanserini teşvik ettiğine yönelik kanıtlar da sunulmuştur (Sambuco ve ark., 1987).

Bu durumun aksine, UV kaynaklı cilt hasarına karşı bergamot yağının güneş koruyucu bir preparatla birlikte uygulanmasının, tek başına güneş koruyucu kullanımından çok daha iyi koruma sağladığı da rapor edilmiştir (Young ve ark., 1990).

Guba (2000)'ya göre, LD₅₀ değeri 1.0'ın altında olan bir uçucu yağ herhangi bir toksik etki potansiyeline sahip değildir ve anti-enflamatuar olarak güvenle kullanılabilir.

Bazı aromatik bileşiklerin, özellikle 1,8 sineol, kafur ve metil salisilatın çok düşük dozlarda dahi toksik etkiye sahip olduğu bilinmektedir. Bu bileşenleri içeren ürünlerin faydalı özellikleri nedeniyle yaygın kullanılması, çocuklarda ve yetişkinlerde ölümcül olabilecek sonuçlara yol açmaktadır (Henry ve Cassidy, 1998).

Yüksek metil salisilat içeriğiyle bilinen kekik üzümü yağının akut oral LD₅₀ değeri ratlarda 1.2 olarak rapor edilirken, metil salisilatın insanlar için daha yüksek toksisiteye sahip olacağı düşünülmektedir. Geçmiş yıllardaki ölüm sayıları göz önüne alındığında, bazı vakalarda yutulan miktar bilindiğinden, insanlar için metil salisilatın LD₅₀ değeri 0.3 olarak tahmin edilmektedir ve 60 kg'lık bir yetişkin için bu yaklaşık 18 g'ın oral alımına denk gelmektedir. Örneğin, bel ağrısı çeken bir kişi, eğer beline kekik üzümü yağının %2.5'lük dilüsyonundan 1 ml uygulamak istediğinde (1 ml x %2.5) yaklaşık 0.025 g metil salisilata maruz kalacaktır. Dolayısıyla, uygulanan doz, ölümcül dozun (LD₅₀ = 18 g) yalnızca % 0.14'ü kadardır veya 720 katından daha azdır. Uygulanan doz 10 ml'ye yükseltildiğinde ise, 0.25 gram metil salisilata erişilecek ve metil salisilatın tamamı absorbe olsa dahi, emilen düzeyi bir tablet aspirindeki ile eşdeğer olacaktır (Guba, 2000).

Geçtiğimiz yıl yayınlanan bir çalışmada (Setianingsih ve ark., 2023), mor hayıt bitkisine (*Vitex trifolia* L.) ait yapraklardan maserasyon tekniğiyle elde edilen esansiyel yağın toksisitesi karides larvaları üzerinde test edilerek, uçucu bileşen profilleri incelenmiştir. Yağın major bileşeninin (%42) furan-2-karboksaldehit olduğu ve tespit edilen LD₅₀ değerinin (51.5 ppm) toksik etkili olduğu sonucuna varılmıştır.

Çözdük otu, biberiye, adaçayı ve kekik uçucu yağlarının yüksek tansiyon üzerinde olumsuz etkilere sahip olduğu, bunun aksine sarımsak, sardunya ve lavanta yağlarının ise deney hayvanlarında tansiyon düşmesine yol açtığı bildirilmiştir (Tisserand ve Young, 2013).

Uçucu yağların aromaterapide kullanılmasına yönelik en fazla tartışılan konuların başında hamilelik süreci yer almaktadır. Bazı esansiyel yağların vücuttan hormon dengesini bozarak doğurganlıkta azalmaya, gelişmekte olan fetüse zarar vererek fetüsün kaybına, erken doğuma veya doğum kusurlarına neden olabileceğine yönelik endişeler geçmişten günümüze kadar gelmiştir (Guba, 2000).

Bu yüzden araştırmacıların bir kısmı bu hassas süreçte esansiyel yağların kullanılmasını tavsiye etmezken (Grace, 1996), bir kısmı ise toksisitesi çok düşük olan bazı esansiyel yağların kullanılabilirliğini belirtmektedir.

Yapılan bir çalışmada (Gunn, 1921), düşük önleyici olarak yaygın kullanılan bazı uçucu yağlara (ardıç, sedefotu, adaçayı ve solucan otu) maruz bırakılan insanların rahimlerinden izole edilen örneklerde, test edilen uçucu yağların rahim kaslarında herhangi uyarıcı bir etkiye sahip olmadığı belirtilmiştir.

Bunun aksine Fawcett (1993), anason, rezene ve fesleğen gibi östrojen benzeri etkiye sahip uçucu yağlardan özellikle hamilelik süresince uzak durulması gerektiğini bildirmiştir. Hamileliğe benzer şekilde, dişil yaşam döngüsünün en önemli basamaklarından biri olan menstrual dönemin düzenlenmesinde hormon benzeri etkiler sergileyen adaçayı, gül, yasemin ekstraktı ve tatlı rezene gibi esansiyel yağlar da öne çıkmaktadır (Guba, 2000).

Sonuç olarak, doğanın bize sunduğu bitkilerin farklı kısımlarının, farklı tekniklerle birer şifa kaynağı olarak kabul görebilmesi için daha somut ve elbette bilimsel dayanağı olan kanıtlara ihtiyaç duyulmaktadır. Modern tıbbın ve farmakolojinin kurucuları arasında yer alan Paracelsus (1493-1541)'un da belirttiği gibi "her madde zehir özelliği gösterebilir ancak ilaç ile zehri birbirinden ayıran maddenin o dozudur" ...

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Chitosan-Coated Nanoparticles of *Calotropis Procera* Escalate Functional Rehabilitation in a Mouse Model of Peripheral Nerve Injury

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Abstract

Patients with peripheral nerve injuries (PNIs) struggle with prominent and difficult health issues. These are the most common types of injuries. The majority of peripheral nerve injuries result from trauma and affect the upper limbs. The professionals on the subject of peripheral nerve injury (PNI) include the scientific community, plastic surgeons, neurologists, and neuroscientists. Despite efforts, full functional recovery is still not promised. Many therapeutic plants have demonstrated varying degrees of efficacy and impact on various neurological and other conditions. The function of Chitosan-coated nanoparticles of *Calotropis procera* (*Calotropis procera*/Cht-NPs) was investigated in a mouse model used to sustain peripheral nerve damage. It was the goal of this study. Experimental models of sciatic nerve injury have been developed to study the development of peripheral nerve damage in rodents. The mice were divided evenly into two groups following the acclimation period. While the normal group (group 1) was gavaged with distilled water, the treatment group (group 2) received *C. procera*/Cht-NPs at a dose of 2.5 mg/kg/day. Both groups were given normal chow and ad libitum water. Animals had their right sciatic nerve mechanically crushed. Behavioral analyses (hot plate, grip strength, SFI, and pinprick test) were used to assess the recovery of sensorimotor function. Blood was extracted to evaluate oxidative stress. After the PNI, it was shown that *C. procera*/Cht-NPs assist in the recovery of motor and sensory functions with a statistically significant difference ($p < .05$). It was concluded that *C. procera*/Cht-NPs demonstrate an impact that enhances function restoration. More thorough research for their use as a therapeutic agent is highly suggested.

Key Words: Peripheral Nerve Injuries (PNI), Sensorimotor function, Oxidative Stress



Effect of Edible Mushroom on The Development of Lactic Acid Bacteria

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Abstract

Currently, many products for human health are available in the market as prebiotics and probiotics. Prebiotics are defined as indigestible dietary fibres and oligosaccharides that promote the growth of lactic acid bacteria in the gastrointestinal tract. With evidence showing that the microbiota is undoubtedly linked to overall health, the discovery of new prebiotics acting on functional foods and beneficial bacteria is important. Mushrooms are well known for their organoleptic qualities as well as for harbouring many different bioactive substances with beneficial health effects. Fungi are of increasing interest as a potential source of prebiotic substrates. Developing a new potential prebiotic from inexpensive and abundant materials such as mushrooms is one of the aspects to be considered. Prebiotic compounds obtained through fungal extraction have been used in numerous research as non-digestible dietary ingredients to show that they inhibit pathogenic organisms and promote probiotic growth. It will take more thorough research to ascertain the metabolic pathways that are triggered in the process of probiotic strains utilizing fungal polysaccharides. Future projections for the food industry indicate that mushrooms will become even more significant. This study examined mushrooms' potential as a prebiotic source and provided a detailed description of its theory and use.

Key Words: Lactic acid bacteria, edible mushroom, prebiotic, probiotic, functional foods

Introduction

Although there are many members of the fungi kingdom, including yeasts, moulds and cap fungi, the word mushroom refers to large, fleshy, edible and medicinal fungi with a distinct sporocarp that are above or below ground, visible to the naked eye, that can be collected by hand. Macrofungi are defined as those sporocarps that have been utilized worldwide for centuries as both food and traditional medicine. Fungi, which do not have the ability to photosynthesise because they do not contain chlorophyll, feed symbiotically, parasitically and saprophytically. Many play important roles in the degradation and recycling of various agricultural and forest wastes and complex biopolymers (Miles and Chang, 2004). It is considered that there are around 1.5 million species of mushrooms on earth and although around 3000 are known to be edible, around 60 species can be cultivated. As mushroom cultivation has become more popular around the world, more than 700 mushroom species have been recognized as safe for human consumption and beneficial to human health. Common mushroom species produced under suitable ecological conditions include *Lentinula edodes*, *Volvariella volvacea*, *Agaricus* sp., *Pleurotus* sp., *Hericium* sp., *Ganoderma* sp., *Grifola frondosa* and *Coprinus* sp. (Cerletti et al., 2021). *Hypsizygus tessellatus*, *Lentinula edodes*, *Agaricus bisporus*, *Pleurotus ostreatus* and *Flammulina velutipes* are some of the most widely cultivated mushroom species in the world (Niego et al., 2021). There has been a notable increase in interest among consumers in the potential health benefits of incorporating mushrooms into their diets. This is because mushrooms are increasingly recognized as a source of protein, minerals, essential vitamins, and fiber. In addition, mushrooms contain bioactive compounds with antioxidant, anti-inflammatory, anti-tumor, antimicrobial and antiviral properties that actively promote health and reduce the risk of disease in the human body (Cateni et al., 2022). Edible mushrooms have a carbohydrate and digestible protein composition, are a source of high-quality fiber and have a low fat content (Araújo-Rodrigues et al., 2022). In addition, mushrooms are a good source of vitamins, essential amino acids and minerals (Sousa et al., 2023).

Prebiotics are substances that promote the growth or action of microorganisms that contribute to the benefit of the host and are widely consumed by humans. Consumption of prebiotics increases immune function, reduces long chain fatty acids (LCFA) in the gut, improves colon integrity, reduces the duration of intestinal infections, and reduces allergic response for better digestion (Douglas & Sanders, 2008). Mushrooms are also regarded as a prospective source of prebiotics, given their content of diverse polysaccharides, including chitin, mannans, hemicellulose, glucans, galactans, and xylans (Singdevsachan et al., 2015). Some edible fungi are still an undiscovered treasure trove of prebiotic and bioactive compounds and their beneficial effects on the immune system. Numerous studies have demonstrated the positive effects of several fungal species in the prevention and treatment of chronic illnesses, including diabetes, cancer, obesity, hyperlipidemia, hypercholesterolemia, and neurodegenerative and cardiovascular diseases (Varshney et al., 2013; Roncero-Ramos & Delgado-Andrade, 2017; Ke et al., 2022). Various bioactive compounds derived from fungi have been shown to modify intestinal



polysaccharides, act as prebiotics and reduce pathogen proliferation by promoting the growth of probiotic bacteria in the gut (Kumari, 2020). Prebiotic substrates are present in certain beneficial bacteria, including lactic acid bacteria (*Lactobacillus* sp., *Pediococcus* sp., *Lactococcus* sp., *Leuconostoc* sp. and *Streptococcus* sp.) and bifidogenic bacteria (*Bifidobacterium* sp.). By lowering intestinal pathogens and/or modifying the synthesis of bacterial compounds linked to health, these bacteria benefit the host (Ringo et al., 2010; Margalho et al., 2021).

Properties of Probiotic Microorganisms

According to the International Scientific Association for Probiotics and Prebiotics (ISAPP), probiotics are defined as non-pathogenic microorganisms that, when administered in sufficient quantities, provide health benefits to the host individual (Paulino do Nascimento et al., 2022). In order for a product to be defined as a probiotic, it must possess a number of specific characteristics. The aforementioned characteristics can be enumerated as follows: the product must be of human origin, demonstrate resistance to bile and gastric acid, survive in the digestive tract, adhere to the intestinal wall, adapt to the natural flora, colonize the digestive tract, secrete antimicrobial products such as bacteriocin, be non-toxic and non-pathogenic, exert beneficial effects on host health, remain stable during production and storage processes, and retain its viability (Şahin, 2018). Concurrently, probiotics must also possess antimicrobial properties (Gülbandılar et al., 2017).

Most of the probiotic microorganisms are included in lactic acid bacteria, which are generally recognized as safe and have GRAS (Generally Recognised As Safe) status. The most commonly utilized bacteria are those belonging to the *Lactobacillus*, *Bifidobacterium*, *Streptococcus*, *Enterococcus*, *Leuconostoc* and *Pediococcus* species (Stavropoulou & Bezirtzoglou, 2020; Buran & Bütünöz, 2022). Especially *Lactobacillus acidophilus*, *L. casei*, *L. rhamnosus*, *L. reuteri*, and *Bifidobacterium lactis* Bb12 species are widely used in commercial preparations since their beneficial effects on health have been proven by clinical trials (Thamacharoensuk et al., 2017). Probiotics must survive in the gastrointestinal tract in order to exert their beneficial effects. *Lactobacillus* and *Bifidobacterium* species are particularly well adapted to this environment, frequently utilizing host-derived glycans for metabolism, which enhances their survival and activity on mucosal surfaces (Zuniga et al., 2018). The regular consumption of probiotics has been linked to a number of beneficial effects, including improvements in gut health, enhanced immunity and protection against certain infections (Aguirre Garcia et al., 2024). The ability of these probiotics to colonize the gut is of significant importance with regard to their efficacy. Several studies have demonstrated that the capacity for colonization of various *Lactobacillus* and *Bifidobacterium* species is dependent on their genetic characteristics and ability to adapt to the host environment (Xiao et al., 2021). In light of the considerable diversity of probiotic products currently available on the market, ensuring the quality and efficacy of these microorganisms is paramount. The specific strain, viability and antimicrobial effect against pathogenic organisms are crucial factors in determining the health benefits of probiotic products (Zawistowska Rojek et al., 2022).

Lactic acid bacteria

In 1919, Orlo-Jensen first described lactic acid bacteria as rod- or cocci-shaped, Gram-positive microorganisms that are catalase- and nitrate-reductase negative and do not form spores. These bacteria typically produce lactic acid as an end product during carbohydrate fermentation. The inability to synthesize the requisite enzymes and cytochromes precludes the possibility of oxidative phosphorylation in the presence of oxygen. Lactic acid bacteria are capable of surviving in temperatures between 5-10 °C, with some species demonstrating tolerance to salt, acid, or alkyls (Mokoena et al., 2021). They need relatively more complex carbon sources to realize their bioactivities. Therefore, they use complex organic molecules as carbon sources. Lactic acid bacteria need many free amino acid molecules, organic acids and sugars for their growth (Fernandes & Jobby 2022; Sharma et al., 2022).

Microorganisms known as lactic acid bacteria (LAB) are able to ferment carbohydrates like lactose and glucose and turn them into lactic acid (Wang et al., 2021; Abedin et al., 2023). LAB have positive effects on the human immune system in addition to preserving the harmony of the gut flora (Rastogi & Singh, 2022). Recently, LAB is widely used in the production and processing of fermented foods due to their generally accepted probiotic effects, safety and acid-producing properties (Alan & Yıldız, 2022). Regular consumption of foods fermented by LAB has been shown to have a beneficial effect on immune system strength and disease protection (Abdul Hakim et al., 2023). Moreover, LAB is employed in the food industry as a natural antibacterial agent, which plays a role in the preservation of food products through the application of antiseptic and freshness-preserving techniques (Kousha et al., 2022).

LAB produces a wide range of metabolites during fermentation, including exopolysaccharides (EPS), amino acids, organic acids, bioactive peptides, and bacteriocins. Antioxidant properties, cholesterol-lowering effects, and improved mineral absorption are just a few of the host health advantages associated with these metabolites (Juraskova et al., 2022; Zapašnik et al., 2022; Sionek et al., 2023, Tang et al., 2023). In addition to assisting in the preservation of foodstuffs, the metabolic processes of LAB contribute to the enhancement of flavour and texture in fermented foods, thereby increasing their appeal to consumers (Aguirre Garcia et al., 2024). Moreover, antinutrients in food that may prevent the absorption of essential nutrients can be decreased by LAB. This decrement enhances the nutritional profile of fermented foods, increasing their safety and benefits (Zapasnik et al., 2022).



Table 1. The most common probiotic-producing lactic acid bacterium (Tamang et al 2016; Onyeaka et al., 2022)

Microorganisms	Strain names
<i>Lactobacillus</i> sp.	<i>Lactobacillus brevis</i> , <i>Lactobacillus fermentum</i> , <i>Lactobacillus delbrueckii</i> , <i>Lactobacillus plantarum</i> , <i>Lactobacillus lactis</i> , <i>Lactobacillus rhamnosus</i> , <i>Lactobacillus acidophilus</i> , <i>Lactobacillus reuteri</i> , <i>Lactobacillus casei</i> , <i>Lactobacillus curvatus</i> , <i>Lactobacillus paraplantarum</i> , <i>Lactobacillus johnsonii</i> , <i>Lactobacillus salivarius</i> , <i>Lactobacillus helveticus</i> , <i>Lactobacillus gasseri</i>
<i>Bifidobacterium</i> sp.	<i>Bifidobacterium longum</i> , <i>Bifidobacterium adolescentis</i> , <i>Bifidobacterium infantis</i> , <i>Bifidobacterium bifidum</i> , <i>Bifidobacterium thermophilum</i> , <i>Bifidobacterium breve</i> ,
<i>Pediococcus</i> sp.	<i>Pediococcus pentoseceus</i> , <i>Pediococcus acidilactici</i> <i>Pediococcus cerevisiae</i>
<i>Streptococcus</i> sp.	<i>Streptococcus intermedius</i> , <i>Streptococcus cremoris</i> , <i>Streptococcus diacetylactis</i> , <i>Streptococcus bovis</i> , <i>Streptococcus suis</i> , <i>Streptococcus lactis</i>
<i>Leuconostoc</i> sp.	<i>Leuconostoc mesenteroides</i> ssp. <i>mesenteroides</i> , <i>Leuconostoc. inhae</i> , <i>Leuconostoc kimchii</i>
<i>Enterococcus</i> sp.	<i>Enterococcus faecium</i> , <i>Enterococcus faecalis</i> , <i>Enterococcus durans</i>
<i>Propionibacterium</i> sp.	<i>Propionibacterium shermanii</i> , <i>Propionibacterium acidipropionici</i> , <i>Propionibacterium freudenreichii</i>
<i>Weissella</i> sp.	<i>Weissella confusa</i> , <i>Weissella cibaria</i> , <i>Weissella paramesenteroides</i> , <i>Weissella hellenica</i> , <i>Weissella kimchi</i>

Prebiotic Potential of Edible Mushrooms

The development of prebiotics is directed towards fungi, which contain carbohydrates, act as potential prebiotics and are also associated with various health-promoting effects (Abd Rahman et al., 2012). Because of its immunosuppressive properties, β -glucan from *Pleurotus* sp. (Pleuran) is utilized as a dietary supplement. Polysaccharides from oyster mushrooms can promote the growth of colonic microorganisms (probiotics), i.e. act as prebiotics. In the study of the structure and potential prebiotic activity of glucans obtained from *Pleurotus ostreatus* and *Pleurotus eryngii* species, oyster mushroom, a biologically active source of glucans, and *Lactobacillus*, *Bifidobacterium* and *Enterococcus* species were used. Specific glucans from the oyster mushroom were used as a carbon source. The polysaccharide composition of these mushroom extracts and the probiotic species showed different growth characteristics. It was reported that *Lactobacillus* species can be used symbiotically with glucan and proteoglucan obtained from *Pleurotus ostreatus* and *Bifidobacterium* species can be used symbiotically with *Pleurotus eryngii* extracts (Synytsya et al. 2009).

β -glucan is derived from a variety of sources, including the cell walls of bread yeast (*Saccharomyces cerevisiae*), cereals (oats and barley), and an array of mushroom species. A study of eight fungi revealed that *Schizophyllum commune* and *Auricularia auricula* exhibited the highest β -glucan content and the lowest cost per β -glucan content, respectively. Despite the established role of β -glucan in immune modulation, there is currently no evidence regarding its interaction with the human gut microbiota. It is hypothesized that the gut microbiota has healing effects through its interaction with indigestible components, particularly fermentable dietary fibre. It is crucial to establish a correlation between the specific microbial communities associated with β -glucan fermentation and the resulting profiles of short-chain fatty acids (SCFAs). Mushroom-derived β -glucan has been demonstrated to possess a prebiotic function that is comparable to that of β -glucan derived from commercial yeast (*S. cerevisiae*) (Chaikliang et al., 2015).

In a different investigation, the impact of polysaccharides from *Ganoderma lucidum* on *Bifidobacterium* species proliferation was ascertained. The prebiotic effect of *G. lucidum* extracts was determined using batch fermentation. It was found that mushroom extracts increased the number of *Bifidobacterium* species by 0.3 and 0.7 log₁₀ cell/mL units, and the number of *Lactobacillus* species by 0.7 and 1 log₁₀ cell/mL units, and inhibited the growth of *Salmonella*. The presence of *Bifidobacterium* species was found to increase the rate of organic acid formation in the environment (Yamin et al., 2012).



In the study in which the prebiotic effect of five different edible mushrooms (*Auricularia auricula-judae*, *Pleurotus ostreatus*, *Pleurotus sajorcaju*, *Pleurotus abalonus* and *Volvariella volvacea*) was investigated, the soluble and insoluble polysaccharides of the mushrooms were extracted. The bifidogenic effect was determined using the *Bifidobacterium bifidum* TISTR 2129, *B. breve* TISTR 2130, *B. longum* TISTR 2194 and *B. animalis* TISTR 2195 strains, and the prebiotic index values were subsequently measured. The highest prebiotic index number was observed in the *Pleurotus sajorcaju* mushroom, followed by the *Pleurotus abalonus* mushroom. It was reported that both mushroom species stimulated the growth of *Bifidobacterium* and *Lactobacillus* species in a human intestinal model and inhibited the growth of harmful bacteria (Saman et al., 2016).

Polysaccharides from *Lentinula edodes*, *Flammulina velutipes* and *Pleurotus eryngii* mushrooms were found to increase the viability of *Bifidobacterium longum*, *Lactobacillus casei* and *Lactobacillus acidophilus* at different concentrations in MRS medium. Mushroom polysaccharides were found to maintain the number of probiotics above 10^7 cfu/mL during storage in yoghurt cultures. The researchers noted that fungal polysaccharides are a cheaper source of raw materials for obtaining new prebiotic components. Liu et al. (2015) investigated the prebiotic properties and immune system supporting effects of *Ganoderma lucidum* residues during tea preparation. They used *G. lucidum* extracts in the diet of chickens. *G. lucidum* was found to stimulate the growth of *Lactobacillus rhamnosus* and *Bifidobacterium longum*. The probiotic activity of bifidobacteria in the feces of chickens was found to be significantly different from the control group. They concluded that *G. lucidum* waste has beneficial effects and can potentially be used in waste recycling.

It was established that *G. lucidum* extracts altered the composition of the intestinal microbiota and resulted in an increase in *Lactobacillus* species in comparison to the control group (Meneses et al., 2016). In a study in which *A. bisporus* mushrooms were fermented with *Lactobacillus plantarum* strains, a sensory analysis, colour analysis and total phenolic compound analysis were conducted. It was reported that mushrooms fermented with probiotic bacteria exhibited elevated phenolic component and antioxidant activity values (Jabłońska-Ryś et al., 2016).

A study was conducted to examine the growth of *Lactobacillus acidophilus* and *L. plantarum* in MRS broth medium containing mushroom extracts. Seven different edible mushroom extracts, including *Auricularia auricula-judae*, *Lentinus edodes*, *Pleurotus citrinopileatus*, *Pleurotus djamor*, *Pleurotus pulmonarius* and *Pleurotus ostreatus*, were investigated for their prebiotic properties. It was reported that the *L. edodes* extract had the greatest stimulatory effect on the growth of the probiotic bacteria, with the *L. acidophilus* and *P. pulmonarius* extracts demonstrating the most significant impact on the growth of *L. plantarum*. In the analysis of gastrointestinal tolerance of probiotics, the highest viability rate was observed in the *P. djamor* extract containing *L. acidophilus* (Sawangwan et al., 2018).

In the study in which the effect of *P. ostreatus* mushroom powder as a prebiotic on yoghurt quality was investigated, mushroom powder was incorporated into the yoghurt production process at concentrations of 0%, 0.5%, 1% and 1.5%. It was reported that the addition of mushroom powder resulted in an increase in lactic acid concentration and the number of lactic acid-producing bacteria (LAB) present (Tupamahu & Budiarmo, 2017). The highest viability of LAB was observed in samples containing 1.5% mushroom powder. In a further study, the prebiotic effect of three different edible mushroom species, namely *Pleurotus sajorcaju*, *P. florida* and *L. edodes*, was compared with that of a range of commercial prebiotics. The optimal prebiotic effect was observed in the medium containing *P. sajorcaju* mushroom, in which *L. acidophilus* was able to grow (Mallik & Bhawsar, 2018). In a study of 53 naturally occurring mushroom extracts, probiotic bacteria (*L. acidophilus* and *L. rhamnosus*) were used in comparison with commercial prebiotics, namely inulin and fructooligosaccharide. The results demonstrated that the tested fungi exhibited a greater capacity to stimulate the growth of *Lactobacillus* species than commercially used prebiotics. It has been demonstrated that mushroom polysaccharides are able to reach the intestine without undergoing alteration in the stomach, where they have been observed to stimulate the growth of beneficial bacteria (Nowak et al., 2018).

Conclusion

Probiotics and prebiotics are the most scientifically studied active ingredients due to their biotherapeutic properties. Among probiotics, *Bifidobacterium* and *Lactobacillus* species are bacteria that have become increasingly important due to their use as starter cultures in foods and in tablet form. The definition of the metabolic activities of these microorganisms and the study of their ability to grow in environments containing different carbohydrate sources has led to the definition of "potential prebiotic components". Due to the increasing demand for industrial foods such as dairy products, bakery products, beverages, sauces, confectionery, baby foods, etc. containing commercial prebiotic components, researchers and manufacturers are turning to the cheaper extraction of prebiotic components from natural materials found in nature.



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Socio-Economic Impact of Rice Mill Industry in the Selected Areas of Dinajpur District

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Abstract

The rice milling industry in Dinajpur District, Bangladesh, plays a crucial role in the local economy, given the region's substantial rice production and the central role of rice in the Bangladeshi diet. This study examines the socio-economic impact of rice mills in this region, considering both the benefits and challenges associated with the industry's growth. The research highlights that the rice milling industry significantly contributes to economic growth, employment generation, and poverty alleviation. It provides direct and indirect job opportunities, enhancing income levels and living standards for many households. However, the industry also poses environmental challenges and socio-economic issues, including poor working conditions, job insecurity, low wages, and gender discrimination. The study's objectives include understanding the industry's socio-economic impact, assessing income generation, and evaluating the socio-economic status of mill employees. Data collection involved both primary and secondary sources, with a sample of 245 employees from Dinajpur's sadar upazila. Analysis using descriptive statistics and OLS regression revealed significant findings, such as the positive impact of job patterns on income and the negative effect of higher education levels. The study concludes with recommendations for enhanced support systems for migrant workers, better job and training opportunities, addressing gender disparities, and ensuring fair compensation for extended working hours. These insights aim to inform policymakers and stakeholders to promote sustainable and inclusive development in Dinajpur's rice milling sector.

Keywords: Rice mill, socio-economic impact, employment, migrant workers, mill employee

Introduction

Milling of rice is an important activity in food chain of the world economies. Rice feeds more than a third of the world's population; the predominant staple food in about 33 countries of the world including Bangladesh (Okoye et al., 2017). Rice is dominant food item as Bangladeshi people eat this meals three times in a day. Per capita rice consumption in Bangladesh is 400 grams daily which is the highest in the world (thedailystar, 2021). Besides this to understand the industrial dynamic of Dinajpur district we must look on rice mill as there is no others dominant industrial activities. However, major sources of this rice production in Bangladesh is Dinajpur District. So many rice mill have been developed in region considering the rice production. In the early days, rice milling in Dinajpur was primarily carried out by traditional methods, where farmers processed their own paddy using simple tools and manual labor. With the passage of time and advancements in technology, the rice milling industry experienced significant changes. In the 1980s and 1990s, the government of Bangladesh implemented policies and programs to promote the modernization of the rice milling sector. As a result, the number of rice mills in Dinajpur expanded, and more advanced machinery and equipment were introduced (Dr. M. A. Awal, 2013). The district became a hub for rice processing, with numerous large-scale and mechanized rice mills established. This growth has led to socio-economic changes in the region, both positive and negative.

The socio-economic impact of the rice mill industry in Dinajpur District has far-reaching implications for various stakeholders, including mill owners, workers, farmers, consumers, and the local community. Understanding these impacts is crucial for policymakers, development practitioners, and industry players to formulate effective strategies, policies, and interventions that promote sustainable development and address potential challenges. On the positive side, the rice mill industry contributes to economic growth and employment generation. The industry provides direct and indirect employment opportunities for a significant number of people, ranging from mill workers to transporters and suppliers. It boosts income levels, improves livelihoods, and stimulates local markets and business activities. The increased economic activity associated with the industry has the potential to alleviate poverty, reduce gender discrimination and enhance the standard of living for many households. However, the rapid expansion of the rice mill industry also poses certain challenges and potential negative impacts. Environmental concerns arise due to the discharge of wastewater, solid waste generation, and the consumption of energy resources.



There is a need for comprehensive research focusing on its socio-economic impact. Such research would provide a deeper understanding of the industry's effects on employment, income distribution, poverty alleviation, environmental sustainability, and social well-being. The findings of this study will provide valuable insights for policymakers to design strategies and policies that maximize the positive impacts and mitigate the negative consequences of the industry.

Problem Statement

The problem this research seeks to address is the need to comprehensively assess and understand the socio-economic impact of the rice mill industry in the selected areas of Dinajpur District. While the industry has experienced significant growth and has the potential for positive contributions to the local economy, there are concerns and challenges that need to be identified and mitigated. The research aims to provide insights into the specific socio-economic issues associated with the industry's expansion, such as income generation, environmental sustainability, social changes, and policy effectiveness.

By conducting an in-depth analysis of these problems, the research aims to inform policymakers, industry stakeholders, and local communities about the potential impacts and identify opportunities for sustainable development. The research seeks to generate evidence-based recommendations and strategies that can address the identified issues and maximize the positive socio-economic impact of the rice mill industry while minimizing any negative consequences. Ultimately, the research aims to contribute to informed decision-making and the formulation of policies and interventions that promote inclusive growth, equitable distribution of benefits, environmental sustainability, and social well-being in the selected areas of Dinajpur District.

Scope or Rationale of the Project :

The rationale for conducting this project lies in the need to address the knowledge gap and provide a comprehensive understanding of the socio-economic impact of the rice mill industry in the selected areas of Dinajpur District.

Firstly, there is a lack of research specifically focusing on the social and economic consequences of the industry's growth. While technical and environmental aspects have been explored, a comprehensive analysis of the industry's effects on employment, backward and forward linkages, poverty alleviation, environmental sustainability, and social dynamics is necessary.

Secondly, the project aims to generate empirical evidence and insights that can contribute to the existing literature. By examining the socio-economic impact of the rice mill industry, the project will enhance our understanding of its broader implications.

Thirdly, the project's scope aligns with the development priorities of Bangladesh. Sustainable and inclusive growth, poverty reduction, environmental conservation, and balanced regional development are key focus areas for the country. Understanding the socio-economic impact of the rice mill industry is crucial for achieving these development goals and ensuring equitable distribution of benefits.

By addressing these factors, the project will provide valuable insights into the socio-economic challenges and opportunities associated with the rice mill industry. The findings will help policymakers and industry stakeholders to formulate strategies and interventions that promote sustainable and inclusive growth, while addressing potential challenges in the selected areas of Dinajpur District. The purpose of this study is to formulate policies considering the problems that need to be addressed.

Objective(s) of the project

- Understanding of the socio-economic impact of the rice mill
- Assess the income generation potential of the rice mill industry in the selected areas of Dinajpur District.
- Assess the socio status of the employee of the mill
- Find out the forward and backward linkage of this industry.
- Understanding the gender dimension in this industry.

Brief review of works already performed or in progress elsewhere

Kabir (2017) found that the expansion of fully automated rice mills has outpaced semi-automatic and husking mills, creating more employment opportunities. Women contribute to about 34% of the workforce during the peak season. However, rice mill workers, mostly young and with low education, face challenges such as poor working conditions, job insecurity, low wages, and gender-based discrimination. Their average monthly income falls well



below the poverty line, with women earning only 69% of men's wages. Addressing these issues is crucial to improve the socio-economic conditions of rice mill workers.

(Rahman & Hasan, 2011) scrutinized the impact of women's contribution to household income on poverty reduction, identify factors influencing family income among farm and rice mill laborers, and highlight the challenges they face in Bochagonj Upazila of Dinajpur district. The area was purposefully chosen due to its high concentration of farm and rice mill laborers. The findings indicated that women's involvement in farm and rice mill work positively affected their educational attainment, land ownership, and household assets. Family expenditure patterns remained consistent but increased over time, indicating a positive impact on poverty levels. Factors such as age, family size, land ownership, number of earning members, and individual income significantly influenced income and employment levels among laborers.

The study revealed major problems related to the nature of the work and gender-based wage disparities. Both male and female laborers faced challenges associated with the nature of their work, while women experienced lower wages compared to men. This wage disparity had a substantial impact on the income and financial well-being of female laborers. Despite contributing a relatively small amount, women's contribution to household income played a significant role in improving socio-economic conditions and reducing poverty levels.

(Dr. M. A. Awal, 2013) study showed that discrimination based on gender in terms of wage rates is prevalent in the rice milling industry. Regarding employment opportunities for daily wage laborers, automatic rice mills with modern equipment have a higher utilization capacity, utilizing approximately 5925 man-days per year. In comparison, other rice mills, including semi-automatic rice mills and husking mills, have lower utilization ranging from 2232 to 3120 man-days per year. Automatic rice mills with modern equipment provided the most employment opportunities for salaried staff, with a total of 6205 man-days per year. This was followed by automatic rice mills without modern equipment, which offered 5840 man-days per year. Semi-automatic rice mills with modern equipment provided 1460 man-days per year, while semi-automatic rice mills without modern equipment and husking mills offered the lowest number of employment opportunities, with 1095 man-days per year.

There is various study have been conducted on rice market but very few on rice mills. Previous studies have explored the economic impact of the rice mill industry in various countries, but there is a lack of systematic research specifically focusing on the rice mill industry in Bangladesh. This current study aims to fill this gap and provide valuable insights into the socio-economic contribution of the rice mill industry in the local economy and surrounding communities. The findings of this study will generate significant knowledge and information that can be utilized at both micro and macro levels. This research will be particularly beneficial for government organizations, NGOs, and policymakers as they can utilize the findings to formulate appropriate policies and make informed decisions regarding the rice mill industry in Bangladesh.

Methodologies

Study Areas

The study areas for this project were focused on selected regions within Dinajpur District. These areas were chosen based on their significant presence and impact of the rice mill industry. The specific study areas might include major rice mill clusters that had a high concentration of rice mills. These areas served as primary study sites to understand the socio-economic dynamics and impacts of the industry. Surrounding agricultural communities who were involved with the rice mill also included in the study. We incorporated the employee of these rice miles.

Determination of Sample Size

Determination of the sample size followed a proportionate to size sampling methodology as specified by Kothari (2004) and is calculated as:

$$N = \frac{Z^2 pq}{e^2} \quad (1)$$

Where;

N = Sample size in number.

Z² = Confidence level at 95% (standard value of 1.96).

p = This was an assumption that 80% of respondent experienced positive impact of rice mill in the study area.

q = This is the weighting variable given by (1- P).

e² = Margin of error at 5% (standard value of 0.05).

By putting values we have

$$N = \frac{(1.96)^2 (0.80)(0.20)}{(0.05)^2}$$

$$N = 245$$

Thus our sample size is 245 employees of rice mill in selected areas of Dinajpur district.



Data Collection

Data were collected from both primary and secondary sources. The sample consists of 245 randomly selected employees from sadar upazila of Dinajpur. The questionnaire were prepared in Bangla and the data collectors ask the respondents in local language for their understanding and then was put the collected information in questionnaire using language. The study were conducted during 2023-24 fiscal year. The responses of the respondents that were recorded in the interview schedule were transferred into a master sheet for entering the data in the computer. Data analysis were then done by using computer software packages like Microsoft Excel, STATA (Version15.0) and various descriptive statistical measures (i.e., sum, average, percentages, ratios, standard deviation etc.) were employed to examine the objectives of this study and explain the present condition of the socio-economic implications of the rice mill industry. Tabular analysis was included socioeconomic characteristics of sample respondents.

Model Specification

For first objective, this study was used the descriptive statistics, graphs and tables based on both primary and secondary collected data. The second objective of this study is to estimate the impact of rice mill on the socio-economics conditions which is measured by income of rice mill employee. To attain this objective, an OLS regression model will be run for analysis. By using OLS regression, we effectively analyzed the relationships between income and the independent variables while benefiting from its linearity assumption, unbiased estimation, efficiency, interpretability, and the widespread acceptance of this method in the field. The regression equation is a statistical model that allows us to understand the relationship between the dependent variable (income) and several independent variables. The equation is as follows:

$$\ln(\text{Income}) = \beta_0 + \beta_1 \ln(\text{Job pattern}) + \beta_2 \ln(\text{Education Level}) + \beta_3 \ln(\text{age}) + \beta_4 \ln(\text{Gender}) + \beta_5 \ln(\text{Experience}) + \beta_6 \ln(\text{Working hours}) + \beta_7 \ln(\text{Training}) + \varepsilon$$

- β_0 represents the intercept term, which captures the baseline income level when all independent variables are zero. It represents the expected income when an individual has no job level, education, technology adoption, skill, age, gender or health status.
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$ are the regression coefficients associated with each independent variable. They indicate the change in income for a unit change in the corresponding independent variable, holding other variables constant. For example, β_1 represents how much income is expected to change for each unit increase in job level, assuming the other variables remain constant.
- Job Level refers to the hierarchical position or level of the job within the firm. It represents the vertical advancement or seniority of individuals within the organization.
- Education Level indicates the level of education attained by individuals. It captures the impact of education on income.
- Technology Adoption measures the extent to which individuals or the firm have embraced and implemented technology in their work processes.
- Skill of Labor represents the level of skill possessed by individuals.
- Age refers to the age of individuals. It captures the influence of age on income, considering that income may change as individuals gain more experience or progress in their careers.
- Health Status represents an indicator of individuals' overall health condition. It reflects the impact of health on income levels, as health can affect work capacity and productivity.
- Gender represents a binary variable indicating the gender of the individual (e.g., 0 for male, 1 for female)
- Here we take the natural logarithm ($\ln$) of the dependent variable (income) and/or the independent variables that is log-log model to show the elasticity of all respective variables.

By estimating the regression coefficients ($\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, \beta_7$) using statistical techniques, we can determine the magnitude and direction of the relationship between each independent variable and income. The coefficients indicate how changes in job level, education level, technology adoption, skill, age, gender and health status relate to changes in income. By analyzing the regression results, we can gain insights into the factors that significantly influence income levels, which can be useful for understanding the socio-economic dynamics.



Table 1. Measurement of variables

Variable Type	Variables	Measurement
Dependent	Income	Income of the employees are measured in BDT.
Independent Variables	Job pattern	Job pattern is measured as dummy where 1 for full time and 0 for part-time
	Education Level	Educational level is measured as years of schooling
	Age	Age of the respondent is measured in years
	Gender	Gender is measured as dummy where 1 for male and 0 for female
	Experience	Experience is measured as years working in rice mills
	Working hours	Working hours is measured as hours
	Training	Training received is measured as dummy where 1 for yes and 0 for no

Result and Discussion

Gender status of household head of the respondents

Figure 1 illustrates the distribution of household heads by gender among the respondents. It shows two categories: male and female, with their respective percentages.

- **Male:** 75% of the respondents reported that the head of their household is male. This indicates that a significant majority of the households are led by males.
- **Female:** 25% of the respondents reported that the head of their household is female. This suggests that a smaller proportion of households are headed by females compared to males.

Overall, the figure 1 highlights a gender disparity in the leadership of households among the respondents, with a predominant male representation.

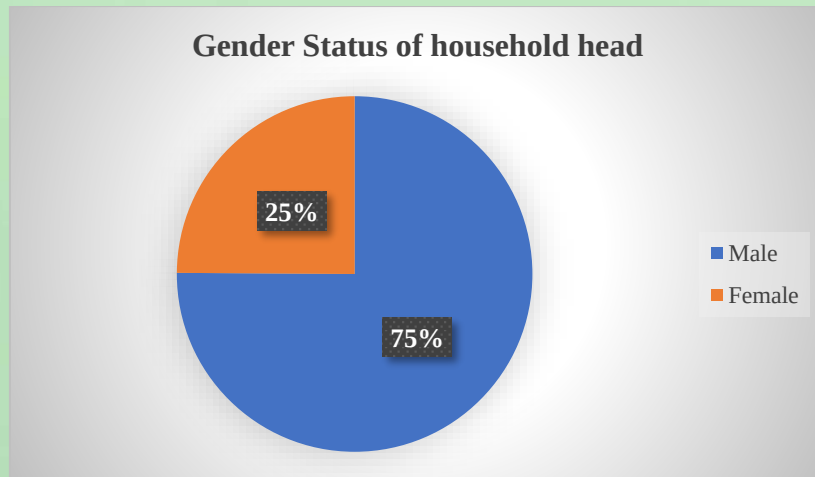


Figure 1. Gender status of household head of the respondents

Respondents' age distribution

The table 2 illustrates the age distribution of the respondents, showing that the majority are middle-aged, with 36.33% falling in the 35 to 50 years range, followed by 31.84% in the 20 to 35 years range. This indicates a significant representation of young and middle-aged adults. A smaller proportion of respondents are older adults, with 19.59% aged 50 to 65 years and only 4.08% over 65 years. The youngest age group, below 20 years, constitutes 8.16% of the respondents. Overall, the data suggests a diverse age demographic with a notable emphasis on the middle-aged population.

Table 2. Respondents' age distribution

Age range	Frequency	%
below 20	20	8.163265
>20 to 35 years	78	31.83673
>35 to 50 years	89	36.32653
>50 to 65 years	48	19.59184
>65 years	10	4.081633
Total	245	100.00



Educational status of the respondents

This table 3 presents the educational status of the respondents, categorized into different levels of education, along with their frequencies and percentages:

- **No formal education:**
 - 33 respondents (13.47%) have no formal education.
- **Primary education:**
 - 93 respondents (37.96%) have completed primary education, making it the most common level of education among the respondents.
- **SSC (Secondary School Certificate):**
 - 72 respondents (29.39%) have completed secondary school, representing a significant portion of the respondents.
- **HSC (Higher Secondary Certificate):**
 - 41 respondents (16.73%) have completed higher secondary education.
- **Hons (Honors degree):**
 - 4 respondents (1.63%) hold an honors degree, showing a much smaller group with higher education.
- **MS or above:**
 - 2 respondents (0.82%) have attained a master's degree or higher, indicating the least common level of education among the respondents.

The table 3 highlights that the majority of respondents have completed primary education (37.96%), followed by those with secondary education (29.39%) and higher secondary education (16.73%). A smaller proportion has no formal education (13.47%), while those with higher education degrees (Hons or MS and above) constitute a very small percentage of the respondents (2.45% combined). This suggests that while primary and secondary education levels are relatively high, the percentage of respondents with higher education is quite low.

Table 3. Educational status of the respondents

Educational status	Frequency	%
No formal education	33	13.46939
Primary education	93	37.95918
SSC	72	29.38776
HSC	41	16.73469
Hons	4	1.632653
MS or above	2	0.816327
Total	245	100

Household size of the respondents

The table 4 illustrates the household size of the respondents, showing that the majority, 71.84%, belong to nuclear families with 2 to 5 members. Childless families, consisting of 2 members, make up 4.89% of the respondents, while joint or extended families with more than 5 members account for 23.27%. The total number of respondents is 245. The household sizes range from a minimum of 2 to a maximum of 14 members, with an average (mean) household size of 4.72 members. This data indicates that most respondents live in smaller, nuclear family units, with a significant portion also residing in larger, extended family settings.

Table 4. Household size of the respondents

Household members	Frequency	%	Min	Max	Mean
Childless family (2family members)	12	4.89	2	14	4.72
Nuclear Family (2 to 5family members)	176	71.84			
Joint or extended family (>5 family members)	57	23.27			
Total	245	100			

Income distribution of the respondents

The table 5 details the income distribution of the respondents, showing that nearly half (48.57%) earn between 10,000 and 25,000 BDT. A smaller group, 18.78%, falls into the 25,000 to 40,000 BDT range, while 15.51% earn between 40,000 and 55,000 BDT. Those earning above 55,000 BDT make up 11.02%, and the lowest income group, earning below 10,000 BDT, comprises 6.12% of the respondents. The total number of respondents is 245, with incomes ranging from a minimum of 7,400 BDT to a maximum of 62,000 BDT, and an average income of 21,300 BDT. This data indicates a significant concentration of respondents in the lower-middle-income bracket.



Table 5. Income distribution of the respondents

Income range (in BDT.)	Frequency	%	Min	Max	Average
below 10000	15	6.122449	7400	62000	21300
>10000 to 25000	119	48.57143			
>25000 to 40000	46	18.77551			
>40000 to 55000	38	15.5102			
>55000	27	11.02041			
Total	245	100			

Migration status of the respondents

The table shows the migration status of the respondents, revealing that a substantial majority, 68.98%, have migrated from other places specifically to work in auto rice mills. In contrast, 31.02% of the respondents have not migrated and are presumably local residents. The total number of respondents is 245. This data highlights that most individuals working in auto rice mills have moved from different locations for their employment, while a significant portion of the workforce consists of locals who have not migrated. This is also shown in figure 2.

Table 6. Migration status of the respondents

Migration status	Frequency	%
Migrated from other place to work in Auto rice mills	169	68.97959
Not migrated	76	31.02041
Total	245	100.00

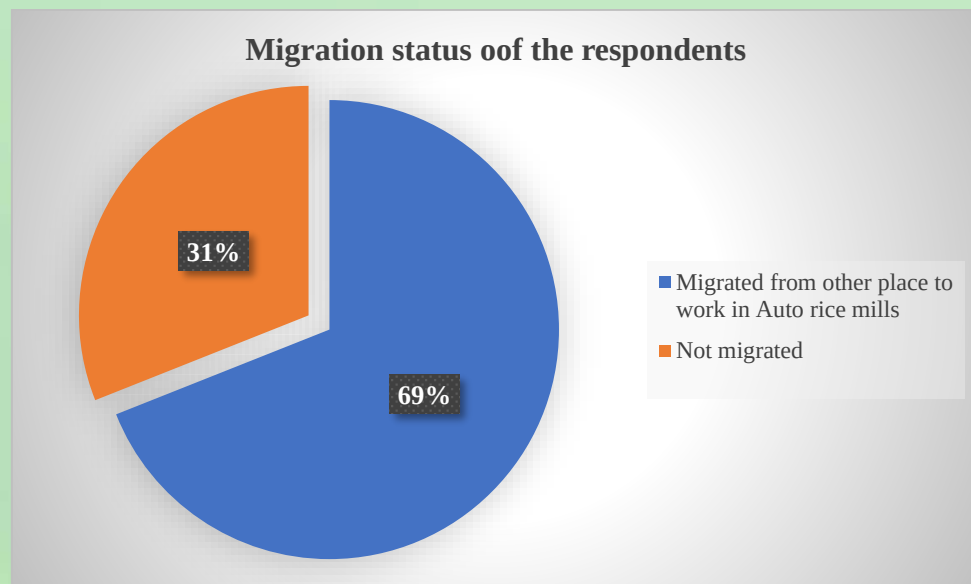


Figure 2. Migration status of the respondents

Job patterns of the respondent

The table 7 outlines the job patterns of the respondents, showing that a majority, 68.49%, are employed full time, while 35.59% hold part-time positions. With a total of 245 respondents, the data reveals a clear predominance of full-time employment among the workers, indicating that most individuals have committed, long-term jobs, whereas a smaller portion works part-time.

Table 7. Job patterns of the respondent

Job patterns	Frequency	%
Part time employee	87	35.59
Full time employee	158	68.49
Total	245	100.00

Working hours spent by the respondents in auto rice mills

The table 8 presents the distribution of working hours among respondents in auto rice mills, showing that 33.46% work more than 12 hours a day, making this the most common category. Additionally, 29.80% of respondents work 12 hours daily, while 25.31% work 10 hours daily, which includes 2 hours of overtime. A smaller group,



11.43%, works the standard 8-hour shift. The total number of respondents is 245, with working hours ranging from a minimum of 8 hours to a maximum of 18 hours per day, and an average (mean) of 12.37 hours. This data indicates that a significant portion of the workforce experiences long working hours, with a substantial number engaged in extreme working conditions.

Table 8. Working hours spent by the respondents in auto rice mills

Working hours	Frequency	%	Min	Max	Mean
Normal (8 hours)	28	11.43	8	18	12.37
Moderate (Normal+2 hours Overtime=10 hr)	62	25.31			
Highly involved (Normal+ 4 hours Overtime=12 hr)	73	29.80			
Extreme case (>12 hours)	82	33.46			
Total	245	100			

Problem facing index of the respondents due to migration

The table 9 presents an index of problems faced by respondents due to migration, ranked by severity based on their scores. The most significant issue, ranked 1, is the lack of support from government or non-government organizations, with a high score of 639. Following this, 2nd rank concerns include inadequate credit facilities, scoring 553, and 3rd rank problems involve a lack of livelihood capitals, with a score of 548. Food-related issues are also prominent, with "We do not have enough food" at 4th place with a score of 474, and "Clothing problem" at 5th place with a score of 449. "Lack of job facility" and "Our children did not get nutritional food" are ranked 6th and 7th, respectively. Problems like "Education of children is negatively affected" and "Societal acceptance problems" rank lowest, with scores of 283 and 300, indicating that they are less severe in comparison. Overall, the table highlights that respondents face various challenges due to migration, with the lack of support and credit facilities being the most pressing issues.

Table 9. Problem facing index of the respondents due to migration

Problems faced due to migration	High	Moderate	Low	No	Score	Rank
1. Our children did not get nutritional food	74	52	81	38	407	7
2. Lack of livelihoods capitals	125	69	35	16	548	3
3. We do not get any support from government or non-government organization or others	192	28	7	18	639	1
4. Clothing problem	70	73	93	9	449	5
5. We do not have enough food	92	52	94	7	474	4
6. Education of children is negatively affected	31	83	24	107	283	10
7. Not enough credit facility	126	64	47	8	553	2
8. Lack of job facility	94	39	64	48	424	6
9. Shelter or accommodation problem	63	42	59	81	332	8
10. Societal acceptances problem	71	30	27	117	300	9

Estimated result of OLS

The table 10 summarizes key statistics from a regression model, revealing that the mean of the dependent variable is 10.835 with a standard deviation of 0.450. The model's R-squared value is 0.250, indicating that 25% of the variance in the dependent variable is explained by the independent variables in the model. With a total of 245 observations, the F-test statistic is 11.287, and the associated p-value of 0.000 signifies that the model as a whole is statistically significant. Additionally, the Akaike Information Criterion (AIC) is 248.577 and the Bayesian Information Criterion (BIC) is 276.588, which are used for model selection where lower values generally indicate a better-fitting model. Overall, these results suggest that while the model explains a quarter of the variance in the dependent variable and is statistically significant, the AIC and BIC values provide metrics for comparing the model against others for potential improvement.

The table 10 presents the results from a linear regression analysis focusing on two variables: job pattern and education level. The job pattern variable has a coefficient of 0.136 with a standard error of 0.026, a t-value of 5.18, and a p-value of 0.00, indicating a statistically significant positive impact on the dependent variable. This suggests that changes in job patterns are strongly associated with increases in the dependent variable. On the other hand, the education level variable has a coefficient of -0.218 with a standard error of 0.058, a t-value of -3.75, and a p-value of 0.00, signifying a statistically significant negative effect on the dependent variable. This implies that higher education levels are associated with decreases in the dependent variable. Both variables are highly significant, as denoted by the *** (three asterisks) in the significance column.

The table 10 shows the regression results for two variables: age and gender. The age variable has a coefficient of 0.08, a standard error of 0.063, a t-value of 1.28, and a p-value of 0.202, indicating that age is not a significant predictor of the dependent variable, as the p-value is above the typical significance threshold of 0.05. In contrast, the gender variable has a coefficient of 0.202, a standard error of 0.091, a t-value of 2.21, and a p-value of 0.028,



demonstrating a significant positive effect on the dependent variable. This suggests that gender is a meaningful predictor, with the positive coefficient indicating that being of a particular gender is associated with an increase in the dependent variable.

The table 10 presents the results of a regression analysis for four variables: experience, working hours, training, and the constant term. The experience variable has a coefficient of 0.066 with a standard error of 0.075, a t-value of 0.88, and a p-value of 0.38, indicating that experience is not a significant predictor of the dependent variable. Similarly, the training variable has a coefficient of 0.067, a standard error of 0.071, a t-value of 0.94, and a p-value of 0.348, suggesting that training also does not significantly affect the dependent variable. However, working hours has a coefficient of 0.058, a standard error of 0.014, a t-value of 4.05, and a p-value of 0.00, which indicates a statistically significant positive effect on the dependent variable. Lastly, the constant term has a coefficient of 10.377 with a standard error of 0.085, a t-value of 122.36, and a p-value of 0.00, confirming that the constant term is highly significant in the model. Overall, the results show that only working hours have a significant impact on the dependent variable, while experience and training do not.

Table 10. Estimated result of OLS

Variables	Coefficients	St.Err.	t-value	p-value	Sig
Job pattern	0.136	0.026	5.18	00	***
Education Level	-0.218	0.058	-3.75	00	***
Age	0.08	0.063	1.28	0.202	
Gender	0.202	0.091	2.21	0.028	**
Experience	0.066	0.075	0.88	0.38	
Working hours	0.058	0.014	4.05	00	***
Training	0.067	0.071	0.94	0.348	
Constant	10.377	0.085	122.36	00	***
Extra statistics					
Mean dependent var	10.835	SD dependent var		0.450	
R-squared	0.250	Number of obs		245	
F-test	11.287	Prob > F		0.000	
Akaike crit. (AIC)	248.577	Bayesian crit. (BIC)		276.588	
*** $p<.01$, ** $p<.05$, * $p<.1$					

Test of multicollinearity and heteroskedasticity

The table 11 presents the results of a multicollinearity test for various variables in a regression model. The Variance Inflation Factor (VIF) values and their reciprocals (1/VIF) are shown for each variable to assess multicollinearity. The job pattern variable has the highest VIF of 2.230, indicating a moderate level of multicollinearity, while education level and age have VIF values of 1.750 and 1.540, respectively, which are also relatively low but higher than the other variables. The remaining variables, including gender (1.320), experience (1.100), working hours (1.070), and training (1.030), have VIF values below 2, suggesting minimal multicollinearity. The mean VIF across all variables is 1.430, which is well below the common threshold of 10, indicating that multicollinearity is not a significant issue in this model. Overall, the results suggest that multicollinearity is generally low among the variables tested.

Table 11. Multicollinearity test

Variables	VIF	1/VIF
Job pattern	2.230	0.449
Education Level	1.750	0.570
Age	1.540	0.651
Gender	1.320	0.759
Experience	1.100	0.910
Working hours	1.070	0.938
Training	1.030	0.973
Mean VIF	1.430	

The table displays the results of the Breusch–Pagan/Cook–Weisberg test for heteroskedasticity in a regression model. The chi-squared statistic is 0.05, with a p-value of 0.81. Since the p-value is much greater than the common significance level of 0.05, the test fails to reject the null hypothesis. This indicates that there is no significant evidence of heteroskedasticity, meaning that the variance of the errors in the model is consistent across different levels of the independent variables. In conclusion, the test results suggest that the assumption of constant variance of the error terms is satisfied in the regression model.



Table 12. Test for heteroskedasticity

Test name	chi2	Prob > chi2	Decision
Breusch-Pagan/Cook-Weisberg test	0.05	0.81	Constant variance

Discussion

The findings from this study offer valuable insights into various aspects of the demographic and employment characteristics of individuals working in auto rice mills. The gender distribution of household heads reveals a significant male dominance, with 75% of respondents reporting male household heads, highlighting a clear gender imbalance in household leadership roles. This gender disparity reflects broader societal patterns where men predominantly occupy leadership positions, which may impact the social dynamics and decision-making processes within these households.

The analysis of the problems faced by respondents due to migration, as shown in Table 9, reveals significant insights into the hardships experienced by workers in auto rice mills. The data indicates that the most pressing issue for migrants is the lack of support from government or non-government organizations, with a high severity score of 639. This finding underscores a critical gap in the support structures available to migrant workers, suggesting that the current systems are inadequate in addressing their needs. This observation aligns with previous research that highlights the challenges faced by migrants due to the insufficient support from institutional frameworks (Anderson et al., 2024; Gupta and Kanungo, 2022). Following the lack of support, inadequate credit facilities are identified as the second most severe issue, with a score of 553. This challenge reflects broader systemic problems where access to financial resources is limited for migrant workers, potentially impeding their ability to invest in their livelihoods or manage financial emergencies. This finding is consistent with studies that emphasize the barriers to financial inclusion faced by low-income workers (Rai & O'Brien, 2018). The third most significant issue is a lack of livelihood capitals, with a score of 548. Livelihood capitals, such as social, financial, and human capital, are crucial for sustaining a migrant's well-being and economic stability. The deficit in these capitals highlights a need for more comprehensive support systems that provide not only immediate assistance but also long-term resources for migrants (Ellis, 2000). Food insecurity, reflected by the problem "We do not have enough food," ranks fourth with a score of 474. This issue indicates that a considerable number of migrants struggle to meet basic needs, which is a serious concern for their overall health and productivity. Similarly, "Clothing problem" ranks fifth, with a score of 449, pointing to the inadequacies in meeting basic living standards. Interestingly, issues such as the negative impact on children's education and societal acceptance problems rank lower in severity compared to the more immediate concerns of food, clothing, and credit facilities. This suggests that while these issues are present, they may not be as urgent as the immediate survival concerns of migrants. This finding supports the view that immediate survival needs often overshadow longer-term concerns in migration contexts (Firlana & Mastur, 2023).

The regression analysis presented in Table 10 offers a comprehensive view of the relationships between several factors and the dependent variable, which reflects various outcomes related to the respondents' experiences in the auto rice mills. The positive coefficient of 0.136 for job pattern with a p-value of 0.00 indicates that full-time employment is associated with higher values of the dependent variable. This suggests that full-time employee's experience outcomes that are more favorable compared to part-time employees. This finding supports the notion that full-time positions offer greater stability and benefits, which can contribute to improved overall conditions for workers (Barth, 2018). The negative coefficient of -0.218 for education level, also statistically significant, implies that higher levels of education are associated with lower values of the dependent variable. This could reflect a potential mismatch between higher education qualifications and the job opportunities available in the auto rice mills, where educational qualifications may not translate into better job outcomes. This observation is in line with the "degree inflation" phenomenon where higher qualifications do not necessarily lead to better job prospects in certain sectors (Murnane et al., 2006). The positive coefficient of 0.202 for gender, with a significance level of 0.028, indicates that being of a particular gender has a significant effect on the dependent variable. This suggests that gender may play a role in determining the experiences or outcomes of the respondents, potentially reflecting gender-specific roles or expectations in the workplace (Klasen, 2008). The variable for working hours shows a positive coefficient of 0.058 with a p-value of 0.00, indicating that longer working hours are associated with higher values of the dependent variable. This finding implies that increased working hours may lead to better outcomes or greater returns for workers, which could be due to the nature of the work or compensation structures in the auto rice mills (Jongen et al., 2014). The analysis shows that age, experience, and training are not significant predictors of the dependent variable. The lack of significance for age and experience suggests that these factors do not have a substantial impact on the outcomes measured in this study. Similarly, training does not appear to affect the dependent variable, which might indicate that the current training programs are ineffective or that additional training does not necessarily improve job outcomes (Dearden et al., 2006).



Implications and Recommendations

The findings from both the problem index and the regression analysis point to several key implications and recommendations:

- **Enhanced Support Systems:** There is a clear need for improved support mechanisms for migrants, including better access to financial services, livelihood capitals, and basic needs. Policymakers and organizations should focus on creating more robust support systems that address both immediate and long-term needs of migrant workers.
- **Job and Training Opportunities:** Expanding job opportunities and improving the effectiveness of training programs could help align workers' qualifications with job market demands. Ensuring that educational achievements are recognized and rewarded in the workplace is crucial for improving job satisfaction and outcomes.
- **Addressing Gender Disparities:** The significant impact of gender on outcomes suggests a need for gender-sensitive policies and practices in the workplace. Efforts should be made to address any gender-based inequalities and to create a more inclusive work environment for all employees.
- **Work Hours and Compensation:** The positive association between working hours and the dependent variable highlights the importance of fair compensation and working conditions. Employers should consider fair compensation structures that reflect the number of hours worked and the demands of the job.

In conclusion, the study provides valuable insights into the challenges faced by migrants and the factors influencing their experiences in the auto rice mills. Addressing these challenges through targeted policies and interventions can improve the conditions for migrant workers and enhance their overall well-being.

Conclusion

In conclusion, the rice milling industry in Dinajpur District has proven to be a vital economic driver, contributing significantly to employment and income generation. The shift towards automated rice mills has particularly enhanced productivity and provided better employment opportunities compared to traditional mills. These developments have positively impacted local livelihoods and contributed to poverty alleviation. Despite these promising results, several limitations were identified in the study. One of the primary limitations is the gender disparity in wages, where women are consistently paid less than their male counterparts. Additionally, working conditions in many mills remain suboptimal, with long working hours and inadequate safety measures posing significant risks to workers' health and well-being. Another limitation is the lack of comprehensive support for migrant workers, who often face precarious living conditions and limited access to essential services. The study also highlights the need for more robust data collection and analysis to better understand the industry's full impact and to develop more targeted interventions. The limited scope of the study, focusing primarily on economic indicators, suggests that further research incorporating social and environmental dimensions is necessary to provide a more holistic assessment of the industry's impacts. Addressing these limitations requires a multi-faceted approach, including the implementation of stricter labor regulations, initiatives to close the gender wage gap, improvements in workplace safety, and enhanced support systems for migrant workers. By tackling these issues, stakeholders can ensure the sustainable and equitable development of the rice milling industry, ultimately benefiting all members of the community.

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Determinants of Food Security and Dietary Diversity Among Small Scale Rice Farmers in Dinajpur District of Bangladesh

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Abstract

Agriculture plays a crucial role in food security and economic stability in developing nations like Bangladesh by enhancing food availability and household income. The study examines the socioeconomic conditions of 399 small scale rice farmers, analyzing factors such as age, education, household size, farm size, and access to markets, credit, and agricultural information. Results indicate that larger household sizes negatively impact dietary diversity, while both income diversification (measured by the Simpson Diversification Index) and crop diversification (measured by the Crop Diversification Index) positively affect dietary diversity and reduce food insecurity. Specifically, income diversification shows a significant positive correlation with dietary diversity but also a slight increase in food insecurity, possibly due to reliance on diverse low-income sources. Crop diversification significantly enhances dietary diversity and decreases food insecurity. Key determinants of food security include household size, income and crop diversification, market access, and agricultural information. Membership in organizations and proximity to markets also influence food security, highlighting the complex interplay of various socioeconomic factors. The findings emphasize the importance of diversified farming practices and income sources in improving food security among small-scale farmers. This study provides insights into policy interventions needed to support agricultural diversification and socioeconomic development in rural Bangladesh.

Keywords: *Crop Diversification, Dietary Diversity Score (DDS), Food Security, Rice Farmers*



Socio-Economic Impact and Profitability of Litchi Cultivation in Bangladesh: Challenges, Opportunities, and Policy Recommendations

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Abstract

Litchi cultivation in Bangladesh, particularly concentrated in regions like Dinajpur, contributes significantly to the agricultural sector and rural economy. This study explores the socio-economic impact of litchi cultivation, focusing on its role in income generation, employment creation, and community development. Litchi, a prized subtropical fruit, faces challenges such as limited market access, post-harvest losses, and inadequate storage facilities. Despite these challenges, litchi remains a profitable venture for small-scale farmers, as evidenced by its high demand and market value. Using primary data collected from 120 respondents in Dinajpur district, this research employs descriptive and econometric analyses to assess the profitability and socio-economic conditions of litchi farmers. Results indicate that litchi cultivation offers substantial economic returns, with a net profit estimated at Tk. 379,747 per acre per season. Moreover, the study identifies key factors influencing litchi farming, including land tenure, access to credit, and participation in cooperatives. The findings underscore the need for strategic interventions to enhance litchi production and marketing. Policy recommendations include investments in infrastructure development, such as modern storage facilities and improved transportation networks, to minimize post-harvest losses and ensure fair market prices. Furthermore, promoting diversification into value-added litchi products and strengthening farmer cooperatives can enhance market stability and profitability. This study contributes valuable insights into the socio-economic dynamics of litchi cultivation in Bangladesh, providing a basis for policy formulation and strategic planning to sustainably enhance the sector's contribution to rural livelihoods and national economic growth.

Keywords: Litchi, litchi production, profitability, socio-economic conditions, Bangladesh





Antihyperglycemic potential of (2E)-3-Phenyl-1-(3-pyridinyl)-2-propen-1-one in alloxanized hyperglycemic rats

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Abstract

Diabetes mellitus is a life threatening disorder due to defects in insulin secretion, action or both. The present study was designed to explore and evaluate the antidiabetic activity of synthetic derivative of chalcone named (2E)-3-Phenyl-1-(3-pyridinyl)-2-propen-1-one. In this study, fifty albino rats were divided into five groups, each containing ten rats. Diabetes was induced by single administration of alloxan monohydrate intraperitoneally (130mg/kg). After induction of diabetes, group 1 was marked as negative control, group 2 as diabetic group, and group 3 was treated with synthetic antidiabetic drug glibenclamide (10mg/kg). Group 4 and group 5 were treated with graded doses (5ml/kg and 10ml/kg) of synthetic research compound respectively. Treatment continues for whole month. Physical parameters were recorded during parameters. After four weeks of treatment, and all groups were subjected to decapitation. Serum and tissues samples were collected. Serum analysis was performed. Resulting data was investigated and subjected to ANOVA and DMR. Histopathological examination was conducted and photomicrographs were investigated. On the basis of histopathological and biochemical analysis, it is concluded that chalcone derivative possess strong antioxidant and antihyperglycemic activity. Statistical report of data confirmed that results are significance ($P < 0.05$).

Keywords:



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Energy equivalent potential of olive (*Olea europaea* L.), which forms a raw material for agricultural biomass energy

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Abstract

The sustainability of energy sources has been among the world's most important issues from past to present. Existing fossil energy sources are limited and cause significant environmental damage. Consequently, interest in renewable energy sources continues to increase. Biomass energy is one of the primary sources used to provide energy sustainably without harming the environment. Biomass is obtained from various sources such as specially cultivated plants, algae, grasses, agricultural residues, forest products, industrial waste, and animal manure. This study aims to determine the olive biomass energy potentials in Türkiye between the years 2014 and 2023. For this purpose, separate calculations were made for Türkiye in general and for the regions and compared with each other. The average dry biomass energy values were found to be as follows: Aegean Region (5.137,10 TEP; 59,75 MW), Marmara Region (1.881,59 TEP; 21,88 MW), Mediterranean Region (1.666,63 TEP; 19,38 MW), Southeastern Anatolia Region (948,30 TEP; 11,03 MW), Central Anatolia Region (29,05 TEP; 0,34 MW), and Black Sea Region (3,19 TEP; 0,04 MW). It was determined that the Aegean (53.15%), Marmara (19.48%), and Mediterranean (17.23%) regions have a significant share in Türkiye's average olive-based agricultural biomass energy equivalent of 9.665,86 TEP; 117,42 MW.

Key Words: Heating value, Amount of agricultural land, Agricultural dry biomass, Renewable energy, Olive

Tarımsal biyokütle enerjisine hammadde oluşturan zeytinin (*Olea europaea* L.) enerji eşdeğer potansiyeli

Özet

Enerji kaynaklarının sürdürülebilirliği, geçmişten günümüze kadar dünyanın en önemli meseleleri arasında yer almıştır. Mevcut fosil enerji kaynakları sınırlıdır ve çevreye ciddi ölçüde zararları vardır. Bundan dolayı yenilenebilir enerji kaynaklarına olan ilgi artarak devam etmektedir. Enerjinin çevreye zarar vermeden sürdürülebilir bir şekilde sağlanabilmesi için başvurulacak kaynakların başında biyokütle enerjisi bulunmaktadır. Biyokütle, özel olarak yetiştirilen bitkiler, yosunlar, otlar, algler, tarımsal atıklar, orman ürünleri, sanayi atıkları ve hayvan gübreleri gibi çeşitli kaynaklardan elde edilmektedir. Bu çalışmada, Türkiye'nin 2014-2023 yılları arasındaki zeytin biyokütle enerji potansiyellerinin belirlenmesi amaçlanmıştır. Bu amaçla Türkiye geneli ve bölgeler için ayrı ayrı hesaplamalar yapılmış ve birbirleriyle karşılaştırılmıştır. Ortalama kuru biyokütle enerji değerleri sırasıyla, Ege Bölgesi (5.137,10 TEP; 59,75 MW), Marmara Bölgesi (1.881,59 TEP; 21,88 MW), Akdeniz Bölgesi (1.666,63 TEP; 19,38 MW), Güneydoğu Anadolu Bölgesi (948,30 TEP; 11,03 MW), İç Anadolu Bölgesi (29,05 TEP; 0,34 MW) ve Karadeniz Bölgesinde (3,19 TEP; 0,04 MW) tespit edilmiştir. Türkiye'nin ortalama 9.665,86 TEP; 117,42 MW'lık zeytine dayalı tarımsal biyokütle enerji eşdeğerinde Ege (%53.15), Marmara (%19.48) ve Akdeniz (%17.23) Bölgeleri'nin önemli bir paya sahip olduğu saptanmıştır.

Anahtar Kelimeler: Isıl değer, Tarımsal alan miktarı, Tarımsal kuru biyokütle, Yenilenebilir enerji, Zeytin

Giriş

İnsanlık için enerji, olmazsa olmaz bir gereksinimdir. Dünya nüfusunun artması ve teknolojinin ilerlemesiyle birlikte yaşam standartlarının yükselmesi, enerji ihtiyacını günbegün artırmaktadır (Kuş vd., 2016). Birincil enerji kaynaklarının rezervler olarak sınırlı olması, enerji ihtiyacının sürekli ve hızlı bir şekilde artması, çevre koruma bilincinin gelişmesi, yakıt fiyatlarındaki artış, nüfus artışı, endüstrileşme, iklim değişikliği sorunu, hava kirliliği, asit yağmurları, mevcut yakıtların çevre üzerindeki olumsuz etkileri insanları farklı yeni kaynaklar bulmaya zorlamış, yenilenebilir enerji kaynaklarının yeni enerji teknolojileri kapsamında kullanılmasını zorunlu hale getirmiştir (Demir vd., 2017).



Uluslararası Yenilenebilir Enerji Ajansı (IRENA) tarafından belirtildiği üzere, yenilenebilir enerji; sürdürülebilir bir şekilde yenilenebilir kaynaklardan elde edilen her türlü enerjiyi içerir. Bunlardan birisi de biyokütle enerjisidir (Anonim, 2024).

Doğal maddelerin ana bileşenleri karbonhidrat bileşikleridir. Bunlar hayvansal ve bitkisel kökenlidir. Bu doğal maddeler biyokütle enerjisi olarak adlandırılır; elde edilen enerji ise biyokütle enerjisi olarak tanımlanır (Öztürk Tophanecioğlu, 2009). Biyokütle oluşumunun ilk adımı fotosentezdir. Güneş ışınları, yeşil bitkilerin klorofilleri tarafından emilir ve bitkiler için karbonhidrat (CH₂O) oluşturmada su ve karbondioksit kullanılır; bu süreçte bitkilerin biyokütle kaynağı sürekli olarak yenilenir ve gelişir (Yeşilkaya, 2017).

Çeşitli ülkeler kendi ekolojik koşullarına uygun, ekonomik tarımsal ürünlerden alternatif enerji kaynakları elde etmek için çaba sarf etmektedirler. Türkiye de bu potansiyele, coğrafi konuma, ekolojik yapıya ve yenilenebilir enerji kaynaklarını etkin bir şekilde kullanabilme imkanlarına sahip olan ülkeler arasındadır (Demir vd., 2017). Biyokütlenin yenilenebilir niteliği, iklim ve çevre korumasına katkısı, ısı ve elektrik üretimi ile akaryakıt olarak kullanılabilmesi, onu stratejik bir enerji kaynağı olarak değerli kılar (Ünal ve Alibaş, 2002). Bu kapsamda hububat, mısır, şekerpancarı, patates, yağlı tohum bitkileri ve zeytincilik atıkları önemli biyokütle hammaddeleridir (Topal ve Arslan, 2008). 2022 yılı zeytincilik verilerine göre dünyada 2.976.000 ton üretim ile Türkiye ikinci sırada yer almaktadır (FAOSTAT, 2024). Ayrıca 2023 yılı verilerine göre Türkiye’de 903.061 ha alanda zeytin yetiştiriciliği yapılmaktadır (TÜİK, 2024). Bu nedenle, zeytin budama artıkları ve çekirdek biyokütlesi oldukça önemli miktarda bulunmaktadır.

Bu çalışmada, Türkiye’de tarımsal faaliyetler sonucunda açığa çıkan ve biyokütle enerjisine hammadde oluşturan zeytinin enerji eşdeğer potansiyeli bölgeler bazlı belirlenerek, Türkiye için elde edilen veri setleriyle karşılaştırılmıştır.

Materyal ve Yöntem

Tarımsal biyokütle enerjisine hammadde oluşturan zeytinin enerji eşdeğer potansiyeli bölgeler bazında belirlenmiş olup, Türkiye geneli verileri ile oransal olarak karşılaştırmalarının ortaya konması amacıyla gerçekleştirilen bu çalışma kapsamında, Türkiye İstatistik Kurumunun (TÜİK) son on yıllık (2014-2023) zeytin üretim miktarları ve dikim alanı verilerinden faydalanılmıştır (TÜİK, 2024). Üretimin yapıldığı alanlar (A) hektar olarak belirlenmiştir. Her bir bölge için ortalama kuru biyokütle miktarları ve ortalama biyokütle enerji potansiyelleri hesap edilmiştir. Hesaplamalar Kurt ve Nacar Koçer (2010)’e göre yapılmıştır; bir hektar tarladan yılda ortalama olarak 25-30 ton kuru biyokütle elde edildiği ve kuru biyokütlenin ısı değeri 3800-4300 kcal/kg arasında değiştiği dikkate alınmıştır. 1 kcal değeri 10⁻⁷ TEP (Ton Eşdeğer Petrol); 1 TEP 0,01163 MW (Megawatt) olarak değerlendirilmiştir. Buna göre her bir yılda üretilebilecek ortalama kuru biyokütle miktarı (OKBM), ortalama kuru biyokütle ısı değeri (OKBID) ve ortalama kuru biyokütle enerji değerinin (OKBED) belirlenmesinde Eşitlik 1; 2; 3; 4’de verilen formüller aracılığıyla hesaplanmıştır (Topal ve Arslan Topal, 2012).

$$OKBM = ((25+30)/2) \times A \quad (1)$$

$$OKBID = OKBM \times ((3800+4300)/2) \quad (2)$$

$$OKBED_{(TEP)} = OKBID \times 1.10^{-7} \quad (3)$$

$$OKBED_{(MW)} = OKBED_{(TEP)} \times 0,01163 \quad (4)$$

Ayrıca bölgelere göre zeytinden elde edilen ortalama kuru biyokütle enerji değerinin oransal dağılımının (OD) hesaplanmasında Eşitlik 5’de verilen formül kullanılmıştır (Topal ve Arslan Topal, 2012). Örneğin 2020 yılında Akdeniz Bölgesi’nin OKBED_(MW)’nin oransal dağılımı şu şekilde hesaplanmıştır (Eşitlik 5);

$$2020 \text{ yılı Akdeniz Bölgesi'nin OD (\%)} = \frac{2020 \text{ yılı Akdeniz Bölgesinin OKBED}_{(MW)}}{2020 \text{ yılı Türkiye'nin toplam OKBED}_{(MW)}} \times 100 \quad (5)$$

Bulgular ve Tartışma

Akdeniz Bölgesi (AB), Ege Bölgesi (EB), Güneydoğu Anadolu Bölgesi (GAB), İç Anadolu Bölgesi (İAB), Karadeniz Bölgesi (KB) ve Marmara Bölgesi (MB)’ne ait on yıllık (2014-2023) zeytin dikili alan miktarı Tablo 1’de detaylı olarak verilmiştir (TÜİK, 2024). TÜİK (2024) verilerine göre Doğu Anadolu Bölgesi (DAB)’nde son on yılda zeytin dikili alan bulunmamaktadır. Bundan dolayı çalışma altı bölge üzerinden gerçekleştirilmiştir. Verilere göre son on yılda zeytin yetiştiriciliği önemli derecede artmıştır. Türkiye genelinde zeytin dikili alan 826.091,5 ha’dan 903.061,1 ha’a yükselmiştir. En büyük zeytin dikili alan ortalama 461.243,43 ha ile Ege Bölgesi’nde bulunurken, en küçük alan 286,53 ha ile Karadeniz Bölgesi’nde bulunmaktadır.



Tablo 1. Bölgelere göre zeytin yetiştiriciliği yapılan alanların yıllara göre dağılımı (ha)

Yıllar/Bölgeler	AB	EB	GAB	İAB	KB	MB	TÜRKİYE
2014	137.427,8	441.488,8	79.224,8	2.239,4	297,1	165.413,6	826.091,5
2015	139.545,0	449.107,0	80.381,1	2.262,6	280,4	165.358,5	836.934,6
2016	141.297,7	455.537,8	80.902,0	2.276,3	278,4	165.249,8	845.542,0
2017	141.094,0	453.115,0	81.547,7	2.304,0	274,2	167.727,0	846.061,9
2018	148.566,2	459.516,4	84.193,6	2.362,6	274,9	169.514,6	864.428,3
2019	155.201,4	464.664,6	86.226,4	2.453,1	275,0	170.355,7	879.176,5
2020	157.427,5	467.768,9	88.264,2	2.479,3	263,9	170.872,9	887.076,8
2021	158.024,9	468.413,9	89.223,6	2.608,8	283,0	170.613,4	889.167,7
2022	158.609,4	476.179,6	90.446,9	3.540,7	318,6	172.030,3	901.126,1
2023	159.223,5	476.642,3	91.034,1	3.558,9	319,8	172.281,9	903.061,1
<i>Ortalama</i>	<i>149.641,74</i>	<i>461.243,43</i>	<i>85.144,44</i>	<i>2.608,57</i>	<i>286,53</i>	<i>168.941,77</i>	<i>867.866,65</i>

Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle miktarı hesaplandığında Türkiye’de 2014 yılında toplam 22.717.516,25 ton, 2023 yılında ise 24.834.163,75 ton ortalama kuru biyokütle miktarı olduğu tespit edilmiştir. Zeytin atık ve artıklarının son on yılda %9.32 oranında arttığı saptanmıştır. Söz konusu miktara en fazla katkıyı 12.684.194,33 ton ile Ege Bölgesi sağlamıştır. Karadeniz Bölgesi ise 7.879,58 ton ile en az katkıyı sağlayan bölge olmuştur (Tablo 2).

Tablo 2. Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle miktarı (ton)

Yıllar/Bölgeler	AB	EB	GAB	İAB	KB	MB	TÜRKİYE
2014	3.779.264,5	12.140.942,0	2.178.682,0	61.583,5	8.170,3	4.548.874,0	22.717.516,3
2015	3.837.487,5	12.350.442,5	2.210.480,3	62.221,5	7.711,0	4.547.358,8	23.015.701,5
2016	3.885.686,8	12.527.289,5	2.224.805,0	62.598,3	7.656,0	4.544.369,5	23.252.405,0
2017	3.880.085,0	12.460.662,5	2.242.561,8	63.360,0	7.540,5	4.612.492,5	23.266.702,3
2018	4.085.570,5	12.636.701,0	2.315.324,0	64.971,5	7.559,8	4.661.651,5	23.771.778,3
2019	4.268.038,5	12.778.276,5	2.371.226,0	67.460,3	7.562,5	4.684.781,8	24.177.345,5
2020	4.329.256,3	12.863.644,8	2.427.265,5	68.180,8	7.257,3	4.699.004,8	24.394.609,3
2021	4.345.684,8	12.881.382,3	2.453.649,0	71.742,0	7.782,5	4.691.868,5	24.452.109,0
2022	4.361.758,5	13.094.939,0	2.487.289,8	97.369,3	8.761,5	4.730.833,3	24.780.951,3
2023	4.378.646,3	13.107.663,3	2.503.437,8	97.869,8	8.794,5	4.737.752,3	24.834.163,8
<i>Ortalama</i>	<i>4.115.147,9</i>	<i>12.684.194,3</i>	<i>2.341.472,1</i>	<i>71.735,7</i>	<i>7.879,6</i>	<i>4.645.898,7</i>	<i>23.866.328,2</i>

Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle ısı değeri hesaplandığında Türkiye’de 2014 yılında toplam 92.005.940.813 kcal/kg, 2023 yılında ise 100.578.363.188 kcal/kg ortalama kuru biyokütle ısı değeri olduğu belirlenmiştir. Ortalama kuru biyokütle ısı değeri miktarına en fazla katkıyı 51.370.987.016 kcal/kg ile Ege Bölgesi sağlarken, Karadeniz Bölgesi ise 31.912.279 kcal/kg ile en az katkıyı sağlamıştır (Tablo 3).

Tablo 3. Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle ısı değeri (kcal/kg)

Y/B	AB	EB	GAB	İAB	KB	MB	TÜRKİYE
2014	15.306.021.225	49.170.815.100	8.823.662.100	249.413.175	33.089.513	18.422.939.700	92.005.940.813
2015	15.541.824.375	50.019.292.125	8.952.445.013	251.997.075	31.229.550	18.416.802.938	93.213.591.075
2016	15.737.031.338	50.735.522.475	9.010.460.250	253.522.912	31.006.800	18.404.696.475	94.172.240.250
2017	15.714.344.250	50.465.683.125	9.082.375.088	256.608.000	30.539.025	18.680.594.625	94.230.144.113
2018	16.546.560.525	51.178.639.050	9.377.062.200	263.134.575	30.616.988	18.879.688.575	96.275.701.913
2019	17.285.555.925	51.752.019.825	9.603.465.300	273.214.013	30.628.125	18.973.366.088	97.918.249.275
2020	17.533.487.813	52.097.761.238	9.830.425.275	276.132.038	29.391.863	19.030.969.238	98.798.167.463
2021	17.600.023.238	52.169.598.113	9.937.278.450	290.555.100	31.519.125	19.002.067.425	99.031.041.450
2022	17.665.121.925	53.034.502.950	10.073.523.488	394.345.463	35.484.075	19.159.874.663	100.362.852.563
2023	17.733.517.313	53.086.036.163	10.138.922.888	396.372.488	35.617.725	19.187.896.613	100.578.363.188
<i>Ortalama</i>	<i>16.666.348.793</i>	<i>51.370.987.016</i>	<i>9.482.962.005</i>	<i>290.529.484</i>	<i>31.912.279</i>	<i>18.815.889.634</i>	<i>96.658.629.210</i>

Y/B: Yıllar/Bölgeler

Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değeri hesaplandığında ise, Türkiye’de 2014 yılında toplam 9.200,59 TEP, 2023 yılında ise 10.057,83 TEP ortalama kuru biyokütle enerji değeri olduğu tespit edilmiştir. Ortalama kuru biyokütle enerji değeri miktarına en fazla katkıyı 5.137,10 TEP ile Ege Bölgesi sağlarken, Karadeniz Bölgesi ise 3,19 TEP ile en az katkıyı sağlamıştır (Tablo 4).



Tablo 4. Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değeri (TEP)

Yıllar/Bölgeler	AB	EB	GAB	İAB	KB	MB	TÜRKİYE
2014	1.530,60	4.917,08	882,37	24,94	3,31	1.842,29	9.200,59
2015	1.554,18	5.001,93	895,24	25,20	3,12	1.841,68	9.321,35
2016	1.573,70	5.073,55	901,05	25,35	3,10	1.840,47	9.417,22
2017	1.571,43	5.046,57	908,24	25,66	3,05	1.868,06	9.423,01
2018	1.654,66	5.117,86	937,71	26,31	3,06	1.887,97	9.627,57
2019	1.728,56	5.175,20	960,35	27,32	3,06	1.897,34	9.791,83
2020	1.753,35	5.209,78	983,04	27,61	2,94	1.903,10	9.879,82
2021	1.760,00	5.216,96	993,73	29,06	3,15	1.900,21	9.903,11
2022	1.766,51	5.303,45	1.007,35	39,43	3,55	1.915,99	10.036,28
2023	1.773,35	5.308,60	1.013,89	39,64	3,56	1.918,79	10.057,83
Ortalama	1.666,63	5.137,10	948,30	29,05	3,19	1.881,59	9.665,86

Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değeri ele alındığında Türkiye’de 2014 yılında toplam 107,01 MW, 2023 yılında ise 116,97 MW ortalama kuru biyokütle enerji değeri olduğu saptanmıştır. Ortalama kuru biyokütle enerji değeri miktarına en fazla katkısı her zamanki gibi 59,75 MW ile Ege Bölgesi sağlarken, Karadeniz Bölgesi 0,04 MW ile en az katkısı sağlamıştır (Tablo 5).

Tablo 5. Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değerini (MW)

Yıllar/Bölgeler	AB	EB	GAB	İAB	KB	MB	TÜRKİYE
2014	17,80	57,19	10,26	0,29	0,04	21,43	107,01
2015	18,08	58,17	10,41	0,29	0,04	21,42	108,41
2016	18,30	59,01	10,48	0,29	0,04	21,40	109,52
2017	18,28	58,69	10,56	0,30	0,04	21,73	109,60
2018	19,24	59,52	10,91	0,31	0,04	21,96	111,98
2019	20,10	60,19	11,17	0,32	0,04	22,07	113,89
2020	20,39	60,59	11,43	0,32	0,03	22,13	114,89
2021	20,47	60,67	11,56	0,34	0,04	22,10	115,18
2022	20,54	61,68	11,72	0,46	0,04	22,28	116,72
2023	20,62	61,74	11,79	0,46	0,04	22,32	116,97
Ortalama	19,38	59,75	11,03	0,34	0,04	21,88	112,42

Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değerinin oransal dağılımı değerlendirildiğinde Türkiye’de (T) en fazla katkısı %53.15 ile Ege Bölgesi sağlarken, Karadeniz Bölgesi ise %0.04 ile en az katkısı sağlamıştır (Tablo 6). Bölgeler yaptıkları katkılara göre büyükten küçüğe doğru, Ege Bölgesi (%53.16), Marmara Bölgesi (%19.48), Akdeniz Bölgesi (%17.23), Güneydoğu Anadolu Bölgesi (%9.81), İç Anadolu Bölgesi (%0.30) ve Karadeniz Bölgesi (%0.04) şeklinde sıralanmaktadır.

Tablo 6. Bölgelere göre zeytinden elde edilebilecek ortalama kuru biyokütle enerji değerinin oransal dağılımı (%)

Yıllar/Bölgeler	AB/T	EB/T	GAB/T	İAB/T	KB/T	MB/T
2014	16,63	53,44	9,59	0,27	0,04	20,03
2015	16,68	53,66	9,60	0,27	0,04	19,76
2016	16,71	53,88	9,57	0,26	0,04	19,54
2017	16,68	53,55	9,64	0,27	0,04	19,83
2018	17,18	53,15	9,74	0,28	0,04	19,61
2019	17,65	52,85	9,81	0,28	0,04	19,38
2020	17,75	52,74	9,95	0,28	0,03	19,26
2021	17,77	52,67	10,04	0,30	0,03	19,19
2022	17,60	52,84	10,04	0,39	0,03	19,09
2023	17,63	52,78	10,08	0,39	0,03	19,08
Ortalama	17,23	53,16	9,81	0,30	0,04	19,48

Baklagiller, endüstriyel bitkiler, tahıllar, yem bitkileri, yağlı tohumlar, yumru bitkiler (Topal ve Arslan Topal, 2012); çeltik (Akçay, 2014); meyveler, sebzeler, tahıllar, yağlı tohumlar, kuru baklagiller (Demir vd., 2015); tarla bitkileri, sebzeler, meyveler, yem bitkileri (Kuş vd., 2016); ceviz (Demir vd., 2017); buğday, arpa, mısır, ayçiçeği, pamuk, şekerpancarı (Polat, 2021) konuları üzerinde araştırmacılar tarafından benzer çalışmalar yapılmıştır. Araştırmacıların bulguları ile bulgularımız bir arada değerlendirildiğinde veri setlerimiz benzerlik göstermemektedir. Bunun sebebi bitki tür ve çeşitlerinin farklı olmasından kaynaklanmaktadır.



Sonuç ve Öneriler

Türkiye için elde edilen bulgular kapsamında, zeytin atık ve artıklarından elde edilebilecek ortalama kuru biyokütle enerji değeri 9665,86 TEP veya 112,42 MW'ye denk gelmektedir. Bu potansiyelin yarıdan fazlası (%53.15) Ege Bölgesi'nden, geri kalanı (%46.85) ise diğer bölgelerden elde edilmektedir. Türkiye, enerji alanında önemli ölçüde dışa bağımlıdır. Ülkemizin enerji konusundaki dışa bağımlılığını minimuma indirmek ve sürdürülebilir bir kalkınma modeli sağlamak için biyokütle enerjisi başta olmak üzere diğer yenilenebilir enerji kaynaklarına geçilip bu kaynaklar aktif olarak kullanılmalı, yenilenebilir enerjinin gelişimi hakkında politikalar geliştirilip, uygulanmalıdır. Gerek ülke genelinde gerek bölgesel bazda gerekse de iller bazında biyokütle enerjisinden optimum seviyede faydalanabilmek için geleneksel kullanımın haricinde modern sistemlerin kullanıldığı ve biyoenerji dönüşümünün sağlandığı tesislerin kurulumu için fizibilite çalışmalarının yapılması zaruri hale gelmiştir. Türkiye, iklim koşulları, güneşlenme, su kaynakları, alan kullanılabilirliği, coğrafi yapısı itibarı ile tarım ülkesi olmasından dolayı tarımsal biyokütle enerjisine hammadde oluşturacak farklı ürünlerin yetiştirilmesi potansiyeline sahiptir. Bu zengin potansiyelin varlığı ile bölgesel kalkınmaya buna bağlı olarak istihdama yapacağı katkı düşünüldüğünde bu konunun ele alınması önem arz etmektedir.

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Usage of Artificial Intelligence in Agriculture

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Abstract

This study investigates the application of various artificial intelligence (AI) techniques in agriculture. The materials used consist of plant leaf images, field images, agricultural production data and climate data obtained from agricultural research institutes and open access databases. The AI techniques applied in this study include fuzzy logic for modeling uncertain data, artificial neural networks for tasks such as disease classification and energy consumption estimation, genetic algorithms for optimization problems, expert systems for diagnosing agricultural problems and ant algorithms for path optimization. The methodology includes several main steps. First, data needs to be collected and preprocessed for AI model training. In this step, the data collection and preparation process is of great importance. In the second step, it is aimed to apply various AI methods to specific agricultural problems. In the third step, the training of the models on training datasets and the evaluation of their performance on test datasets with metrics such as accuracy and F1 score are carried out. Finally, the results are analyzed and interpreted. In this step, the focus is on the analysis of model performance, discussion of successful findings and highlighting the advantages and disadvantages of AI techniques in agricultural applications. The study demonstrates an approach to comprehensively use AI to increase productivity in agriculture, optimize resource use, and improve decision-making processes in agricultural practices.

Keywords: Artificial Intelligence (AI), Agriculture, Fuzzy Logic, Genetic Algorithms, Expert Systems

Tarımda Yapay Zeka Kullanımı

Özet

Bu çalışma, tarımda çeşitli yapay zeka (YZ) tekniklerinin uygulanmasını araştırmaktadır. Kullanılan materyaller, tarım araştırma enstitülerinden ve açık erişim veri tabanlarından elde edilen bitki yaprağı görüntüleri, tarla görüntüleri, tarımsal üretim verileri ve iklim verilerinden oluşmaktadır. Bu çalışmada uygulanan YZ teknikleri arasında belirsiz verilerin modellenmesi için bulanık mantık, hastalık sınıflandırma ve enerji tüketimi tahmini gibi görevler için yapay sinir ağları, optimizasyon problemleri için genetik algoritmalar, tarımsal sorunların teşhisi için uzman sistemler ve yol optimizasyonu için karınca algoritmaları yer almaktadır. Metodoloji birkaç ana adımı içermektedir. İlk olarak, YZ model eğitimi için verilerin toplanması ve ön işlenmesi gerekmektedir. Bu adımda, veri toplama ve hazırlama süreci büyük önem taşımaktadır. İkinci adımda, belirli tarımsal problemlere yönelik çeşitli YZ yöntemlerinin uygulanması hedeflenmektedir. Üçüncü adımda, eğitim veri setlerinde modellerin eğitilmesi ve test veri setlerinde performanslarının doğruluk ve F1 skoru gibi metriklerle değerlendirilmesi gerçekleştirilmektedir. Son olarak, sonuçların analizi ve yorumu yapılmaktadır. Bu aşamada, model performansının analizi, başarılı bulguların tartışılması ve tarımsal uygulamalarda YZ tekniklerinin avantaj ve dezavantajlarının vurgulanması üzerinde durulmaktadır. Çalışma, tarımda verimliliği artırmak, kaynak kullanımını optimize etmek ve tarımsal uygulamalarda karar verme süreçlerini iyileştirmek amacıyla YZ'nin kapsamlı bir şekilde kullanılmasına yönelik bir yaklaşım sergilemektedir.

Anahtar kelimeler: Yapay Zeka (YZ), Tarım, Bulanık Mantık, Yapay Sinir Ağları (YSA), Genetik Algoritmalar, Uzman Sistemler

Introduction

One of the two fundamental changes in human history is the "Agricultural Revolution," and the other is the "Industrial Revolution," which significantly reduced the population engaged in agriculture and increasingly transformed humans into service and manufactured goods producers (Güran, 1990). The latest link in this chain of changes is artificial intelligence technologies, which represent the pinnacle of modern science. Artificial intelligence is related to mimicking natural systems like humans and animals using human-made tools such as computers and robots. This method involves understanding how to represent knowledge—especially uncertain and imprecise knowledge—so that it can be stored in computer memory and automatically inferred from. It also



includes understanding how to make decisions based on stored knowledge, how to create action plans, and how to acquire processable knowledge in computers by learning from examples or questioning human experts (Borgelt and Kruse, 2006). AI systems are machines enhanced with abilities related to human intelligence such as acquiring information, perceiving, learning, thinking, and decision-making, by examining and formulating mental functions related to intelligence through computer models and applying them to different systems (Bozüyük et al., 2005). AI methods used in artificial intelligence applications are grouped as follows (Alpaydın, 2004):

- **Classification:** Determining which class new data belongs to when the classes of past data are specified.
- **Clustering:** Separating data into clusters based on similarities when the classes of past data are not specified or unknown.
- **Regression (Curve Fitting):** Creating a curve model from continuous numerical values of past data.
- **Feature Selection:** Identifying features that determine the class of data when there is an abundance of past data. This can involve creating a subset of existing features or forming new features from their combination.
- **Association Rule Learning:** Analyzing the co-occurrence of data to identify the most frequent associations.

AI Applications in Agriculture

In agriculture, AI techniques are being extensively used to increase efficiency, optimize resource use, and improve decision-making processes. The materials used for these AI applications include plant leaf images, field images, agricultural production data, and climate data obtained from agricultural research institutes and open-access databases.

Key AI Techniques in Agriculture

- **Fuzzy Logic:** Fuzzy logic is employed for modeling and interpreting uncertain data. In agriculture, it can help in determining irrigation needs, evaluating plant health, and managing soil conditions. For example, fuzzy logic systems can analyze soil moisture levels and environmental factors to decide when and how much to water crops, ensuring optimal growth conditions and water conservation.
- **Artificial Neural Networks:** These are used for tasks such as disease classification, yield prediction, and energy consumption forecasting. Neural networks can process vast amounts of agricultural data, identifying patterns and correlations that may not be immediately apparent. For instance, neural networks can detect early signs of plant diseases from leaf images, allowing for timely interventions that can save entire crops from destruction.
- **Genetic Algorithms:** Genetic algorithms are utilized for solving complex optimization problems in agriculture. They can optimize planting schedules, resource allocation, and even the design of irrigation systems. By simulating the process of natural selection, genetic algorithms find the most efficient solutions to problems that involve numerous variables and constraints.
- **Expert Systems:** Expert systems are designed to mimic the decision-making abilities of human experts. In agriculture, they can diagnose plant diseases, recommend treatments, and guide farmers in best practices for crop management. These systems use a knowledge base of agricultural expertise and can provide farmers with instant, reliable advice, reducing the dependency on human experts and minimizing delays in decision-making.
- **Ant Algorithms:** Inspired by the behavior of ants, these algorithms are used for path optimization and resource distribution. In agriculture, ant algorithms can optimize the routes of agricultural machinery, ensuring that fields are covered efficiently with minimal fuel consumption. They can also be used to manage the logistics of food distribution, ensuring that fresh produce reaches markets in the shortest possible time.

Materials and Methods

Materials

This study utilized a range of datasets, algorithms, and computational resources to investigate the application of artificial intelligence techniques in agriculture. The details of the materials used are as follows:

- **Datasets:**
 - **Plant Leaf Images:** Images of various plant leaves, including healthy and diseased leaves, were collected from the PlantVillage dataset (<https://plantvillage.psu.edu/>) and other agricultural research institutions.
 - **Field Images:** A collection of field images depicting various crop types and agricultural scenarios was sourced from the Kaggle database (<https://www.kaggle.com/datasets>).



- **Agricultural Production Data:** Data on crop yields, production volumes, and historical agricultural trends were obtained from the FAO (Food and Agriculture Organization) database (<https://www.fao.org/faostat/en/#data>).
- **Climate Data:** Weather and climate data relevant to agricultural conditions, such as temperature, precipitation, and humidity, were acquired from the NOAA (National Oceanic and Atmospheric Administration) database (<https://www.noaa.gov/>).
- **Software and Algorithms:**
 - **Programming Language:** Python was used for data analysis and model development.
 - **Libraries and Frameworks:** TensorFlow, Keras, Scikit-learn, and OpenCV were utilized for building and training models, performing image processing, and conducting data analysis.
 - **Development Tools:** Jupyter Notebook and PyCharm were employed for writing and executing the code.
- **Computer Hardware:**
 - **Hardware Specifications:** High-performance computing resources with NVIDIA GPUs (e.g., RTX 3090) were used for model training and evaluation to handle large datasets and complex computations.
- **Literature Sources:**
 - Previous Studies: Relevant publications and research articles were reviewed to gain insights into existing applications of AI in agriculture. Sources include journals like *Computers and Electronics in Agriculture* and *Agricultural Systems*.

Methods

The study was structured into several phases, each with specific techniques and processes. The following describes these methods in detail:

Data Collection and Preparation

- **Data Collection:**
 - **Plant Leaf Images:** A total of 10,000 images of 14 different plant species, with labels for healthy and diseased conditions, were collected.
 - **Field Images:** 5,000 images of various crop types and growth stages were gathered.
 - **Agricultural Production Data:** Historical data from 2000 to 2022 for different crops, including yield, price, and production area, were compiled.
 - **Climate Data:** Monthly climate data for the past 10 years, including temperature, precipitation, and humidity, were collected.
- **Data Preprocessing:**
 - **Data Cleaning:** Images were resized to 256x256 pixels. Data entries with missing or inconsistent values were corrected or removed.
 - **Normalization:** Numerical data were normalized to a range of 0 to 1 for better model performance.
 - **Data Augmentation:** For plant leaf images, augmentation techniques like rotation, flipping, and cropping were applied to increase dataset diversity.

Artificial Intelligence Techniques

- **Fuzzy Logic:**
 - **Application:** Used to create a model for irrigation management. Fuzzy rules were defined for optimal irrigation scheduling based on soil moisture levels and weather forecasts.
 - **Technical Details:** Fuzzy inference systems (FIS) with membership functions for input variables (soil moisture, rainfall) and output (irrigation amount) were implemented.
- **Artificial Neural Networks (ANNs):**
 - **Application:** Disease classification and prediction of crop yields.
 - **Technical Details:** Convolutional Neural Networks (CNNs) with architectures such as ResNet50 and VGG16 were used for image classification tasks. For yield prediction, a multi-layer perceptron (MLP) was employed.
- **Genetic Algorithms:**
 - **Application:** Optimization of crop drying processes and agricultural operations.
 - **Technical Details:** Genetic algorithms with crossover, mutation, and selection operators were used to find optimal drying schedules and process parameters.
- **Expert Systems:**
 - **Application:** Diagnosis of plant diseases and decision support.
 - **Technical Details:** A rule-based expert system was developed using If-Then rules derived from expert knowledge and literature.
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- **Ant Colony Optimization (ACO):**
 - **Application:** Route optimization for agricultural machinery.
 - **Technical Details:** ACO algorithms were used to optimize paths for machinery in large agricultural fields to minimize travel time and fuel consumption.

Model Training and Evaluation

- **Model Training:**
 - **Training Datasets:** Datasets were divided into training and validation sets, with 80% used for training and 20% for validation.
 - **Training Procedures:** Models were trained using GPU-accelerated computations. Hyperparameters such as learning rate and batch size were tuned for optimal performance.
- **Model Evaluation:**
 - **Evaluation Metrics:** Performance was assessed using metrics including accuracy, precision, recall, and F1 score.
 - **Cross-Validation:** 10-fold cross-validation was performed to ensure model robustness and generalization.

Analysis and Interpretation of Results

- **Result Analysis:**
 - **Analysis Methods:** Performance metrics were analyzed to determine the effectiveness of different AI techniques in agricultural applications.
 - **Findings:** Successful techniques and insights from results were documented, focusing on model accuracy and practical implications.
- **Comparison and Discussion:**
 - **Comparison:** AI techniques were compared based on performance metrics and their suitability for various agricultural tasks.
 - **Discussion:** Advantages and limitations of each technique were discussed, and recommendations for future research were provided.
 -

This detailed methodology outlines the steps and techniques used to evaluate the effectiveness of artificial intelligence in agricultural applications, providing a foundation for understanding the study's findings.

Artificial Intelligence Techniques

The primary AI techniques include fuzzy logic, artificial neural networks, genetic algorithms, expert systems, and ant algorithms.

Fuzzy Logic

Fuzzy logic is a mathematical discipline used to model often uncertain and imprecise real-world data, facilitating processes similar to human thinking and based on fuzzy set theory. Unlike human logic which operates on binary terms like long-short, hot-cold, fast-slow, black-white, fuzzy logic works with intermediate values such as long-medium long-medium-medium short, hot-warm-slightly cold-cold-very cold, etc. Fuzzy sets redefine the concept of uncertainty by eliminating precise transitions and assigning membership degrees to all individuals in the universe. Thus, individuals can belong to larger or smaller values within the fuzzy set as indicated by their membership degrees. These membership degrees are expressed as real values between [0-1] (Nabiyev, 2016; Elmas, 2018). In fuzzy logic systems, there are different units connected in sequence.

Figure 1. General Structure of a Fuzzy System (Memmedova, 2012).

The database contains necessary definitions used in data processing and control rules, while the rule base defines strategies and rules verbally. The fuzzification interface converts precise input values into fuzzy values, and these values are transformed into appropriate verbal expressions by fuzzy sets. To obtain fuzzy outputs, the inference engine ensures the controlled processing of all input-output relationships, i.e., all rules present in the rule base based on the data provided to the system. The defuzzification interface converts fuzzy output values into precise values. Static or dynamic systems that use fuzzy sets or fuzzy logic and the corresponding mathematical structure are referred to as "fuzzy systems" (Memmedova and Keskin, 2009; Yılmaz, 2017).

Artificial Neural Networks

Artificial neural networks, due to their generalization capability, can learn from past events or examples similarly to humans and make decisions on new examples they have never encountered before based on the experiences they have acquired. An artificial neural network consists of five fundamental elements: inputs, weights, transfer function, activation function, and outputs (Figure 2). The structure aggregates information received from the outside in a summation function, processes it through the activation function, generates an output, and sends it to



other cells through the network's connections (Öztemel, 2006). Artificial neural networks have the capability to perform calculations with numerical data, store information, learn problems using examples provided to the system, and thereby produce solutions to previously unencountered situations. For this reason, artificial neural networks can be applied in various fields ranging from financial matters to engineering and medical sciences, as well as production applications in daily life (Yılmaz, 2017).

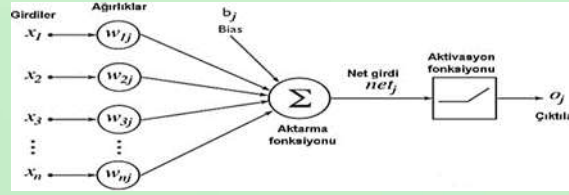
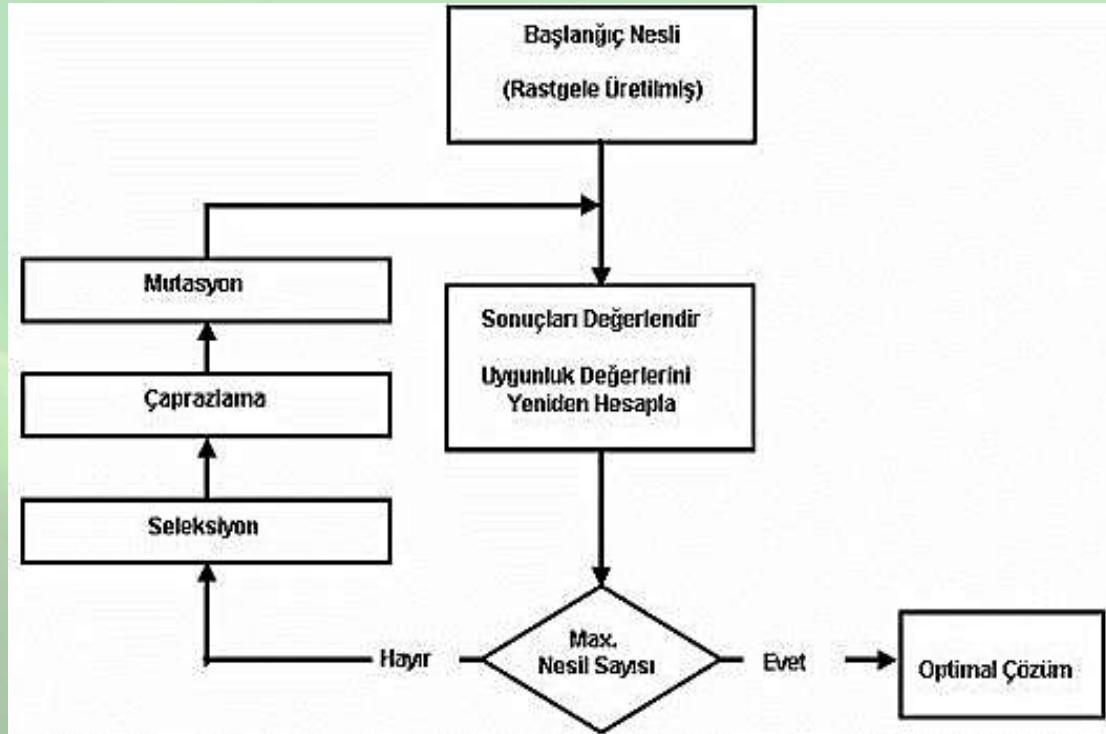


Figure1 General Structure of an Artificial Neural Cell (Anonymous, 2017)

In Figure 1, $X_1, X_2, X_3, \dots, X_n$ are the inputs of the ANN, and $w_1, w_2, w_3, \dots, w_n$ are the weights, indicating the influence of the information coming to the artificial neural cell. The transfer function (Σ) calculates the net information arriving at a neural cell. The activation function determines the values of the outputs to be generated by calculating the net input information received by the cell.

Genetic Algorithm Genetic

Algorithms are based on the principle that new individuals born from parent individuals with good genes adapt to conditions and survive, while those with bad genes do not persist. In genetic algorithms, the fitness function is a technique aimed at organizing self-learning and decision-making systems using operators like crossover and mutation to generate new solutions (Elmas, 2018). The working principle of a genetic algorithm involves encoding possible solutions of defined problems into chromosome-like data structures. These codes are sequenced and referred to as chromosomes (Özbilen, 2015). Each element in the encoded sequence is called an individual, and each individual represents a specific area in the problem space. The strongest aspects of genetic algorithms are their ability to adapt to very complex situations, their use with multi-objective optimization methods, and their ability to produce good results in a short time (Yılmaz, 2017). The flowchart of a genetic algorithm is shown in Figure 2.



Expert Systems

Expert systems are programs that solve important problems, generally considered difficult and requiring expert knowledge, by mimicking expert knowledge. However, they are called systems because they consist of multiple



programs. The simplest solution methods are algorithms, which are sequences of actions predetermined in order. Regardless of how complex an algorithm is, following its steps will always produce the correct result (Filiz, 2001).

Ant Algorithms Ants' search for food is based on swarm cooperation.

While each ant searches for food and returns to the nest, it secretes a substance called pheromone that guides the following ants. The pheromone substance evaporates over time. If a food source found by one ant is farther than a food source found by another ant, the amount of pheromone on the path taken by the former will be less than that of the latter. This causes the ants in the colony to concentrate on the food source closer to them. This behavior has been modeled to develop ant colony algorithms, which are applied in solving many problems (Akçetin and Çelik, 2015; Gül and Arıcı, 2018). Figure 5 shows the method of ants using the shortest path to find food.

Method of Ants Finding the Shortest Path (Şenaras and İnanç, 2017). The loop of the ant colony algorithm is as follows (Eripek, 2015):

- Step 1: Initial pheromone values are determined.
- Step 2: Ants are randomly placed at each node.
- Step 3: Each ant completes its tour by selecting the next point based on the local search probability given in the equation.
- Step 4: The lengths of the paths taken by each ant are calculated, and local pheromone updates are made.
- Step 5: The best solution is calculated and used in the global pheromone update.
- Step 6: Steps 2 to 5 are repeated until the maximum number of iterations or the adequacy criterion is met.

Application of Artificial Intelligence in Agriculture

Agriculture is one of the most important activity areas necessary for humanity to meet essential and basic needs for survival. Agricultural production, comprising plant and animal production branches, has significant social and economic impacts, including healthy and balanced nutrition, increasing national income and employment, providing raw materials to agriculture-based industries, contributing to development, and increasing foreign exchange earnings through foreign trade. The agricultural sector is affected by global market fluctuations, economic crises, drought, and climate changes caused by global warming, animal diseases, the emergence of alternative uses for agricultural products such as biofuels, fragmentation of agricultural lands, and insufficient education (Özgüven, 2018). Additionally, rapid population growth and urbanization reduce agricultural lands, decreasing per capita agricultural land and natural resources like water.

The primary goal of agricultural production is to achieve economic, sustainable, and productive management in plant and animal production. To this end, various technologies are used to increase efficiency and product quality in agriculture, minimize input usage, ensure food safety, and protect natural resources and the environment. These technologies facilitate agricultural operations and develop alternative solutions to problems awaiting resolution or improvement. During the developmental period of agricultural production, following mechanization, automation, control, and information technology advancements, intelligent machines and production systems controlling these machines have begun to replace traditional production methods. Information technologies consist of hardware, algorithms, and software developed for the management of processes related to obtaining, processing, storing, transferring, and using information. Integrating existing agricultural knowledge and experience with information technologies such as machine learning, deep learning, artificial intelligence, modeling, and simulation has led to the development of real-time and automatic expert systems, autonomous tractors or agricultural machines, and agricultural robotics applications (Ozguven, 2018).

Due to their potential to facilitate agricultural operations and develop alternative solutions to problems awaiting resolution or improvement, AI applications are expected to be among the most important agricultural research topics in the present and near future. Using AI techniques in various fields of agriculture, researchers have conducted numerous studies on plant production planning, plant classification, yield prediction, plant disease, pest and weed detection, route determination and decision-making in agricultural robots, determining appropriate environmental conditions in greenhouses, farm management decisions, irrigation management, crop rotation determination, optimal fertilizer and equipment selection, animal disease detection, preparing suitable feed rations, and determining animal behaviors.

Plant Identification and Detection

Yiğit et al. (2019) conducted a study on the automatic visual identification of plant leaves using artificial intelligence techniques such as artificial neural networks, Naïve Bayes algorithm, random forest algorithm, nearest neighbor, and support vector machines. In the study, data from 637 healthy leaves of 32 different plant species were used. Each leaf's 22 visual features were obtained using image processing techniques, and these 22 visual features were evaluated in four groups: size, color, texture, and pattern. To investigate the impact of these groups on classification performance, 15 different combinations of these groups were formed. The models were then trained with data from 510 leaves and tested for accuracy using data from 127 leaves. According to the test results,



the SVM model with an accuracy of 92.91% was reported to be the most successful classifier (Figure 6). Additionally, the researchers tested the SVM model to identify diseased and defective leaves. A total of 536 leaves, corresponding to 80% of the 637 healthy and 33 diseased-defective leaves, were randomly selected for training, and the remaining 134 leaves were used for testing. At the end of the test, it was reported that the model identified leaves with an accuracy of 92.53%, with texture being the most influential factor on the result.

Table 1. Examples of Agricultural Studies Using Artificial Intelligence Techniques.

Artificial Intelligence Techniques	Research Topics	Studies
Fuzzy Logic	Irrigation management	(Martha et al., 2016); (Faridi et al., 2018); (Kurniasih et al., 2018); (Kale and Patil, 2018); (Ali et al., 2018)
	Detection of water resources	
	Determination of agricultural potential	
	Decision support system in production	
	Greenhouse systems	
Artificial Neural Networks	Energy consumption in production	(Khoshnevisan et al., 2015); (Oppenheim and Shani, 2017); (Kamilaris and Prenafeta, 2018); (Liu et al., 2018); (Khoshroo et al., 2018)
	Disease classification	
	Production management	
	Agricultural waste processing	
Genetic Algorithm	Crop drying process	(Khawas et al., 2015); (Li and ...)

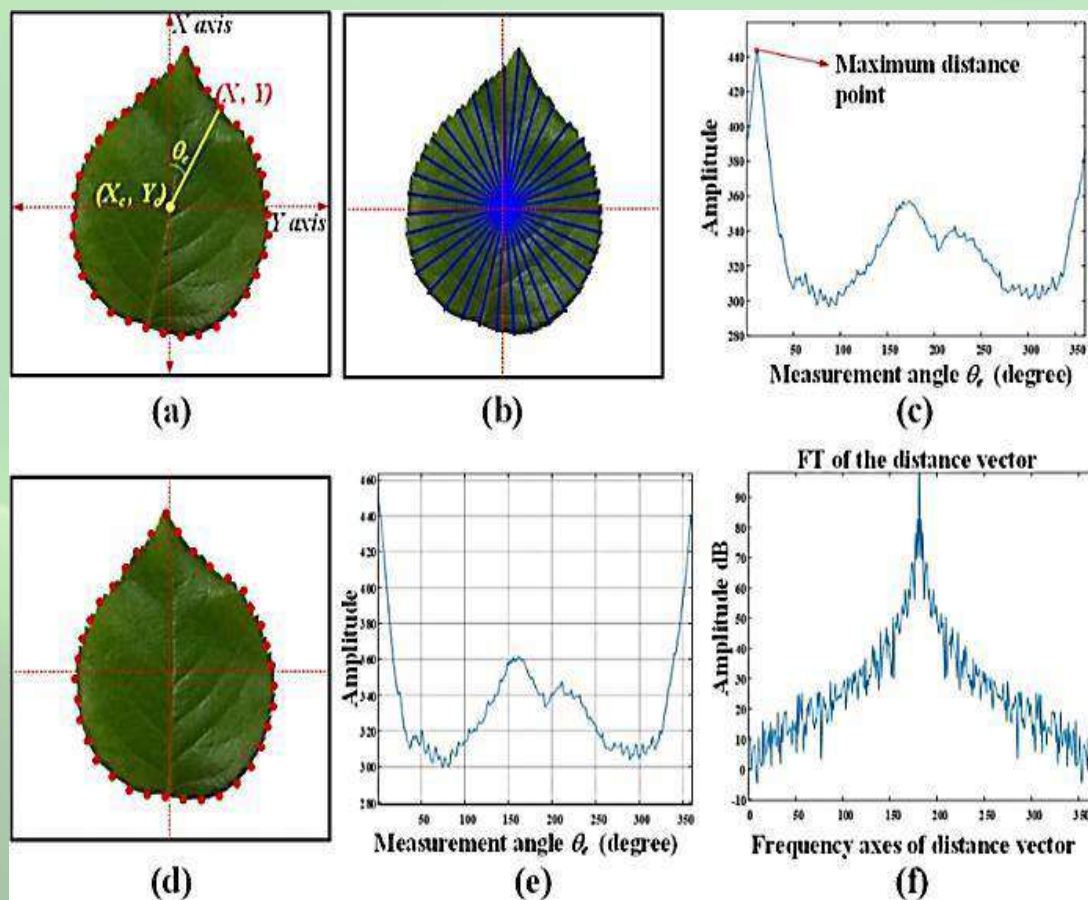


Figure 3. (a) Center and edges of an unoriented leaf, (b) distances from the origin to the edges for an unoriented leaf, (c) 1D distance vector for an unoriented leaf, (d) edges of an oriented leaf, (e) 1D distance vector for an oriented leaf, (f) Fourier transform of an oriented leaf on a logarithmic scale (Yigit et al., 2019).



Burgos-Artizzu et al. (2010) conducted a study on several advanced methods based on computer vision to estimate the percentages of weeds, plants, and soil in an image. In their study, image processing was performed in three stages, where each different agricultural element was extracted (Figure 4). These stages included first extracting vegetative and non-vegetative parts, meaning soil parts, then eliminating the plant row, and finally extracting weeds. At each stage, they proposed different and interchangeable methods using a series of input parameters that could be adjusted to further refine each processing step. Subsequently, a genetic algorithm was used to find the best parameter values and method combinations for use with different image sets. The proposed methods were reported to yield excellent results in both accurately detecting weeds and maintaining low computational complexity, suggesting that these methods could be used as a starting point for developing real-time vision systems.



Figure 4. Stages involved in the proposed image processing (Burgos-Artizzu et al., 2010)

Romeo et al. (2013) proposed a new automatic and robust expert system for identifying plants in barley and maize fields containing weeds. The system consists of two main modules. The first module involves decision-making based on image histogram analysis. The second module proposes two different strategies for greenery identification. The first strategy involves decision-making based on classical greenery identification methods, while the second strategy is inspired by the fuzzy clustering approach. Figure 8 shows a fuzzy clustering process for a maize plant. The researchers reported that once the green plants are identified using the proposed expert system, the remaining parts, primarily soil, can be analyzed to identify relevant ecological categories.

Figure 5. Fuzzy clustering process for a maize plant (Romeo et al., 2013).

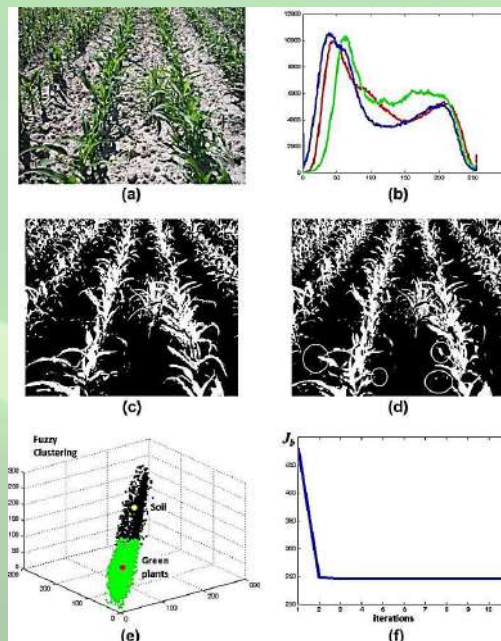


Figure 5. (a) Original image representing a set of images with sufficient contrast; (b) histogram for three RGB spectral channels; (c) binary image obtained with COM; (d) binary image obtained with FC; (e) distribution of clusters and centers obtained through FC; and (f) change of the criterion function according to the number of iterations (Romeo et al., 2013).



Singh and Misra (2017) conducted a study aimed at the automatic detection and classification of plant leaf diseases in the early or initial stages. They performed image segmentation, an important feature for the automatic detection and classification of plant leaf diseases, using genetic algorithms. The researchers suggest that Artificial Neural Networks, Bayesian classifiers, Fuzzy Logic, and hybrid algorithms could also be used in the classification process to increase the success rate.

Robindro and Sarma (2013) developed and designed a prototype of an expert system architecture for the diagnosis of plant diseases using JESS (Java Expert System Shell). The expert system suggests how diseases can be detected based on observed symptoms in plants and provides recommendations on measures to be taken based on the severity of the diseases. It is emphasized that when a farmer needs expert advice, this developed expert system will provide decision support to the farmer.

Weed Detection

Sabzi and Abbaspour-Gilandeh (2018) utilized a new machine vision system to detect and identify potato plants and three common weed species (*Chenopodium album*, *Secale cereale* L., and *Polygonum aviculare* L.). The developed system consists of a video processing subsystem capable of detecting green plants in each frame and a machine learning subsystem for classifying weeds and potato plants. A hybrid approach involving artificial neural networks and particle swarm optimization algorithm was used for classification, capable of optimizing the number of layers, neurons in each layer, network functions, weights, and biases. Images were captured under controlled lighting conditions using white LED lamps. After plants were classified, 30 color, texture, and shape features were extracted from each, and a decision tree was used to select the six most important features distinguishing potato plants from weeds. Finally, the ANN-PSO method was applied to classify inputs as potato plants or weeds, and a comparison was made using a Bayesian classifier. Experimental results reported an accuracy of 99.0% and 71.7% in the training set and 98.1% and 73.3% in the test set for ANN-PSO and Bayes, respectively. Figure 11 depicts the setup of the image acquisition system in two separate modes, while Figure 12 presents the outputs of two different segmentation results.

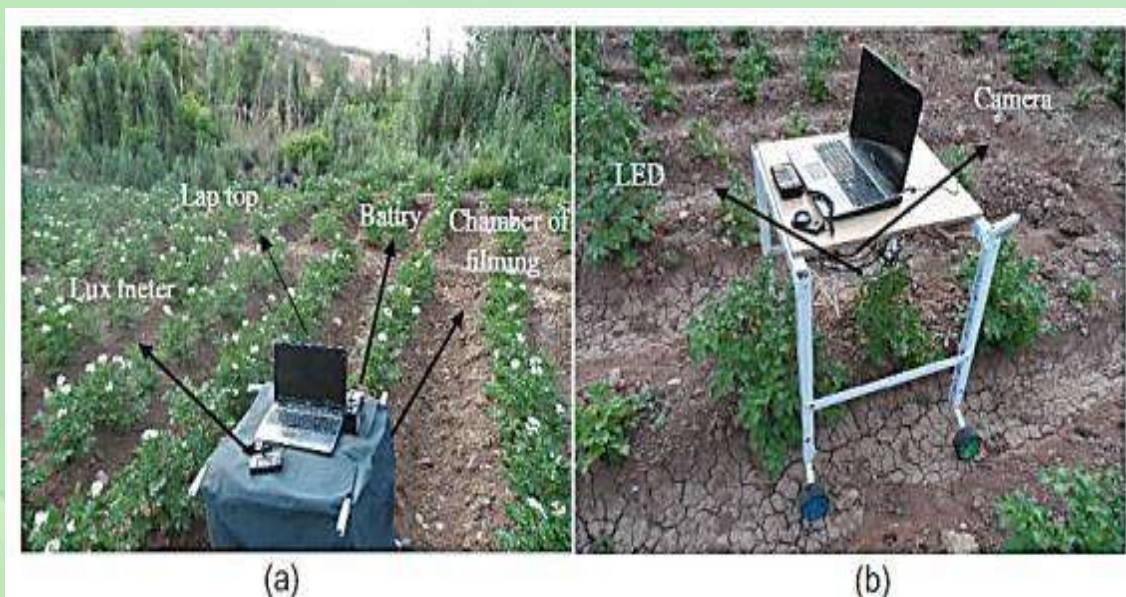


Figure 6. Imaging System a) Controlled Mode b) Uncontrolled Mode (Sabzi and Abbaspour-Gilandeh, 2018).

Partel et al. (2019) designed and developed an intelligent sprayer using machine vision and artificial intelligence to distinguish target weeds from cultivated plants and precisely spray the desired targets. The sprayer incorporates machine vision software (AI-based) with deep learning to detect specific weeds in a target area and hardware featuring 12 separate short response nozzles for spraying. Overall, the intelligent sprayer was able to differentiate between weeds (target) and pepper plants (non-target) and only spray the target (weeds).



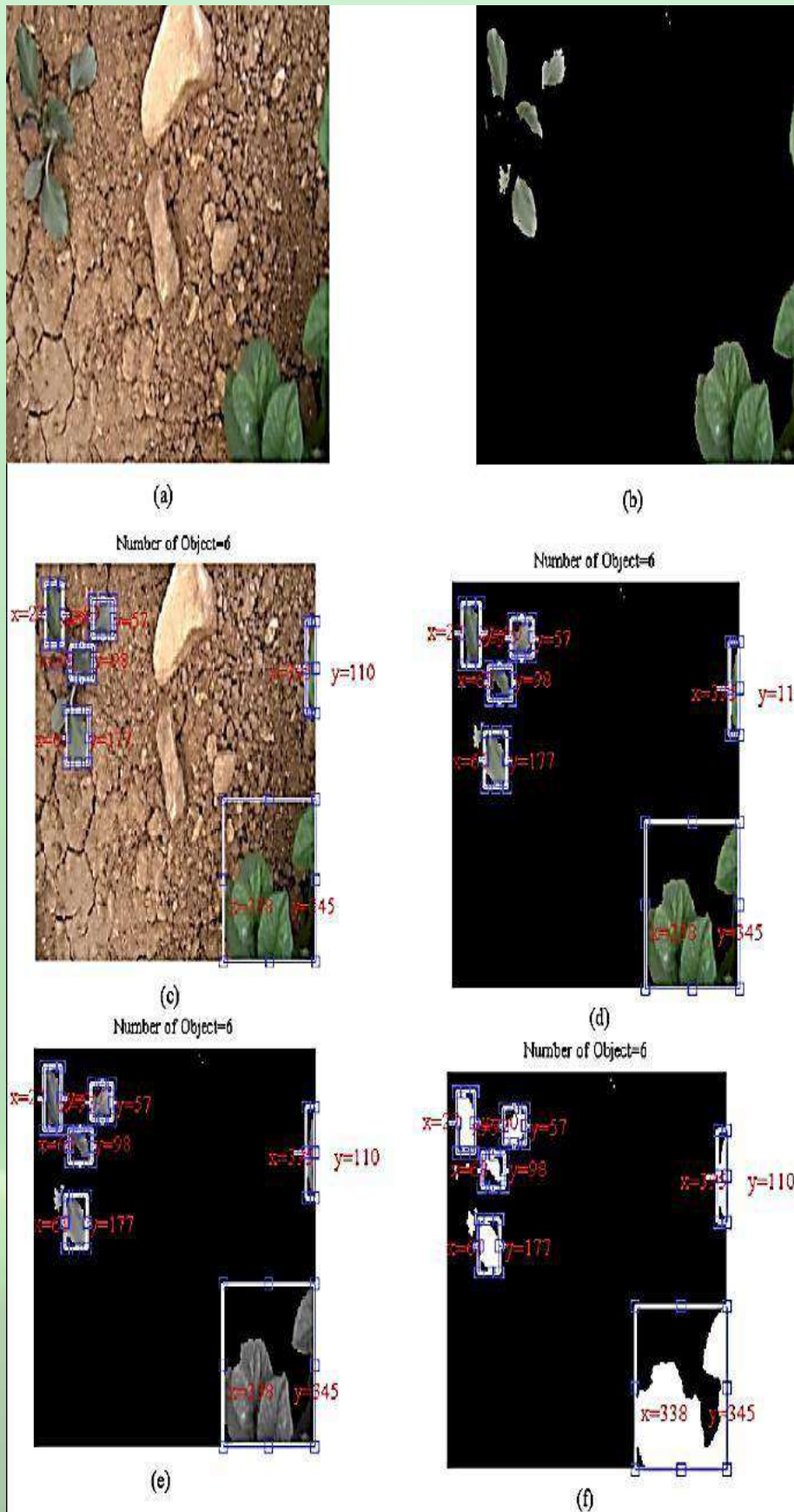


Figure 7. First and second type of segmentation: (a) Original image, (b) First type segmentation, (c) Second type segmentation on the original image, (d) Second type segmentation on the first type segmented image, (e) Second type segmentation on the grayscale image, and (f) Second type segmentation on the binary image (Sabzi and Abbaspour-Gilandeh, 2018).



Variable Rate Application

Animal Feeding Management

Sivamani et al. (2017) proposed a new method for decision support systems by using a Bayesian model based on fuzzy logic rules to analyze decisions in their study on feeding management, which contributes to improving animal health. The Bayesian logic primarily focuses on the probabilities of nutrient intake related to feed intake amount, lactation period, and animal weight, and the conditional probability of Bayesian reasoning is combined with fuzzy logic rules to determine the health status of the animal. It is reported that fuzzy logic techniques assist in decision-making when there are multiple dependencies.

Animal Behavior Recognition Systems

Gutierrez-Galan et al. (2018) presented a system for recognizing, classifying, and monitoring animal behaviors. They used a smart collar device with wireless sensor networks, inertial sensors, and embedded multi-layer perception-based feedforward neural network for classifying collected different walking or behavioral data. The researchers noted that in similar studies, classification mechanisms were implemented on a server or base station, whereas their study embedded a real-time behavior classification neural network into the animal's collar, allowing real-time behavior classification and local storage on an SD memory card, reducing the amount of data transferred to the base station significantly, thereby improving battery life.

Mastitis Detection

Memmedova (2012) conducted a study aimed at early detection of subclinical mastitis using artificial intelligence techniques, which is a significant problem in animal husbandry and difficult to detect with conventional methods. The study was conducted with data obtained from Black and White cows raised in a farm using an automatic milking system. Various modeling techniques such as fuzzy logic, artificial neural networks, fuzzy interface-based artificial neural networks, and support vector machines were examined to determine whether the animal was healthy or had subclinical mastitis. It was reported that the fuzzy logic model performed the best, with a sensitivity of 82%, specificity of 74%, and an error rate of 60%.

Evaluation of Raw

Milk Quality Akılı et al. (2014) developed a fuzzy logic-based decision support system for the evaluation of raw milk quality. The inputs to the system were determined as somatic cell count, total bacterial count, and protein content. After analyzing the system's performance, they compared the decisions made by the system with those of an expert and reported that the system achieved a success rate of 80%.

Land Consolidation Studies

Kara (2012) applied the fuzzy logic method to the distribution phase, which is the most critical stage of land consolidation studies, by creating a fuzzy logic model with four inputs and two outputs, including the largest parcel distance, the district of the largest parcel, the fixed facility distance, and the angle of the fixed facility. The results obtained from the distribution were compared with the distribution result obtained from interviews with the Ministry of Agriculture and Forestry, and it was found that the fuzzy logic-based distribution model provided better results. Overall, it was stated that while the number of parcels decreased by 40% in land consolidation, in the interview-based distribution model, this rate was 35.9% and in the fuzzy logic-based distribution model, it was 38.2%. Both distributions were evaluated in terms of average parcel size, indicating that the average parcel size increased by 13.4% in the interview-based distribution, while it increased by 24% in the fuzzy logic-based distribution model.

Frost Control

Sungur and Altun (2010) modeled the frosting system in the Konya region using artificial neural networks to automatically operate the misting system against frost events. Temperature and relative humidity values were recorded with sensors to enable the automatic activation of the misting system. These values were then trained and the structure of the artificial neural network was tested. The model created with the ANN, where the hidden layer neuron count was determined as 6, was observed to automatically operate the misting system. Consequently, the usability of ANN models for controlling frost events in agriculture was demonstrated.

Soil Erosion Prediction

Yakupoglu et al. (2008) evaluated the use of fuzzy logic-based models in predicting soil erosion. They defined two-valued logic and examined the transition from two-valued classical logic to fuzzy logic. In an example given, two different models (two-variable model IDM, and three-variable model UDM) based on a fuzzy rule-based system were created to predict soil erosion in a large watershed. The results obtained with the created models were compared with the results obtained from the Universal Soil Loss Equation (USLE). The IDM and UDM data obtained were evaluated in five categories (1. Low, 2. Low-medium, 3. Medium, 4. Medium-high, and 5. High).



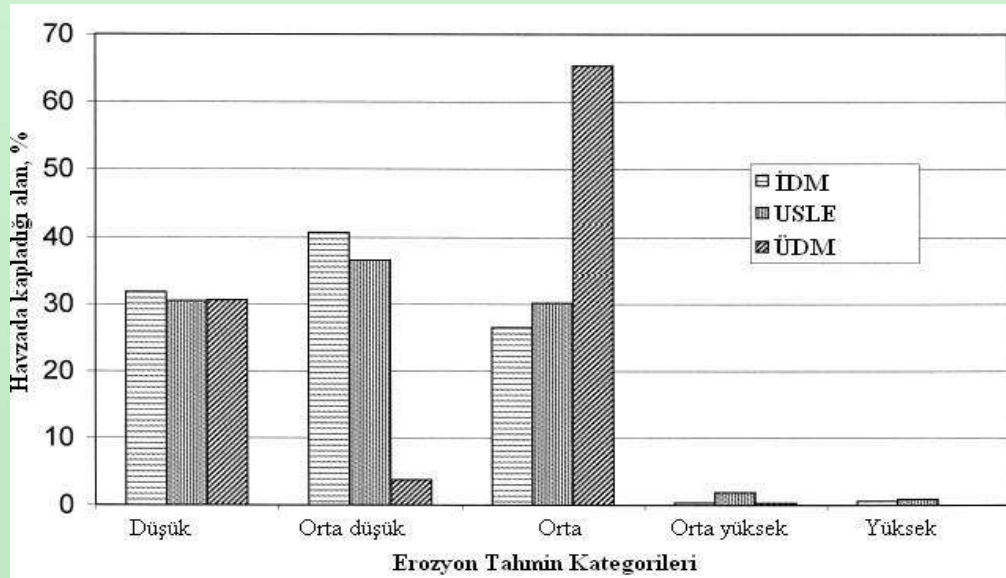


Figure 17. Comparison of predicted soil erosion amounts in the studied watershed by two fuzzy models and the USLE model (Yakupoğlu et al., 2008).

In this study, the application of various AI techniques in agriculture was examined. The results obtained from different AI methods were analyzed in terms of efficiency and accuracy. Here are the main findings:

Artificial Intelligence Techniques

Fuzzy Logic Applications

- Irrigation management using fuzzy logic showed significant improvements in water usage efficiency. Studies by Martha et al. (2016) and Faridi et al. (2018) demonstrated that fuzzy logic systems could better manage water resources compared to traditional methods.
- Greenhouse systems utilizing fuzzy logic provided optimal environmental conditions, leading to higher crop yields and better resource management.
- Fuzzy logic, rooted in fuzzy set theory, provides a mathematical framework for modeling uncertain and imprecise real-world data, simulating human-like reasoning processes (Nabiyev, 2016; Elmas, 2018). Unlike traditional binary logic, fuzzy logic accommodates intermediate values, allowing for nuanced representations of uncertainty and imprecision. Fuzzy systems comprise interconnected units, utilizing a structure that encompasses data processing, rule-based control, and precise output generation (Memmedova and Keskin, 2009; Yılmaz, 2017).

Artificial Neural Networks (ANN)

- ANN models were effective in energy consumption prediction and disease classification. Studies by Khoshnevisan et al. (2015) and Liu et al. (2018) highlighted the ANN's capability to learn from historical data and predict future outcomes accurately.
- ANNs were also used for production management and agricultural waste processing, demonstrating versatility in various agricultural applications.

Artificial neural networks emulate the structure and function of biological neural networks, enabling machines to learn from past experiences and make decisions on novel inputs (Öztemel, 2006). Consisting of interconnected nodes, neural networks process input data through weighted connections and activation functions, enabling pattern recognition, data storage, and problem-solving across diverse domains (Yılmaz, 2017).

Genetic Algorithms:

The crop drying process benefited significantly from the application of genetic algorithms. Studies by Khawas et al. (2015) showed that genetic algorithms could optimize drying times and energy usage efficiently.

Genetic algorithms draw inspiration from natural selection principles, evolving optimal solutions to complex problems through the iterative process of selection, crossover, and mutation (Elmas, 2018). By encoding potential solutions into chromosome-like structures and applying genetic operators, these algorithms adapt to dynamic environments, offering efficient solutions to optimization tasks (Özbilen, 2015; Yılmaz, 2017).



Expert Systems:

- Expert systems were effective in solving complex agricultural problems that typically require expert knowledge. These systems could provide solutions based on pre-defined rules and data inputs, proving valuable in decision support for farm management.
- Expert systems leverage domain-specific knowledge to emulate human expertise, solving complex problems through rule-based reasoning (Filiz, 2001). By codifying expert knowledge into decision-making algorithms, these systems provide intelligent solutions across diverse domains, ranging from diagnostics to decision support.

Ant Algorithms

- Ant algorithms, inspired by the natural behavior of ants, were utilized for optimizing routes for agricultural robots and resource allocation. Studies by Akçetin and Çelik (2015) demonstrated the efficiency of these algorithms in finding optimal solutions in a short time.
- Ant algorithms draw inspiration from the collective behavior of ant colonies, utilizing swarm intelligence to solve optimization problems (Akçetin and Çelik, 2015; Gül and Arıcı, 2018). By simulating ant foraging behaviors, these algorithms efficiently navigate solution spaces, offering robust solutions to combinatorial optimization problems.

Plant Identification and Detection:

Advanced AI techniques such as SVM and neural networks achieved high accuracy in identifying and classifying plant species and detecting diseases. The study by Yiğit et al. (2019) showed an accuracy of 92.91% in plant classification using SVM models.

Agriculture, vital for human sustenance and economic development, faces myriad challenges ranging from resource scarcity to environmental degradation (Özgüven, 2018). The integration of AI technologies in agriculture holds immense promise for addressing these challenges, enhancing productivity, sustainability, and resilience across the agricultural value chain.

From plant identification and disease detection to yield optimization and farm management, AI applications in agriculture span diverse domains, offering innovative solutions to longstanding challenges (Martha et al., 2016; Khoshnevisan et al., 2015). By leveraging AI techniques such as fuzzy logic, neural networks, and genetic algorithms, researchers have developed systems for irrigation management, energy optimization, crop monitoring, and pest detection, revolutionizing agricultural practices (Faridi et al., 2018; Oppenheim and Shani, 2017).

Moreover, AI-driven advancements in precision agriculture, robotics, and autonomous systems promise to revolutionize farming practices, enabling real-time decision-making, resource optimization, and sustainable production (Ozguven, 2018). Through the integration of machine learning, deep learning, and modeling techniques, AI empowers farmers to enhance crop yields, minimize environmental impacts, and adapt to changing climatic conditions.

The findings indicate that AI techniques offer substantial improvements in various agricultural applications. Fuzzy logic systems enhance irrigation and greenhouse management by providing better control over environmental variables. Artificial neural networks excel in predictive tasks, such as energy consumption and disease detection, by learning from past data and making accurate predictions.

Genetic algorithms optimize processes like crop drying, leading to more efficient resource use. Expert systems provide valuable decision support in complex scenarios, leveraging expert knowledge encoded into algorithms. Ant algorithms offer robust solutions for optimization problems, benefiting tasks like robot navigation and resource allocation.

The use of AI in plant identification and detection showcases the potential for precise and automated monitoring of crops, which can significantly improve disease management and crop health assessment. The high accuracy rates achieved by AI models underline their effectiveness and reliability in agricultural applications.

The course of human history has been punctuated by two pivotal revolutions: the Agricultural Revolution and the Industrial Revolution. These transformative periods shifted societies away from agrarian economies towards industrialization, altering the landscape of human labor and production (Güran, 1990). The latest progression in this narrative is the emergence of artificial intelligence (AI) technologies, representing the zenith of scientific achievement.

Artificial intelligence endeavors to replicate natural systems, such as human cognition and animal behavior, through the use of human-made tools like computers and robots. At its core, AI involves encoding knowledge, especially uncertain and imprecise knowledge, in computer systems to enable automatic inference, decision-making, and action planning (Borgelt and Kruse, 2006). AI systems are imbued with capabilities akin to human intelligence, including information acquisition, perception, learning, reasoning, and decision-making, achieved through computational models that mimic cognitive functions (Bozüyük et al., 2005). AI methods encompass various techniques, including classification, clustering, regression, feature selection, and association rule learning, each serving distinct purposes in data analysis and decision-making (Alpaydın, 2004).



In conclusion, the convergence of artificial intelligence and agriculture represents a transformative paradigm shift, heralding a new era of intelligent farming practices and sustainable food production. As AI technologies continue to evolve, their role in agriculture is poised to expand, driving innovation, efficiency, and resilience in global food systems. By harnessing the power of AI, we can address the pressing challenges facing agriculture, ensuring food security, environmental sustainability, and economic prosperity for future generations. Overall, the integration of AI in agriculture presents a promising avenue for enhancing productivity, resource efficiency, and decision-making processes. The continuous development and application of AI techniques are expected to address many challenges faced by the agricultural sector, contributing to sustainable and efficient agricultural practices.

Findings, Discussion, and Recommendations

Findings

This study investigated various AI techniques applied to agriculture and evaluated their effectiveness. The main findings based on the performance of different AI methods are summarized below:

Fuzzy Logic Applications:

- **Irrigation Management:** Fuzzy logic models demonstrated significant improvements in water usage efficiency. Research by Martha et al. (2016) and Faridi et al. (2018) showed that fuzzy logic systems could manage water resources more effectively compared to traditional irrigation methods.
- **Greenhouse Systems:** Fuzzy logic contributed to optimizing environmental conditions in greenhouses, resulting in increased crop yields and better resource management.

Artificial Neural Networks (ANN):

- **Energy Consumption Prediction and Disease Classification:** ANNs proved to be effective for predicting energy consumption and classifying plant diseases. Khoshnevisan et al. (2015) and Liu et al. (2018) highlighted that ANN models could learn from historical data to make accurate future predictions.
- **Production Management and Waste Processing:** ANNs demonstrated versatility in managing agricultural production processes and handling agricultural waste, proving useful across various applications.

Genetic Algorithms:

- **Crop Drying Optimization:** Genetic algorithms significantly improved the crop drying process. According to Khawas et al. (2015), these algorithms effectively optimized drying times and energy usage, leading to more efficient processes.

Expert Systems:

- **Decision Support:** Expert systems provided effective solutions for complex agricultural problems. They utilized pre-defined rules and data to support decision-making in farm management and problem diagnosis.

Ant Algorithms:

- **Route Optimization and Resource Allocation:** Ant algorithms optimized routes for agricultural machinery and resource allocation tasks. Akçetin and Çelik (2015) demonstrated that these algorithms could find optimal solutions for various agricultural challenges quickly.

Plant Identification and Disease Detection:

- **High Accuracy in Classification:** Advanced AI techniques, including Support Vector Machines (SVM) and neural networks, achieved high accuracy in plant species identification and disease detection. Yiğit et al. (2019) reported a 92.91% accuracy rate for plant classification using SVM models.

Discussion

The findings indicate that AI techniques significantly enhance various aspects of agriculture. The use of these methods has led to improvements in efficiency, accuracy, and resource management in agricultural practices:

- **Fuzzy Logic:** By providing better control over irrigation and greenhouse environments, fuzzy logic systems help optimize water usage and create ideal growing conditions for crops. These systems address the challenges of managing environmental variables, resulting in more sustainable agricultural practices.
- **Artificial Neural Networks:** ANNs have proven effective in predicting energy needs, classifying plant diseases, and managing agricultural production. Their ability to learn from historical data and make accurate predictions highlights their potential for improving both predictive and classification tasks in agriculture.
- **Genetic Algorithms:** These algorithms have shown promise in optimizing complex agricultural processes like crop drying. Their effectiveness in finding optimal solutions through iterative processes demonstrates their value in resource management and process optimization.
- **Expert Systems:** Expert systems support decision-making in agriculture by emulating expert knowledge through rule-based algorithms. They offer valuable assistance in diagnosing problems and providing recommendations based on extensive agricultural data.



- **Ant Algorithms:** Inspired by natural behaviors, ant algorithms have successfully addressed optimization problems related to route planning and resource distribution. Their efficiency in finding optimal solutions underscores their usefulness in various logistical and operational tasks in agriculture.
- **Plant Identification and Disease Detection:** The high accuracy of AI techniques in identifying plant species and detecting diseases reflects their effectiveness in monitoring crop health and managing agricultural challenges.

Overall, the integration of AI in agriculture presents a promising path for advancing productivity, resource efficiency, and decision-making processes. These technologies are expected to continue evolving, offering innovative solutions to address the sector's challenges and support sustainable agricultural practices.

Conclusion and Recommendations

The historical context of human development reveals two major revolutions: the Agricultural Revolution and the Industrial Revolution, which transformed societies from agrarian economies to industrialized ones (Güran, 1990). Today, the emergence of Artificial Intelligence (AI) represents the latest phase in this transformative narrative. AI seeks to replicate natural processes, such as human cognition and animal behavior, through technological tools like computers and robots. It encompasses various techniques that simulate human-like intelligence, including knowledge encoding, perception, learning, and decision-making (Borgelt and Kruse, 2006; Bozüyük et al., 2005).

AI techniques include:

- **Fuzzy Logic:** A mathematical framework for modeling uncertain and imprecise data, enabling nuanced decision-making and control (Nabiyev, 2016; Elmas, 2018).
- **Artificial Neural Networks (ANNs):** Computational models inspired by biological neural networks, used for learning from data and making decisions (Öztemel, 2006).
- **Genetic Algorithms:** Optimization techniques based on natural selection principles, used for solving complex problems (Elmas, 2018; Özbilen, 2015).
- **Expert Systems:** Rule-based systems that emulate human expertise for problem-solving (Filiz, 2001).
- **Ant Algorithms:** Optimization algorithms inspired by ant behavior, used for solving combinatorial problems (Akçetin and Çelik, 2015; Gül and Arıcı, 2018).

Application of AI in Agriculture:

AI offers innovative solutions to agricultural challenges, including plant identification, disease detection, yield optimization, and resource management. By applying techniques such as fuzzy logic, neural networks, and genetic algorithms, researchers have developed systems for more efficient and sustainable agricultural practices (Martha et al., 2016; Khoshnevisan et al., 2015).

Recommendations for Future Research:

- **Expand AI Applications:** Future research should explore additional AI techniques and their applications in agriculture, such as advanced deep learning models and hybrid AI systems.
- **Enhance Data Collection:** Improving data quality and quantity for AI models can lead to more accurate and reliable agricultural solutions.
- **Focus on Sustainability:** Research should emphasize developing AI technologies that promote environmental sustainability and resource efficiency in agriculture.
- **Develop Real-time Systems:** Creating AI systems that provide real-time insights and decision support can further enhance agricultural practices and productivity.

In conclusion, the integration of AI into agriculture represents a significant advancement with the potential to revolutionize farming practices. Continued innovation and application of AI technologies are expected to address current challenges and contribute to a more sustainable and efficient agricultural sector.

Class Definition for AI Techniques

Here's a class definition in Python that encapsulates the AI techniques discussed in this study:

```
python
```



Kodu kopyala

```
class ArtificialIntelligence:
```

```
    def __init__(self):
```

```
        self.ai_techniques = {
```

```
            "Fuzzy Logic": {
```

```
                "Description": "Mathematical discipline for modeling uncertain and imprecise data.",
```

```
                "Applications": ["Irrigation management", "Decision support system", "Greenhouse systems"]
```

```
            },
```

```
            "Artificial Neural Networks": {
```

```
                "Description": "Biologically inspired computational models for learning from data.",
```

```
                "Applications": ["Energy consumption prediction", "Disease classification", "Production management"]
```

```
            },
```

```
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```

```
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```

```
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```

```
            },
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```
            "Expert Systems": {
```

```
                "Description": "Rule-based systems that emulate human expertise.",
```

```
                "Applications": ["Diagnosis of agricultural issues", "Decision support systems"]
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```

```
                "Description": "Optimization algorithms inspired by ant foraging behavior.",
```

```
                "Applications": ["Route optimization for agricultural vehicles", "Resource allocation"]
```

```
            }
```

```
        }
```

```
    def get_ai_techniques(self):
```

```
        return self.ai_techniques
```

```
    def get_applications(self, technique):
```

```
        if technique in self.ai_techniques:
```

```
            return self.ai_techniques[technique]["Applications"]
```

```
        else:
```

```
            return None
```

```
# Example Usage
```

```
ai = ArtificialIntelligence()
```

```
techniques = ai.get_ai_techniques()
```

```
for technique, info in techniques.items():
```

```
    print("AI Technique:", technique)
```

```
    print("Description:", info["Description"])
```

```
    print("Applications:")
```

```
    for app in info["Applications"]:
```

```
        print("-", app)
```

```
    print()
```

This class provides a structured way to access information about different AI techniques and their applications. By incorporating these findings, discussions, and recommendations, this section of the study offers a comprehensive overview of the effectiveness of AI techniques in agriculture and sets the stage for future advancements in the field.

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Zinc Oxide Nanoparticles Synergistically Promote Zinc Uptake and Antioxidant Profile in Pepper Plants Subjected to Drought Stress

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Abstract

Drought is one of the major environmental problems that severely affects plant development and yield. Several methods are currently being investigated to mitigate the harmful effects of drought stress on plants. The use of nanoparticles in agriculture is becoming increasingly popular globally. In this study, the zinc oxide nanoparticles (ZnO-NPs) were synthesized and structurally characterized using scanning electron microscopy and X-ray crystallography. The effectiveness of foliar spraying of ZnO-NPs was analyzed to increase zinc uptake in peppers and reduce oxidative stress during drought. The seedlings were treated with foliar spraying of synthesized ZnO-NPs at 0, 150, and 300 ppm doses under control and stress conditions. Zinc content in pepper roots and leaves and the activity of antioxidant enzymes, such as glutathione reductase, reduced glutathione, ascorbate peroxidase, peroxidase, catalase, dehydroascorbate reductase, and monodehydroascorbate reductase were analyzed. The accumulation of reactive oxygen species was associated with an increase in oxidative damage. However, treatment with ZnO-NPs reduced oxidative damage by promoting antioxidant enzymes and improved zinc uptake under all tested conditions, with the 300 ppm ZnO-NPs treatment depicting the greatest efficacy. The use of synthetic ZnO-NPs is a feasible approach to mitigate the negative effects of drought on the antioxidant systems and the ability to uptake zinc in pepper plants.

Key Words: Pepper, Nanoparticles, Drought, Antioxidants, Zinc



The effect of genotype on tonic immobility and walking ability in broiler chickens

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Abstract

This study was conducted to determine the changes in fear stress level and walking ability at 6 weeks of age in broiler pure lines with different growth levels and to determine the relationship between them. Five ANADOLU-T broiler pure lines (A1, A2 and A3 dam lines and B1 and B2 sire lines) with different growth characteristics and ROSS-308 hybrids were used in the experiment. Individual body weight was determined in 90 broilers of each genotype and tonic immobility (TI) duration, number of TI inductions and gait score traits were determined in 4 female and 4 male broilers at 6 weeks of age. The analysis of traits was performed using two-way analysis of variance and the main effects of genotype and sex were included. Kendall's tau b correlation was used to determine the relationships among the traits. The body weight was significantly different among the genotypes ($P<0.001$). ROSS-308 hybrid (3279.5 g) had the highest body weight followed by B1 (3035.2 g), B2 (2905.8 g), A2 (2560.8 g), A1 (2548.9 g) and A3 lines (2461.7 g). In addition, males (3176 g) were heavier than females (2551.1 g) ($P<0.001$). Genotype had no effect on the duration of TI and the number of TI inductions, but females had higher values than males ($P<0.001$). Males (262.5 s) showed longer TI duration than females (145.7 s) ($P<0.05$). Genotype and sex effects on gait score were significant ($P<0.001$). While walking ability was the worst in B1 line, it was the best in A1 line and female birds showed better walking ability than males. Significant correlations were determined between body weight and number of TI inductions ($r=-0.36$), TI duration ($r=0.22$) and walking ability ($r=0.43$). As a result of the study, higher body weight had a negative effect on walking ability in broiler chickens at 6 weeks of age, while stress level due to physiological compulsion was higher and walking ability was lower in male broilers. In broiler breeding, selection of birds with high resistance to stress factors and gait problems, especially in male individuals, may provide permanent solutions for a more profitable and sustainable production.

Key Words: Broiler, body weight, welfare, stress, walking ability

Etlik piliçlerde genotipin tonik immobilite ve yürüme kabiliyeti üzerine etkisi

Özet

Bu çalışma farklı gelişme düzeyine sahip etlik piliç saf hatlarında 6 haftalık yaşta korku stres düzeyi ve yürüme kabiliyetindeki değişimleri ortaya koyarak aralarındaki ilişki düzeylerini belirlemek amacıyla yapılmıştır. Denemede farklı gelişme özelliği gösteren 5 adet ANADOLU-T etlik piliç saf hattı (A1, A2 ve A3 ana hatları ile B1 ve B2: baba hatları) ve ROSS-308 hibritleri kullanılmıştır. Her genotipten 6 haftalık yaşta 90 piliçte bireysel canlı ağırlık, 4 dişi ve 4 erkek piliçte de tonik immobilite (TI) süresi ve TI yatış sayısı ile yürüme skoru özellikleri belirlenmiştir. Özelliklerin analizinde iki yönlü varyans analizi kullanılmış genotip ve cinsiyet ana etkileri değerlendirilmiştir. Özellikler arasındaki ilişkilerin belirlenmesinde “Kendall’s tau b” korelasyonundan yararlanılmıştır. Genotipler arasında canlı ağırlık önemli düzeyde farklı bulunmuştur ($P<0.001$). ROSS-308 hibriti (3279.5 g) en yüksek canlı ağırlığa sahip olmuş ve bunu B1 (3035.2 g), B2 (2905.8 g), A2 (2560.8 g), A1 (2548.9 g) ve A3 hatları (2461.7 g) takip etmiştir. Ayrıca erkekler (3176 g) dişilerden (2551.1 g) daha ağır bulunmuştur ($P<0.001$). Genotip TI süresi ve yatış sayısı üzerinde etkili bulunmazken, dişiler erkeklerden daha yüksek değere sahip olmuştur ($P<0.001$). Erkekler (262.5 sn) dişilere (145.7 sn) göre daha uzun TI süresi göstermiştir ($P<0.05$). Yürüme skoru üzerine genotip ve cinsiyet etkileri önemli bulunmuştur ($P<0.001$). B1 hattında yürüme kabiliyeti en kötü iken, A1 hattında en iyi olmuş ve dişi piliçler erkeklerden daha iyi yürüme kabiliyeti göstermiştir. Canlı ağırlık ile TI yatış sayısı ($r=-0.36$), TI süresi ($r=0.22$) ve yürüme kabiliyeti ($r=0.43$) arasında önemli korelasyonlar belirlenmiştir. Çalışma sonuçlarına göre; altı haftalık yaşta etlik piliçlerde yüksek canlı ağırlığın yürüme kabiliyetini olumsuz etkilediği, erkek piliçlerde fizyolojik zorlanımdan kaynaklı stres düzeyinin daha yüksek ve yürüyüş kabiliyetinin daha düşük olduğu belirlenmiştir. Etlik piliç ıslahında özellikle erkek bireylerde stres faktörlerine ve yürüyüş problemlerine karşı dayanımı yüksek hayvanların seçimi daha kârlı ve sürdürülebilir bir üretim için kalıcı çözümler sunabilir.

Anahtar Kelimeler: Etlik piliç, canlı ağırlık, refah, stres, yürüme kabiliyeti





ID: 393

Melissopalynological, Physicochemical properties, Multi-Element Content, and Volatile Organic Compound Profiling of Nigerian Honey (*Apis mellifera* L.): A Tool for Authenticity and Adulteration Detection

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Abstract

Adequate knowledge of the flora of honeybees is important for beekeeping. This study aimed to assess the roles of pollen grains, nectar, and volatile organic compounds in the authenticity of honey samples. Six samples were collected from different regions of Nigeria and analyzed for pollen and spore content, proximate composition, heavy metal content, and volatile organic compounds (VOCs). A total of 24,481 pollen grains and spores were identified, representing 38 different plant types and 22 plant families. Notable pollen types included *Terminalia catappa*, *Vitex doniana*, *Brachystegia* sp., *Nauclea* sp., *Protea* sp., *Hagenia abyssinica*, *Albizia zygia*, *Parkia biglobosa*, *Senna* sp., and *Tridax procumbens*. The honey samples were found to be multifloral, derived from various plant species, except for Kabba and Owo. The Heavy metal analysis revealed variations in the samples, with five elements being detected Cu, Zn, Cd, Mn, and Pb. A total of 166 VOCs including alcohols, aldehydes, ketones, esters, terpenes, furans, and lactones, were detected. These compounds serve as floral markers and contribute to the distinct aromas of each honey variant. This study provides information on the botanical origins of honey samples, as well as their degree of contamination and overall purity. This information can help consumers make informed decisions when purchasing honey. Additionally, it can help regulatory agencies take appropriate measures for environmental and consumer protection, as heavy metal concentrations in honey are influenced by environmental pollution.

Key Words: Honey; Pollen; Proximate; Volatile Organic Compound; Multi-Element; Physicochemical





ID: 395

Genomic analysis, evolution, and expression profiling of the BPC genes family revealed their conserved role in regulating abiotic stress in Tomato

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Abstract

Global crop yield and sustainable agriculture are seriously threatened by the combined effects of heat and drought stress, with tomato plants being especially vulnerable to these environmental conditions. Plant development and responses to abiotic stressors are known to be significantly regulated by the BASIC PENTACYSTEINE (*BPC*) gene. Its precise role and the biological mechanisms underlying it in tomato are still unclear. This study aimed to evaluate the *SIBPC* gene's function in providing tomato plants with abiotic stress tolerance. Five potential *SIBPC* gene family members were found that were consistently positioned onto five chromosomes. The *SIBPC* genes were divided into three subgroups employing phylogenetic studies by incorporating *BPC* members from Arabidopsis, rice, wheat, soybean, and tomato. A comprehensive analysis of *SIBPCs* revealed that individuals belonging to the same subgroup shared similar patterns, gene structures, and cis-regulatory regions. Several members have components linked to hormones, stress reactions, and developmental processes. Using data from the NCBI database, the expression patterns of *SIBPC* genes in seedlings and leaves under heat and drought stress conditions were analyzed. Under heat stress, expression levels peaked after 12 hours, and during the first day of the drought, *SIBPC* genes reached their maximum. RNA-seq analysis showed significant differential expression in the vein and intervein during drought (T1). In the vein, *SIBPC1* and *SIBPC4* were upregulated, while *SIBPC2* and *SIBPC5* were downregulated, and in the intervein. The implication is that *SIBPCs* play a role in facilitating plant adaptation to abiotic stress conditions by responding to abiotic stressors. The findings, taken together, provide a framework for functional research of *SIBPCs* in tomato, particularly for controlling heat and drought stress.

Key Words: Genome-wide, BASIC PENTACYSTEINE, Tomato, Heat, Drought



ID: 397

Investigation of the Effects of Agricultural Waste and Nitrogen Doses on Corn Plant

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Abstract

The increasing cultivation of corn has led to a growing demand for plant nutrients. The present study aimed to investigate the effects of applying plant residues and liquid animal manure as fertilizers on corn plant growth. Therefore, it was aimed to investigate the effects of using plant residues and liquid animal waste as fertilizer on corn plants. In the research, the characteristics of corn plant such as tassel emergence time, plant height, first node diameter, stem thickness in the plant, number of leaves in the plant, total leaves area above with cob leaf, cob length, thousand grain weight, and grain yield were investigated. It was recorded that the examined characteristics that plant height, upper cob leaf area, cob length, thousand grain weight, grain yield values of the corn plant showed statistically significant differences in terms of agricultural plant waste, fertilizer applications, and agricultural plant waste x fertilizer application interaction. It was determined that the diameter of the first internode according to the agricultural plant residues, while the days to tassel emergence, stem thickness, and leaf number were not affected by the applied factors. According to the research results, it was determined that chickpea straw, which gave the highest results in terms of many features, can be used in corn cultivation as agricultural plant waste in terms of organic agriculture. When the effects of liquid animal waste and urea fertilizer on corn cultivation were examined, it was recorded that the 40 kg da⁻¹ dose of nitrogen fertilizer gave higher values than the liquid animal waste doses.

Key Words: corn, liquid animal waste, plant waste, fertilizer.

Tarımsal Atığın ve Azot Dozlarının Mısır Bitkisine Etkilerinin İncelenmesi

Özet

Mısır tarımındaki artışa paralel olarak bitki besin elementlerine duyulan ihtiyaç da yükselmektedir. Bu çalışmada, bitkisel atıklar ve sıvı hayvan gübrelerinin mısır bitkisinde gübre olarak kullanılmasının bitki gelişimi üzerindeki etkileri incelenmiştir. Bölünmüş parseller deneme deseninde yürütülen çalışmada, tarımsal bitki atıkları olarak nohut, buğday samanı ve kontrol grubu ana materyal olarak kullanılmış, ikinci alt faktör olarak ise kontrol grubu, sıvı hayvan atığı ve üre dozları uygulanarak mısır bitkisi üzerindeki etkileri araştırılmıştır. Araştırmada mısır bitkisinin tepe püskülü çıkış süresi, bitki boyu, ilk boğum çapı, bitkide sap kalınlığı, bitkide yaprak sayısı, koçan ve yukarıdaki toplam yaprak alanı, koçan uzunluğu, bin tane ağırlığı, ve tane verimi özellikleri incelenmiştir. Mısır bitkisinin incelenen özelliklerinden bitki boyu, koçan yukarısı yaprak alanı, koçan uzunluğu, bin tane ağırlığı, tane tane verim değerleri, tarımsal bitki atığı, gübre uygulamaları, tarımsal bitki atığı x gübre uygulama interaksyonunda istatistiki olarak önemli farklılıklar gösterdiği kaydedilmiştir. İncelenen diğer özelliklerden ilk boğum çapı tarımsal bitki atıklarına göre istatistiki olarak önemli farklılıklar gösterdiği, tepe püskül çıkış süresi, sap kalınlığı, bitkide yaprak sayısının ise uygulanan faktörlerden etkilenmediği belirlenmiştir. Araştırma sonucuna göre birçok özellikler bakımından en yüksek sonuçları veren nohut samanının organik tarım açısından tarımsal bitki atığı olarak mısır yetiştiriciliğinde kullanılabilirliği tespit edilmiştir. Sıvı hayvansal atık ve üre gübresinin ise mısır yetiştiriciliği üzerine etkisine bakıldığında, azot gübresinin 40 kg da⁻¹ dozunun, sıvı hayvansal atık dozlarına göre daha yüksek değerler verdiği kaydedilmiştir.

Anahtar Kelimeler: mısır, sıvı hayvan atığı, bitki atığı, gübre.

Giriş

İnsanlık tarihi boyunca süregelen tarım faaliyetleri, medeniyetlerin gelişimiyle birlikte çeşitli tarım uygulamalarının ortaya çıkmasına ve zamanla değişmesine neden olmuştur. Arazi yapılarının bozulması, küresel ısınma, gıda güvenliği gibi sorunlar konvansiyonel tarımın uzun vadede sürdürülebilir olmayacağını göstermiştir (Gliessman, 2007). Bu nedenle, üretim artışıyla birlikte kaliteyi ön planda tutmayı ve uygun yetiştirme tekniklerine fırsat veren alternatif yöntemler önemlilik arz etmiştir. Bu alternatif yöntemlerden bir tanesi ise uygun yetiştirme tekniklerinin yanı sıra insan, hayvan ve çevre sağlığını da ön planda tutan “organik tarım”



yöntemidir. Araştırmalar, organik tarım kullanımının; biyolojik çeşitliliği zenginleştirdiğini (Hole vd., 2005), toprak verimliliğini artırdığını (Watson vd, 2002) ve konvansiyonel tarımın oluşturduğu zararlı çevresel etkileri azalttığını (Bengtsson, vd., 2005; Badgley, 2007) göstermektedir. Organik tarım sistemlerinde, bitki ve sıvı hayvansal atıklarının gübre olarak değerlendirilmesi, toprak verimliliğini artırmak ve sürdürülebilir bir tarım uygulaması gerçekleştirmek için sıklıkla tercih edilen yöntemler arasındadır.

Mısır, çok çeşitli kullanım alanlarına sahip çok yönlü bir bitkidir. Mısır, insan gıdası, hayvan yemi ve endüstriyel amaçlar için yetiştirilir. Mısır, insanlar için önemli bir kalori ve besin kaynağıdır. İyi bir karbonhidrat, lif, vitamin ve mineral kaynağıdır. Mısır, çiftlik hayvanları, kümes hayvanları ve diğer hayvanlar iyi bir enerji ve protein kaynağıdır (Uskutoğlu ve İdikut, 2024). Mısır insan ve hayvan beslenmesinde kullanıldığı gibi endüstri alanında da yoğun olarak kullanılan bir sıcak iklim tahıl bitkisidir. Tarımın tamamen mekanize olması, bitkinin kısa sürede yetişmesi, diğer ürünlere göre daha yüksek verim vermesinden dolayı mısır bitkisinin tarımı tercih edilmektedir. İdikut ve Kara, (2013) çalışmalarında mısırın besleyici değerinin yüksek olduğunu, tanesinde %50'den fazla oranda nişasta olduğunu ve böylece iyi bir enerji kaynağı olduğunu belirtmişlerdir. Mısır Türkiye'de hemen hemen bütün bölgelerinde farklı kullanım amaçlarıyla yetiştirilmektedir. Yetiştiriciliği sırasında çok fazla bitki aksamını kısa sürede oluşturduğu için topraktan fazla miktarda besin maddesi kaldırmaktadır. Bu nedenle bu araştırmada çevre dostu üretim yapılması için bitki ve sıvı hayvansal atıkların kullanılmasıyla mısır yetiştiriciliğinin tarımının artırılması amaçlanmıştır.

Materyal ve Yöntem

Araştırma, merkez Kahramanmaraş ekolojik koşullarında 2019 yılında Kahramanmaraş Sütçü İmam Üniversitesi Ziraat Fakültesi'ne ait Tarla Bitkileri deneme alanında gerçekleştirilmiştir. Çalışmada "P 0729" adlı ikinci ürün mısır çeşidi kullanılmıştır. Deneme alanı bölünmüş parseller deneme desenine göre üç tekerrürlü kurulmuştur. Ekimden önce deneme alanı 8-10 cm derinlikte kültivatör ile sürülmüştür. Ana parseller, bitki atıklarından buğday samanı, nohut samanı ve kontrol olmak üzere üç uygulamadan oluşmuştur. Bitki materyali uygulamasında nohut ve buğdayın dekarda elde edilen bitki artığı miktarı dikkate alınarak uygulanmıştır. Söz konusu bitki artığı uygulamasında dekara 350 kg nohut samanı ve 650 kg buğday samanı serpilip tırmıkla karıştırılarak tesviye edilip deneme alanı ekime hazır hale getirilmiştir. Mısır bitkisini ekimi mibzerle 70x20 bitki sıklığında ekilmiştir. Ekim ile beraber damla sulama sistemi kurularak sulama yapılmıştır. Ekimle birlikte dekara 6 kg saf fosfor gübresi uygulanmıştır. Denemenin alt parseller uygulamalarından olan kontrol, sıvı hayvan gübresi ve üre dozları uygulama şekli Çizelge 1'de verilmiştir.

Çizelge 1. Mısır bitkisine farklı dozlardaki sıvı hayvansal atık ve azot gübresinin uygulama şekli ve dozları.

Ana Parsel Uygulamaları	Alt Parsel Uygulamaları				
Kontrol (0 kgda ⁻¹)	Kontrol	Sıvı Hayvansal Atık 1. Doz	Sıvı Hayvansal Atık 2. Doz	Üre 1. Doz	Üre 2. Doz
	0 kg da ⁻¹	1000 lt da ⁻¹	2000 lt da ⁻¹	20 kg da ⁻¹	40 kg da ⁻¹
Buğday Samanı (650 kgda ⁻¹)	Kontrol	Sıvı Hayvansal Atık 1. Doz	Sıvı Hayvansal Atık 2. Doz	Üre 1. Doz	Üre 2. Doz
	0 kg da ⁻¹	1000 lt da ⁻¹	2000 lt da ⁻¹	20 kg da ⁻¹	40 kg da ⁻¹
Nohut Samanı (350 kgda ⁻¹)	Kontrol	Sıvı Hayvansal Atık 1. Doz	Sıvı Hayvansal Atık 2. Doz	Üre 1. Doz	Üre 2. Doz
	0 kg da ⁻¹	1000 lt da ⁻¹	2000 lt da ⁻¹	20 kg da ⁻¹	40 kg da ⁻¹

Alt parsellere uygulanan gübre dozları bölünerek farklı zamanlarda uygulanmıştır. Gübre uygulama işlemi mısır bitkisi 50 cm boya ulaşınca kadar devam etmiştir. Her gübre uygulamasından sonra damla sulama sistemi ile 6 saat süre ile bitkiler sulanmıştır. Deneme toplamda 1'er hafta arayla 9 kere sulanmıştır. Sulama işlemi bitkilerin su ihtiyacı dikkate alınarak uygulanmış ve koçan yapraklarının kurumasına kadar sürdürülmüştür. Mısır bitkisi el çapası ve traktör çapası olmak üzere 2 kere çapalanmıştır. Tarladaki bitki zararlıları dikkate alınarak sap ve koçan kurdu için insektisit kullanılmıştır. Hasat işlemi için tanenin nem miktarı ve tanenin somağa bağlandığı nokta dikkate alınarak elle yapılmıştır.

Denemenin yürütüldüğü dönemde Kahramanmaraş ilinin iklim verileri Çizelge 2'de verilmiştir (Anonim a, 2019). Araştırmada mısır bitkisinin yetiştirilmesinde ve gelişmesinde önemli etkiye sahip olan iklim ve toprak özelliklerinin yanı sıra bitki atıkları da kullanıldığı için bitki atıklarının kimyasal yapısının da önemli etkisinin



olduğunu düşünülerek nohut ve buğday samanının kimyasal bileşenlerinin analizleri de yapılmıştır. Kimyasal bileşen analizlerinin sonuçları ise Çizelge 3’de verilmiştir.

Çizelge 2. Denemenin yürütüldüğü 2019 yılında Kahramanmaraş iline ait iklim verileri.

Aylar	Ortalama Nispi Nem (%)	Toplam Yağış (mm)	Ortalama Sıcaklık (°C)	Maksimum Sıcaklık (°C)	Minimum Sıcaklık (°C)
Temmuz	47.2	0.1	28.4	38.9	18.9
Ağustos	47.7	0.1	29.5	43.1	20.7
Eylül	41.2	1.5	26.3	37.9	14.7
Ekim	55.1	36.6	21.3	34.9	11.5
Kasım	56.2	39.1	13.5	25.5	5.0
Toplam	-	77.4	-	-	-
Ortalama	49.48	-	23.8	36.06	14.16

Çizelge 2’de, denemenin yapıldığı 2019 yılına ait Kahramanmaraş ilinin iklim verileri verilmiştir. Mısırın yetiştirme süresine önemli etkisi olan Temmuz, Ağustos ve Eylül aylarının nisbi nem bakımından % 50’nin altında olduğu ve toplam yağış miktarının da çok düşük olduğu, ortalama sıcaklığın, maksimum sıcaklığın ve minimum sıcaklığın ise yüksek olduğu görülmektedir.

Çizelge 3. Nohut ve buğday samanının kimyasal bileşenlerinin analizleri

Analizler	Nohut Samanı	Buğday Samanı	Analiz Metodu
Toluen-aseton-etanol çözünürlüğü (%)	7.395	5.679	(Anonim, 2007)
Holoselüloz oranı (%)	66.742	79.825	Wise’ nin klorit metodu (Wise, 1962)
Selüloz oranı (%)	39.228	52.937	Hoffer metodu (Kürschner and Hoffer, 1969)
Lignin oranı (%)	13.419	27.717	TAPPIT 222 om-88 (Anonim, 1992)
Kül (%)	8.332	13.944	TAPPIT 211 om-85 (Anonim, 1992)

Çizelge 3’de görüldüğü gibi kimyasal bileşen analiz sonucuna göre toluen-aseton-etanol çözünürlüğü nohut samanında (%7.395) buğday samanına (%5.679) göre daha fazladır. Diğer kimyasal bileşen analizlerine göre ise buğday samanı nohut samanına oranla daha yüksek değerlere sahip olmuştur. Buğday samanında lignin ve selüloz oranının daha yüksek çıkması bitki atıklarının daha sert olmasını sağlamaktadır. Deneme alanının toprağı, özellikle organik madde (%1.41) ve fosfor (5.78 ppm) açısından fakir, ancak potasyum (146.1 ppm) bakımından zengindir. Toprak yapısı kumlu-killi, pH değeri hafif alkali (7.53), kireç içeriği yüksek (%4.02) ve tuz içeriği düşük (%0.11) olarak belirlenmiştir. Toplam azot miktarı (%0.78) ise yüksek bulunmuştur (Anonim b, 2019). Bitkinin gelişme dönemleri izlenerek gözlem ve ölçümler yapılmıştır. Tepe püskülü çıkış süresi (gün), bitki boyu (cm), ilk boğum çapı (cm), bitkide sap kalınlığı (cm), bitkide yaprak sayısı (adet bitki⁻¹), koçan ve yukarıdaki toplam yaprak alanı (cm), koçan uzunluğu (cm), bin tane ağırlığı (gr) ve tane verimi (kg da⁻¹) özellikleri incelenmiştir. İncelenen özelliklerin varyans analizi ve ortalamalarının karşılaştırılması Jump İstatistik paket programında yapılmıştır.

Bulgular ve Tartışma

Kahramanmaraş koşullarında yürütülen bu çalışmada, nohut ve buğday saplarının toprağı karıştırılmasıyla ekilen mısır bitkisine uygulanan farklı sıvı hayvan gübresi ve azot dozlarının tepe püskülü çıkış süresine (gün), bitki boyuna (cm), ilk boğum çapına (cm), etkileri Çizelge 4’de, bitkide sap kalınlığına (cm), bitkide yaprak sayısına (adet bitki⁻¹), koçan ve yukarıdaki toplam yaprak alanına (cm) etkileri Çizelge 5’de, koçan uzunluğuna (cm) bin tane ağırlığına (g), ve tane verimine (kg da⁻¹) etkileri ise Çizelge 6’da verilmiştir.

Tepe püskülü çıkış süresine tarımsal bitki atığı, gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarının etkisinin istatistiksel olarak önemsiz olduğu görülmüştür. Tepe püskülü çıkış süresi 37.00 ile 48.66 gün arasında değişmiştir. Tepe püskülü çıkış süresi bakımından erkencilik nohut samanının uygulandığı sıvı hayvansal atığın 2. dozunda (37.00 gün), en geç tepe püskülü çıkış süresi ise buğday samanının kontrol (48.66 gün) uygulamasında görülmüştür (Çizelge 4.). Daha önce yapılan çalışmalarda Yılmaz (2024), Bursa ilinde ikinci ürün olarak yetiştirilen mısır bitkisinde ekim sıklığı ve uygulanan azot gübre dozlarının tepe püskülü çıkış süresi bakımından istatistiki olarak önemli olmadığı belirterek bizim bulgularımızı desteklemektedir. Cui



ve ark. (2015), mısır çeşitlerinde gölgelemenin etkisi üzerine yaptıkları araştırmada tepe püskülü çıkışının önemsiz olduğunu belirtmiştir. Bazı araştırmalarda ise mısıra uygulanan faktörlere göre tepe püskülü çıkış süresinin istatistiki olarak önemli olduğu tespit edilmiştir (İdikut ve Kara (2013), Öktem ve Toprak (2013), Rah Khosravani ve ark. (2017), Taş ve Öktem (2017), Yüreklı ve ark. (2021)). Araştırmalardan tepe püskülü çıkış süresinin kullanılan çeşide, ekim zamanına, mısır türlerine, gölgelemeye, lokasyonlara, sulama koşullarına ve uygulanan gübre faktörlerine göre değişiklik gösterebildiği anlaşılmaktadır. Yürütülen araştırmada tek çeşit kullanılması, denemenin yürütüldüğü Temmuz ve Ağustos aylarında sıcaklıkların yüksek, nemin düşük olması, tepe püskülü oluşumunu hızlandırarak önemli farklılığın oluşmasının ortadan kalmasına neden olduğu düşünülmektedir.

Çizelge 4. Bitki atıklarının, farklı dozdaki azot ve sıvı hayvan atığı dozlarının mısır bitkisinin tepe püskülü çıkış süresine (gün), bitki boyuna (cm) ve ilk boğum çapına (cm) etkileri

TBAU GU	Kontrol	Nohut	Buğday	Gübre Doz Ort.
Tepe püskülü çıkış süresi (gün)				
Kontrol	43.66	43.00	48.66	45.11
Üre 1. doz	46.33	42.66	47.00	45.33
Üre 2. doz	44.00	42.33	47.33	44.55
SHG 1. doz	43.00	44.33	47.66	45.00
SHG 2. doz	42.33	37.00	46.33	41.88
Ortalama	43.86	41.86	47.40	44.37
Bitki boyu (cm)				
Kontrol	176.46 cd	190.30 ab	153.60 e	169.12 c
Üre 1. doz	183.46 bc	194.13 a	167.33 e	186.31 a
Üre 2. doz	194.26 a	195.96 a	170.36 d	186.86 a
SHG 1. doz	192.90 ab	184.83 bc	147.80 e	175.17 b
SHG 2. doz	193.53 ab	174.03 d	156.66 e	172.74 bc
Ortalama	187.32 a	187.85 a	157.95 b	178.04
TBAU: **, GU: **, TBAUxGU: **				
İlk boğum çapı (cm)				
Kontrol	2.32	2.47	2.87	2.29
Üre 1. doz	2.38	2.47	2.21	2.35
Üre 2. doz	2.45	2.51	2.16	2.27
SHG 1. doz	2.21	2.34	2.03	2.19
SHG 2. doz	2.42	2.25	2.08	2.25
Ortalama	2.36 a	2.41 a	2.11 b	2.29
TBAU:*,				

SHG:Sıvı hayvan gübresi, TBAU: Tarımsal bitki atık uygulaması, GU: Gübre uygulaması

Bitki boyunda tarımsal bitki atığı, gübre uygulamaları ve tarımsal bitki atığı x gübre interaksyonu uygulamaları istatistiki olarak önemli farklılık oluşturmuştur. Buğdayın bitki artığı uygulamasında mısır bitkisinin bitki boyunun 157,95 cm ile nohut ve kontrol uygulamasından daha düşük olduğu, istatistiksel önemli farklılığın olduğu kaydedilmiştir. Farklı azot doz ve sıvı hayvan gübre uygulamasında bitki boyları 169.12-186.86 cm arasında değişim görülmüştür. En yüksek bitki boyunun azot doz uygulamalarından elde edildiği, kontrol ve hayvan sıvı gübre uygulamalarından önemli derecede farklılık oluşturduğu kaydedilmiştir. Tarımsal bitki atığı x gübre interaksyonu uygulamalarında mısır bitkisinin boyu 147.80 -195.96 cm arasında değişmiştir. En uzun bitki boyu nohut samanına uygulanan ürenin 2. dozunda, kontrole uygulanan ürenin 2. dozunda ve nohut samanına uygulanan ürenin 1. dozunda (sırasıyla 195.96 cm, 194.26 cm ve 194.13 cm) gözlemlenirken, en kısa bitki boyu ise buğday samanına uygulanan sıvı hayvansal atığın 1. dozunda (147.80 cm) görülmüştür (Çizelge 4.). Daha önce yapılan çalışmalarda Kan (2011), Konya yöresinde mısır yetiştiriciliğinde organik ve inorganik gübre dozlarının bitki boyu bakımından değişkenlik gösterdiğini 1.yıl 189.75-214.15 cm, 2. yıl ise 188.50-223.25 cm arasında değiştiğini bildirmiştir. Sing ve ark. (2012), çalışmalarında mısır bitkisinde azot miktarının artması ile bitki boyunun arttığını tespit etmişlerdir. Altunlu ve ark. (2019), mikrobiyal gübre uygulamalarının bitki boyunu olumlu etkilediğini belirterek bitki boyunu 150.1-174.0 cm arasında değiştiğini belirtmişlerdir. Cokkızgın ve ark. (2022) Kahramanmaraş koşullarında üç farklı organik (sığır, solucan, leonardit) gübre uygulamasında bitki boyunun 157.87-180.71 cm arasında olduğunu kaydetmişlerdir. Bapaimu ve ark. (2024), çalışmalarında farklı dozlardaki (0, 20, 25 ve 30 ton ha⁻¹) inek gübresi uygulamasında en yüksek bitki boyunu 138 cm ile 30 ton ha⁻¹ gübre dozunda tespit etmiştir. Nohut samanındaki çözünürlüğün buğday samanına göre yüksek olmasından kaynaklandığı düşünülmektedir. Çizelge 3’de veriler bu durumu açıklamaktadır.



İlk boğum çapında tarımsal bitki atığı uygulamaları istatistiki olarak farklılıklar oluştururken, gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarının istatistiki olarak farklılıklar oluşturmadığı görülmüştür. Tarımsal bitki atığı uygulamasında en yüksek ilk boğum çapı nohut samanı ve kontrol uygulamalarında (sırasıyla 2.41 cm ve 2.36 cm) gözlemlenirken en düşük ise buğday samanı (2.11 cm) uygulamasında tespit edilmiştir (Çizelge 4.). Esfandiary ve ark. (2012), İran'ın yarı kurak koşullarında mısır çeşitlerinde ilk boğum çapının 19 ile 21 mm arasında değiştiğini bildirmişlerdir. Mısır bitkisinde ilk boğum çapının kalınlığının topraktan aldığı besinle ve kök yayılımıyla ilgili olduğu bildirilmiştir (Ngairangbam ve ark., 2024).

Çizelge 5. Bitki atıklarının, farklı dozdaki azot ve sıvı hayvan atığı dozlarının mısır bitkisinin sap kalınlığına (cm), yaprak sayısına (adet bitki⁻¹) ve koçan ve yukarıdaki toplam yaprak alanına (cm²) etkileri

TBAU GU	Kontrol	Nohut	Buğday	Ortalama
Sap kalınlığı (cm)				
Kontrol	2.00	1.97	1.76	1.91
Üre 1. Doz	2.05	1.93	1.74	1.91
Üre 2. Doz	1.96	2.03	1.81	1.93
SHG 1. Doz	1.80	1.91	1.43	1.81
SHG 2. doz	1.97	1.79	1.75	1.83
Ortalama	1.96	1.93	1.76	1.88
Bitkide yaprak sayısı (adet bitki⁻¹)				
Kontrol	11.00	11.33	11.07	11.13
Üre 1. Doz	11.00	11.93	10.80	11.24
Üre 2. Doz	11.67	11.73	11.40	11.60
SHG 1. Doz	11.27	11.13	11.13	11.17
SHG 2. Doz	11.53	10.93	10.73	11.07
Ortalama	11.29	11.41	11.02	11.24
Koçan ve yukarıdaki toplam yaprak alanı (cm²)				
Kontrol	2078.58 ab	2198.35 ab	1214.08 e	1830.78 b
Üre 1. doz	2065.56 ab	2274.61 ab	1548.01 de	1962.72 ab
Üre 2. doz	2331.51 ab	2385.18 a	1483.56 de	2066.78 a
SHG 1. doz	2347.04 ab	1774.07 cd	1274.08 e	1781.73 bc
SHG 2. doz	2045.57 bc	1436.16 de	1332.08 e	1604.60 c
Ortalama	2173.67 a	2003.67 a	1370.46 b	1849.27
TBAU: ** GU: ** TBAU x GU: **				

SHG:Sıvı hayvan gübresi, TBAU: Tarımsal bitki atık uygulaması, GU: Gübre uygulaması

Tarımsal bitki atığı, gübre, tarımsal bitki atığı x gübre interaksyonu uygulamalarında istatistiki olarak koçanın bağlandığı sap kalınlığı bakımından farklılıklar oluşturmadığı kaydedilmiştir. Koçanın bağlandığı sap kalınlığı 2.05 – 1.43 cm arasında değişmiştir (Çizelge 5.). Daha önce yapılan çalışmalarda Grazia ve ark. (2003), çalışmalarında mısır bitkisinde azot ve fosfor gübre interaksyonunun sap kalınlığı bakımından istatistiki olarak önemsiz olduğunu bildirmişlerdir. Özel ve Öktem (2021), mısır bitkisinde vermikompost uygulamasının sap kalınlığı bakımından istatistiki olarak önemli olmadığını belirterek mısırdaki sap kalınlığını 22.12 ile 24.00 mm arasında değer aldığını tespit etmişlerdir.

Tarımsal bitki atığı, gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarında istatistiki olarak bitkide yaprak sayısı bakımından fark görülmemiştir. Bitkide yaprak sayısı 10.73-11.93 adet bitki⁻¹ arasında değişmiştir (Çizelge 5.). Daha önce yapılan çalışmalarda Budaklı ve Çarpıcı (2009), mısır bitkisinde farklı azot dozlarının (0,10,20,30 ve 40 kg da⁻¹) yaprak sayısına etkisini incelediği çalışmada en az yaprak sayısının dekara 0 kg azot uygulamasında, en fazla yaprak sayısının ise dekara 30 ve 40 kg azot uygulamasında elde etmiştir. Öztürk ve Büyükgöz (2021), bazı mısır popülasyonlarında yaprak sayısının 7.73 ile 13.38 adet arasında değiştiğini tespit etmişlerdir. Maryani ve ark. (2024), deterjan içeren çamaşır atıklarından elde edilen zeolit mısır bitkisindeki etkisini araştırdıkları çalışmalarında yetiştiriciliğin 5. ve 10. günlerinde yaprak sayısının arttığını fakat 15. günde besin elementlerinin alınamamasından özellikle başta azot eksikliğinden dolayı yaprak sayısında azalma olduğunu belirterek mısır bitkisi için ihtiyaç duyulan besin maddelerinin bitki gelişimi bakımından önemli olduğunu vurgulamışlardır. Bapaimu ve ark. (2024), çalışmalarından farklı dozlardaki (0, 20, 25 ve 30 ton ha⁻¹) inek gübresi uygulamasında en yüksek yaprak sayısının 8.56 adet ile 25 ton ha⁻¹ gübre dozunda tespit etmiştir. Mısır bitkisinde yaprak sayısında genetik özelliğin etkisi yüksek olmakla birlikte, çok fazla stres yaratacak faktörlerin yaprak sayısını azaltıcı etkisini olabileceği bildirilmiştir.(Blancon ve ark., 2024).

Koçan ve yukarıdaki toplam yaprak alanı değerleri tarımsal bitki atığı, gübre dozları, tarımsal bitki atığı x gübre interaksyon uygulamaları bakımından istatistiki olarak önemli farklılıklar görülmemiştir. Koçan ve



yukarıdaki toplam yaprak alanı 2173.67-1274.08 cm² arasında değişmiştir. Tarımsal bitki atığı uygulamalarında kontrol ve nohut samanının (sırasıyla 2173.67, 2003.67 cm²) buğday samanına (1370.46 cm²) göre koçan ve yukarıdaki toplam yaprak alanı bakımından yüksek olduğu gözlemlenmiştir. Gübre uygulamalarına göre en yüksek koçan ve koçan yukarı yaprak alanı 2066.78 cm² ile ürenin ikinci dozundan elde edildiği, ürenin birinci dozu hariç diğer gübre uygulamalarından önemli derecede farklılık olduğu kaydedilmiştir. En düşük koçan ve yukarı yaprak alanı 1604.60 cm² ile hayvan sıvı atığının ikinci dozundan elde edildiği, hayvan sıvı atığının birinci dozu hariç diğer gübre uygulamalarından önemli derecede farklılık olduğu belirlenmiştir. Tarımsal bitki atığı x gübre interaksyonu uygulamalarında en yüksek koçan ve yukarıdaki toplam yaprak alanı nohut samanına uygulanan ürenin 2. dozunda (2385.18 cm²) gözlemlenirken, en düşük koçan ve yukarıdaki toplam yaprak alanı buğday samanı uygulamasının kontrol, sıvı hayvansal atığın 1. ve 2. dozları (sırasıyla 1214.08, 1274.08 ve 1332.08 cm²) uygulamalarında tespit edilmiştir (Çizelge 5.). Daha önce yapılan çalışmalarda Thenveetil ve ark. (2024), mısır bitkisine uyguladıkları K gübresinin % 0.7'den % 1.3'e çıkması yaprak alanında artış sağladığını fakat daha fazla artışın yaprak alanına etki etmediğini, K eksikliğinde ise yaprak alanının önemli bir şekilde azaldığını bildirmişlerdir. Mutmainna (2024), mısır bitkisine uygulanan organik gübre, fosfat çözücü madde ve organik gübre + fosfat çözücü maddenin yaprak alanına etkisini araştırdığı çalışmada en yüksek yaprak alanının 2000 cm² ile organik gübre + fosfat çözücü maddede en düşük yaprak alanının ise 1200 cm² ile kontrol uygulamasında görüldüğünü tespit etmiştir.

Çizelge 6. Bitki atıklarının, farklı dozdaki azot ve sıvı hayvan atığı dozlarının mısır bitkisinin koçan uzunluğuna (cm), bin tane ağırlığına (gr) ve tane verimine (kg da⁻¹) etkileri

TBAU GU	Kontrol	Nohut	Buğday	Ortalama
Koçan uzunluğu (cm)				
Kontrol	13.58 fg	16.28 bc	10.59 ı	13.49 c
Üre 1. doz	16.70 bc	17.38 b	13.42 fg	15.83 b
Üre 2. doz	18.59 a	18.98 a	14.06 ef	17.21 a
SHG 1. doz	15.68 cd	15.08 de	11.32 hı	14.02 c
SHG 2. doz	14.43 ef	13.39 fg	12.38 gh	13.40 c
Ortalama	15.80 a	16.22 a	12.35 b	14.79
TBAU: **, GU: **, TBAU x GU: **				
Bin Tane Ağırlığı (gr)				
Kontrol	231.07 g	246.70 cdef	229.06 g	235.61 c
Üre 1. doz	245.72 def	261.19 b	240.87 efg	249.26 b
Üre 2. doz	281.76 a	289.21 a	259.37 bcd	276.78 a
SHG 1. doz	241.12 efg	236.13 fg	246.00 cdef	241.09 c
SHG 2. doz	236.22 fg	253.32 bcde	259.68 bc	249.74 b
Ortalama	247.18 b	257.31 a	247.00 b	250.50
TBAU: **, GU: **, TBAU x GU: **				
Tane Verimi (kg da⁻¹)				
Kontrol	655.95 de	774.17 cd	590.59 e	673.57 c
Üre 1. doz	750.92 cd	864.68 bc	681.79 de	781.42 b
Üre 2. doz	1205.12 a	991.25 b	756.85 cd	1068.79 a
SHG 1. doz	850.83 c	749.77 cd	576.82 e	725.81 c
SHG 2. doz	825.31 c	606.16 e	571.87 e	667.78 c
Ortalama	857.63 a	797.21 a	535.58 b	763.47
TBAU: *, GU: **, TBAU x GU: **				

SHG:Sıvı hayvan gübresi, TBAU: Tarımsal bitki atık uygulaması, GU: Gübre uygulaması

Koçan uzunluğunda, tarımsal bitki atığı, gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarının istatistiki olarak önemli farklılık oluşturduğu belirlenmiştir. Tarımsal bitki atığı uygulamalarında nohut samanı ve kontrol uygulamasının (sırasıyla 16.22 ve 15.80 cm) buğday samanına (12.35 cm) göre koçan uzunluğu bakımından yüksek olduğu gözlemlenmiştir. Gübre uygulamasında üre gübresinin 2. dozu en yüksek koçan uzunluğuna (17.21 cm) sahip olduğu, onu ikinci sırada azot dozunun birinci dozunun izlediği kendi aralarında istatistiksel önemli farklılık oluştururken diğer uygulamalardan da önemli derecede farklılık oluşturduğu kaydedilmiştir. En düşük koçan uzunluğu sırasıyla sıvı hayvansal atığın 2. dozu, kontrol ve sıvı hayvansal atığın 1. dozunda (13.40, 13.49 ve 14.02 cm) görülmüştür. Tarımsal bitki atığı x gübre interaksyonu uygulamalarında koçan uzunluğu 10.59 – 18.98 cm arasında değiştiği kaydedilmiştir. En yüksek koçan uzunluğu nohut samanına ve kontrole uygulanan ürenin 2. dozunda (sırasıyla 18.98 ve 18.59 cm) gözlemlenirken, en kısa koçan uzunluğu ise buğday samanına uygulanan kontrol (10.59 cm) uygulamasında tespit edilmiştir. (Çizelge 6.). Daha önce



yapılan çalışmalarda Sarikurt ve Bengisu (2020), çalışmalarında Diyarbakır koşullarında ikinci ürün mısır çeşitlerinde koçan uzunluğunu 14.50-19.41 cm arasında, Yılmaz (2024), Bursa ilinde ikinci ürün olarak yetiştirilen mısır bitkisinde en yüksek koçan uzunluğunu 30 kg da⁻¹ uygulamasında 19.2 cm, en düşük koçan uzunluğunu ise 7.5 kgda⁻¹ uygulamasında 16.1 cm olarak, Bapaimu ve ark. (2024), farklı dozlardaki (0, 20, 25 ve 30 tonha⁻¹) inek gübresi uygulamasında en yüksek koçan uzunluğunu 19.56 cm ile 25 ton ha⁻¹ gübre dozunda tespit etmiştir. Koçan uzunluğu çeşidin genetik özelliği olması yanı sıra, verimle ilişkili olduğu ve çevresel faktörlerden etkilendiği daha önceki araştırmacıların bulgularından da anlaşılmaktadır (Kovacevic ve ark., 2024). Bin tane ağırlığı bakımından gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarında istatistiki olarak önemli bulunmuştur. Nohut samanı uygulamasında mısırın bin tane ağırlığı 257.31 g ile kontrol ve buğday samanı uygulamasından önemli derecede farklılık oluşturmuştur. Kontrol ve buğday samanı uygulamasında mısırın bin tane ağırlığı aynı grupta yer alarak nohut saman uygulamasından daha düşük değere sahip olduğu görülmüştür. Gübre uygulamasında üre gübresinin 2. dozu en yüksek bin tane ağırlığına (276.78 gr), kontrol ve sıvı hayvansal atığın 1. dozu ise en az bin tane ağırlığına (sırasıyla 235.61 ve 241.09 gr) sahip olmuştur. Tarımsal bitki atığı x gübre interaksyonu uygulamalarında bin tane ağırlığı 229.06 -289.21 gr arasında değiştiği, en yüksek bin tane ağırlığı nohut samanında ve kontroldeki azottun 2. dozunda (sırasıyla 289.21 ve 281.76 gr) gözlemlenirken, en az bin tane ağırlığı ise buğday samanının kontrolünde ve kontrol uygulamasında (sırasıyla 229.06 ve 231.07 gr) tespit edilmiştir. (Çizelge 6.). Daha önce yapılan çalışmalarda Esfandiary ve ark. (2012), İran'ın yarı kurak koşullarında mısır çeşitlerinde bin tane ağırlığının 190 ile 224 g, İdikut ve ark. (2020), 17 adet hibrit mısır çeşitlerinde bin tane ağırlığının 274.0 ile 383.9 g, İdikut ve ark (2021) yerel patlak mısır çeşitleri bin tane ağırlığının 128.79 - 181.06 g, Yılmaz (2024), Bursa ilinde ikinci ürün olarak yetiştirilen mısır bitkisinde en yüksek bin tane ağırlığını 30 kg da⁻¹ azot uygulamasında 271.3 g, en düşük bin tane ağırlığını ise 7.5 kg da⁻¹ azot uygulamasında 194.3 g olarak tespit etmiştir. Bin tane ağırlığının çeşide, yetiştirildiği bölgeye ve uygulanan faktörlere göre değiştiği daha önce yapılan çalışmalardan anlaşılmaktadır. Yürütülen çalışmada da bin tane ağırlığının uygulama faktörlerden etkilendiği görülmektedir. Bin tane ağırlığı genotiplerin veriminin belirlenmesinde direkt etili olan faktörlerden biridir (Reddy ve ark 2022).

Tarımsal bitki atığı, gübre ve tarımsal bitki atığı x gübre interaksyonu uygulamalarının tane verimi üzerine etkisi istatistiksel olarak önemli bulunmuştur. Tarımsal bitki atığı uygulamalarında kontrol ve nohut samanı uygulamasının (sırasıyla 857.63 ve 797.21 kg da⁻¹) buğday samanına (535.58 kg da⁻¹) göre tane verimi bakımından yüksek olduğu gözlemlenmiştir. Gübre uygulamasında üre gübresinin 2. dozu en yüksek tane verimini (1068.79 kg da⁻¹) gerçekleştirdiği, sıvı hayvansal atığın 2. dozu, kontrol ve sıvı hayvansal atığın 1. dozu en düşük tane verimine (sırasıyla 667.78, 673.57 ve 725.81 kgda⁻¹) sahip olduğu kaydedilmiştir. İnteraksiyon uygulamasında tane verimi 571.87 – 1205.12 kgda⁻¹ arasında değişmiştir. Tarımsal bitki atığı x gübre interaksyonu uygulamalarında en yüksek tane verimi kontrole uygulanan ürenin 2. dozunda (1205.12 kgda⁻¹) gözlemlenirken, en düşük tane verimi ise buğday samanına uygulanan sıvı hayvansal atığın 2. dozunda, sıvı hayvansal atığın 1. dozunda ve kontrolde (sırasıyla 571.87, 576.82 ve 590.59 kgda⁻¹) görülmüştür (Çizelge 6.). Daha önce yapılan çalışmalarda Pangaribuan ve ark. (2019), lamtoro yaprakları, muz hörgüçleri ve hindistan cevizi liflerinden elde edilen bir özüt karışımından elde edilen sıvı organik gübrenin tatlı mısır üzerinde inorganik gübre ve 25, 50, 75 ve 100 lha⁻¹ sıvı organik dozlarının verim üzerine etkisini inceledikleri araştırmalarında en yüksek verimin 17.81 ton ha⁻¹ ile 100 lha⁻¹ sıvı organik gübre dozunda olduğunu belirtmişlerdir. Alp ve Koca (2020), Aydın koşullarında mısır çeşitlerinde yapmış oldukları araştırmada tane veriminin 1177.3 ile 1703.4 kgda⁻¹ arasında değiştiğini bildirmişlerdir. Yılmaz (2024), Bursa ilinde ikinci ürün olarak yetiştirilen mısır bitkisinde en yüksek tane verimini 30kgda⁻¹ uygulamasında 955.2 kgda⁻¹, en düşük tane verimi ise 7.5 kgda⁻¹ uygulamasında 648.0 kgda⁻¹ olarak tespit etmiştir.

İklim koşulları, su ve gübre temini mısır bitkisi yetiştiriciliğini belirleyen temel unsurlardır. Mısır tarımında tarımsal atıkların gübre olarak kullanımı, doğal çevrenin korunmasını sağlarken, gübre harcamalarını da en aza indirecektir. Bu nedenle ikinci ürün mısır ekim öncesi, birinci ürün olarak yetiştirilen buğday ve nohut samanı toprağa karıştırılmış, mısır bitkisinin çıkışından sonrada farklı dozlarda hayvanın sıvı atığı ve azot gübresi uygulanmıştır. Tarımsal bitki atığı, gübre uygulamaları, tarımsal bitki atığı x gübre uygulama interaksyonunda mısır bitkisinin bitki boyu, koçan yukarısı yaprak alanı, koçan uzunluğu, bin tane ağırlığı, tane tane verimleri istatistiksel olarak önemli farklılıklar göstermiştir. Bitki boyunda, ilk boğum çapında, koçan ve yukarıdaki toplam yaprak alanında, koçan uzunluğunda ve bin tane ağırlığında nohut samanı uygulamasındaki üre gübresinin 2. dozunda (40 kg da⁻¹), tanede yağ oranında kontrole uygulanan sıvı hayvansal atığın 1. dozunda (1000 lt da⁻¹), tane veriminde kontrole uygulanan üre gübresinin 2. dozunda (40 kg da⁻¹) en yüksek değerler elde edilmiştir. Yürütülen çalışmada nohut samanının buğday samanına göre daha yüksek pozitif etkide bulunduğu belirlenmiştir. Nohut samanının selüloz ve lignin değerlerinin buğday samanına göre daha düşük olması ve organik tarım açısından kullanılabilir olduğunu göstermektedir. Farklı dozlardaki sıvı hayvansal atık ve azot dozlarının etkisi bakımından ise üre gübresinin 2. dozu (40 kg da⁻¹) mısır yetiştiriciliği bakımından ön plana çıkmıştır.



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Evaluation of wheat genotypes for heat tolerance in late sown condition of Nepal

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Abstract

To study the effect of higher temperature on the yield of wheat (*Triticum aestivum* L.) genotypes, two field experiments (normal and late sown condition) were conducted from November 2021 to April 2022 at the Research farm of Rampur campus, Khairahani, Chitwan, Nepal. Twelve wheat genotypes were experimented in alpha lattice design with 3 replications. Observations for days to heading, days to maturity, plant height, grain filling period, thousand kernel weight, and grain yield were recorded, and analysis was done at 0.05 probability level. The performance of grain yield and other studied traits were significantly ($p \leq 0.05$) higher in the normal season compared to the late season. Highly significant effects ($p \leq 0.001$) of genotypes, season, and genotype by season interaction on grain yield and other traits were obtained. Genotype MYT1718-24 was one of the top grain yielding genotypes in both the environmental condition, while genotypes MYT1718-06, MYT1617-22172 were high yielding genotypes in late sown condition and MYT1819-08, MYT1819-19 were high yielding genotypes in normal season. The relative heat tolerance of the genotypes ranged from -13.99% to -57.64%. The genetic variability found in germplasms is adequate for developing heat-tolerant wheat varieties.

Key Words: Correlation, Heat stress, Late season, Variability, Wheat

Introduction

Wheat (*Triticum aestivum*) is the world's most crucial cereal crop, widely cultivated across the globe. It serves as a staple food in over 40 countries, supplying 82% of essential calories and 85% of the population's protein intake (Pandey et al., 2019). The global population is projected to reach 9.8 billion by 2050, with food demand expected to rise by 50-80%. Therefore, a significant increase in wheat yield will be necessary to ensure global food security (Collins & Chenu, 2021; Elferink & Schierhorn, 2016; UN, 2019). At the same time climate change is affecting the average weather pattern. Wheat growing areas lie from tropical to subtropical regions experiencing lots of stress due to climate change. Furthermore, the constantly shifting climate presents significant obstacles to maintaining the sustainability of worldwide wheat cultivation and production (Hasan et al., 2019). The major environmental stresses impacting wheat growth and development include cold, salinity, heat, and drought, all of which significantly reduce its yield potential. However, water scarcity and high temperatures are recognized as the leading environmental factors contributing to the global decline in wheat yields (Lesk et al., 2016; Liu et al., 2016). Wheat crops typically require temperatures between 12–22°C during most of their growth stages, especially during flowering and grain filling. Heat stress is one of the primary challenges to maintaining sustainable wheat production. Heat stress is described as an increase in temperature above a certain limit for a duration long enough to result in permanent harm to plant growth and development. It can lead to the partial or complete disruption of the crop's structure, form, biochemistry, and physiological processes. Heat stress from high temperatures occurs when the air temperature exceeds a critical threshold for an extended period, leading to injury or permanent damage to crop plants. Over 7 million hectares of wheat across approximately 50 countries are consistently affected by high temperatures. When temperatures rise above the optimal range, plants experience reduced nutrient absorption and photosynthetic efficiency. Additionally, the duration for organ growth (such as leaves, tillers, and spikes) shortens at different stages of wheat development. The continuous rise in global temperatures poses a threat to wheat production, with projections indicating an increase of 2°C–5°C by the year 2050 (Cheng et al., 2021). High temperature stress affects the wheat crop in each and every stage of the crop cycle (Farooq et al., 2011; Hunt, 2017). However, the impact of high temperature stress varies across different phenological stages, with its effects being more pronounced during reproductive development, also known as terminal heat stress, compared to vegetative growth (Yadav et al., 2022). Heat stress significantly reduces both the number and size of wheat leaves, causing the plant to remain in its vegetative stage for an extended period. Additionally, heat stress during the reproductive phase negatively impacts chloroplast function, which diminishes the activity of the plant's source organs and decreases its sink capacity. This leads to lower yields and early leaf senescence, reducing the green leaf area during reproduction. An elevation in temperature during the grain filling period results in a shortened grain filling duration, directly influencing both grain number and yield (Djanaguiraman et al., 2020). Previous research has suggested that for every degree Celsius increase in temperature between 18°C and 22°C, there is a 5% reduction in grain filling duration and a 3-4% reduction in



yield, respectively. Based on these estimates, losses of up to 50% in yield potential have been projected when exposed to temperatures ranging from 32°C to 38°C during the critical grain formation period (Garg et al., 2013). To mitigate the adverse impact of high temperature stress, it is imperative to comprehend the heat tolerance mechanisms during crucial growth stages, with the aim of cultivating heat-resilient wheat varieties (Ali et al., 2020). While conventional breeding methods have led to the development of some heat-tolerant varieties suitable for various agroclimatic zones, the molecular, physiological, and genetic foundations of heat tolerance remain largely unidentified (Driedonks et al., 2016). Examining genotype reactions under heat stress conditions can aid in unraveling the mechanisms underlying heat tolerance mechanisms. Thus, the research objective was to explore the genetic variation present in twelve elite wheat genotypes at normal and late sown (heat stress) environmental conditions for identifying heat-tolerant genotypes.

Materials and Methods

Two field trials, one in the normal season and the other in the late season, were conducted at the research farm of Rampur Campus, Khairahani Chitwan, Nepal at 165 masl. The normal season was from November 2021 to March 2022 and the late season was from January 2021 to April 2022. Both experiments were conducted using an Alpha lattice design, with three replications. Each replication consisted of 4 blocks, and each block contained 3 plots. Each plot measured 3 m * 2 m (6 m²). The row spacing was 25 cm, with 8 rows, each 3 meters long, maintained in each plot. Genotypes used in this trial were Bandganga, MYT1617-22, MYT1718-06, MYT1718-14, MYT1718-16, MYT1718-17, MYT1718-24, MYT1819-08, MYT1819-19, MYT1819-40, MYT1819-42 and Vijay. During the crop growing period, standard agronomic practices were applied. Six economically significant quantitative traits plant height, thousand-kernel weight, heading days, grain filling period, maturity days, and grain yield were measured across 12 wheat genotypes. The experimental data were processed using Microsoft Excel 2019, and analysis of variance (ANOVA) was performed using R.

$$\text{Relative heat tolerance} = \frac{Y_h - Y_c}{Y_c} / 100\% \quad \text{Haque et al. (2009),}$$

Where,

Y_h is grain yield in late sown condition (heat stress),

Y_c is grain yield in normal season condition.

Pearson's correlation coefficients of the parameters studied were obtained using SPSS version 16 software (SPSS, Chicago, Illinois, USA).

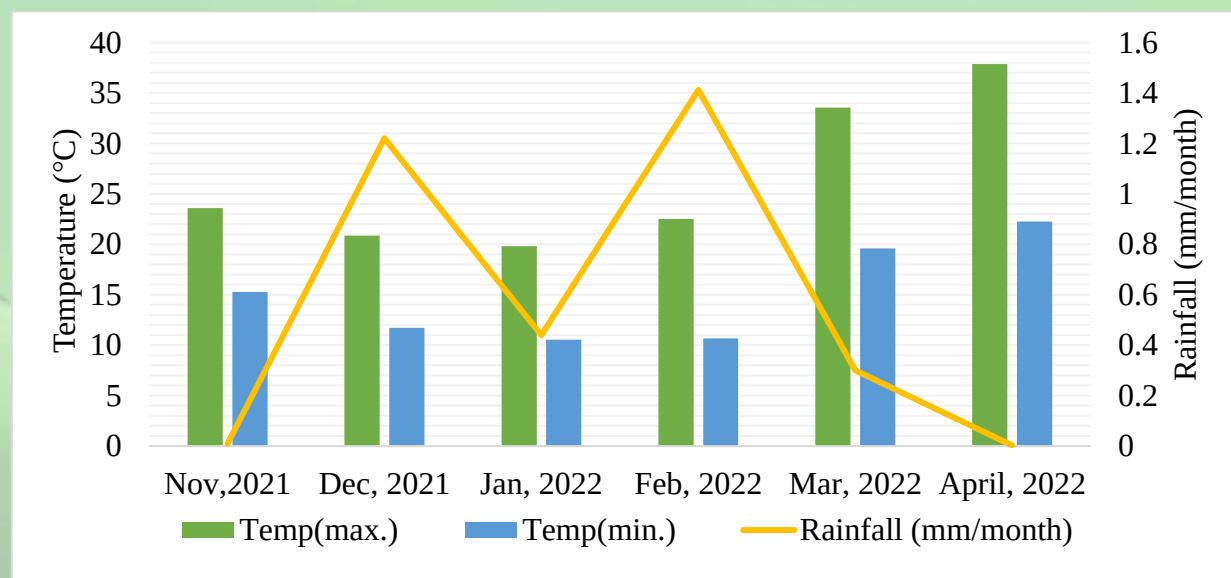


Figure 1: Mean monthly maximum, minimum temperature and Precipitation during wheat growing period (2021–2022)

Result and discussion

The findings in Table 1 revealed a significant variation among wheat genotypes, indicating that their yield performance differed at a 95% significance level (Rehman et al., 2021), showing that the genotypes responded differently under both conditions.



Table 1. Analysis of variance for grain yield under normal and heat stress conditions of 12 wheat genotypes in Chitwan

Source of variation	df	Mean squares	
		Normal condition	Stress condition
Replication	2	98372	818533
Genotypes	11	1395211***	2473797***
Block*Replication	9	137637	268413
Residual	13	242195	260165

Significant traits are denoted by * for $p < .05$, ** for $p < .01$, and *** for $p < .001$.

These results highlighted significant variation among genotypes, enabling the selection of superior genotypes for heat stress conditions. The maximum grain yield was observed in MYT1718-24 (5410.22 g) per ha followed by MYT1718-06 (5128.77 g) in stressed condition and MYT1819-19 (7346.17 g) and MYT1819-40 (7090.49 g) was highest grain yielding genotype under normal condition. The mean grain yield is reduced by 36.76% under heat stress condition. In the lab research conducted at Bangladesh by Karim et al. (2020) also reported loss of grain yield by 3-49% due to heat stress in wheat. Temperature acceleration during the period in wheat between the beginning of spike ignition and flowering appears to be the primary cause of the decrease in sink size, resulting in poor grain yield (Miroslavljević et al., 2021). Additionally, heat stress leads to a reduction in the duration of the grain filling phase, the number of tillers, and the number of spikelets per spike (Miroslavljević et al., 2021; Qin et al., 2008).

The performance of wheat genotypes exhibited significantly higher levels during the normal season compared to the late season, aligning with findings from various researchers regarding the detrimental effects of heat stress on wheat. According to Rehman et al. (2021), higher temperatures led to a notable decrease in the number of days required for booting, heading, flowering, and maturity. Additionally, exposure to elevated temperatures can substantially diminish grain yield (GY) (Fernie et al., 2022). The increased temperatures observed during the late season, as reported in meteorological data, had a pronounced impact on heat stress (Puri et al., 2015).

Effects of genotype, season, and genotype by season interaction on the germplasm

Table 2 revealed that the effects (mean squares) of genotype (G), season (S), and genotype by season interaction ($G \times S$) on maturity days, plant height, and grain yield were consistently highly significant ($p \leq 0.001$). The impact of season (S) consistently surpassed that of genotype (G) and the genotype by season interaction ($G \times S$) for each trait. Additionally, the effect of G was generally greater than that of $G \times S$, except for plant height ($G = 39$ and $G \times S = 54$) and grain yield ($G = 1.39$ and $G \times S = 2.33$).

Table 2. Analysis of variance of agronomic traits of 12 wheat genotypes as influenced by late season and normal season in Chitwan

Traits	NG	Rep	Season	MSG	MSS	MS($G \times S$)	MSR	CV
DTH	12	3	2	13.6***	1081.1***	1.3	2	1.50%
DTM	12	3	2	3***	5339***	1***	1	0.95%
GFP	12	3	2	10.6***	1530.9***	1.3	1.6	3.36
PH	12	3	2	39***	21439***	54***	5	2.35%
TKW	12	3	2	103.97***	220.67***	34.72*	17.11	9.08%
GY	12	3	2	1.39***	96.95***	2.33***	0.53	9.50%

Significant traits are denoted by * for $p < .05$, ** for $p < .01$, and *** for $p < .001$. DTH = Days to heading, DTM = Days to maturity, GFP = Grain filling period, PH = Plant height, TKW = Thousand kernel weight, GY = Grain yield

The significant effects of G, E, and $G \times E$ obtained agree with the results of (Okechukwu et al., 2016; Khazratkulova et al., 2015). Most of the observed changes in the wheat germplasm are primarily due to seasonal (environmental) influences, as evidenced by the significantly stronger effect of season on all parameters compared to the effects of genotype and genotype by season interaction. Wan et al. (2022) explained that wheat grain yield (GY) is heavily influenced by production environments. Moreover, the significant genotypic effect on GY and other parameters suggests that there is sufficient genetic variation among wheat germplasms to be utilized in breeding programs for heat tolerance (Okechukwu et al., 2016).

Relative heat tolerance (RHT) of wheat germplasm

Figure 2 depicted the plasticity/stability of grain yield among genotypes in late seasons (heat-stressed environments) relative to their performance in corresponding normal seasons (control/heat-favorable environments). In Figure 1 (late season 1 vs. normal season 1), the RHT ranged from -13.99% in genotype MYT1718-24 to -57.64% in genotype MYT1819-40. MYT1718-24, MYT1617-22, MYT1718-17 are most resistant genotypes with relative heat tolerance 13.99, 17.21, 17.31 respectively while most susceptible genotypes for relative heat tolerance are MYT1819-08, MYT1819-19, MYT1819-40 with values -42.77%, -44.90%, -57.64% respectively.



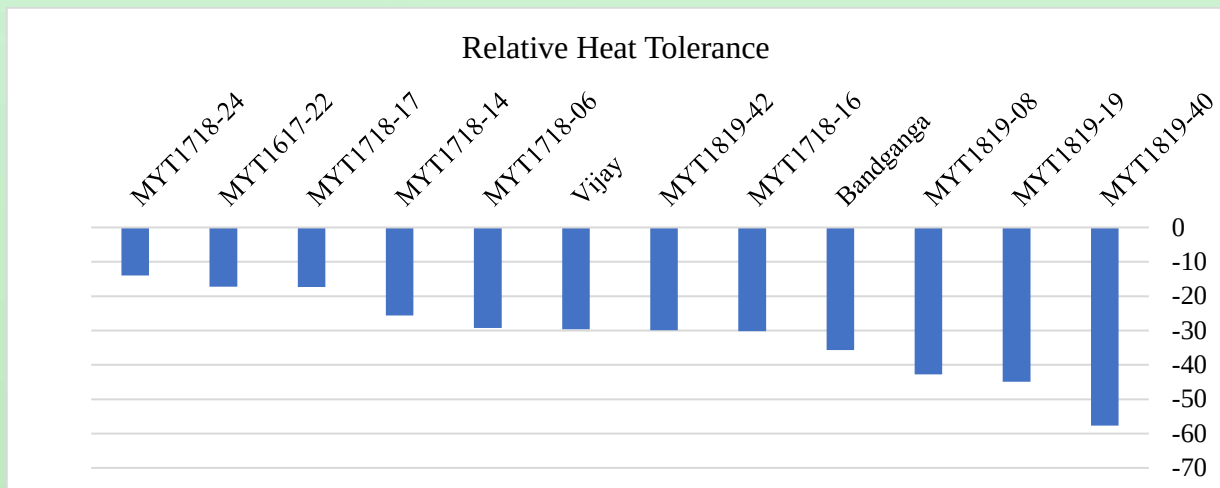


Figure 2: Relative Heat tolerance of twelve wheat genotypes in Chitwan

The relative heat tolerance graph (Figure 2) shows that the percentage of grain loss due to high temperatures experienced in the late season, compared to the normal season, ranged from 33.69% to 77.95% (Karim et al., 2020). Okechukwu et al. (2016) previously reported that wheat planted in the late season experienced severe yield losses exceeding 50%. Consistently, the genotypes MYT1718-24, MYT1617-22, and MYT1718-17 showed relative heat tolerance (RHT) of less than 20%. These genotypes could serve as genetic sources for heat tolerance breeding programs, with MYT1718-24 standing out as the highest-yielding genotype in the late season.

Association of the grain yield and other parameters

In both normal and late sown condition grain yield has only significant correlation with grain filling period. Days to heading (DTH) negatively correlated with grain yield (GY) in both late and normal season (Table 3). Days to maturity have negative correlation with grain yield in late season while it has positive correlation in normal season. The grain filling period has a significant positive correlation with grain yield in both conditions. Plant height has a positive correlation with grain yield in normal condition whereas it has negative correlation with grain yield in late sown condition. Thousand kernel weight has negative correlation with grain yield in both conditions.

Table 3. Pearson correlation of grain yield and other studied traits of wheat germplasm in normal condition (below the diagonal) and late sown condition (above diagonal) in Chitwan

	DTH	DTM	GFP	PH	TKW	GY
DTH	1	.381*	-.736**	.858**	-.284	-0.21
DTM	0.302	1	.345*	.538**	-0.131	-.213*
GFP	-.860**	0.227	1	-.477**	0.193	-.057*
PH	-0.284	0.131	.360*	1	-0.216	-0.167
TKW	-.411*	-0.064	.386*	0.203	1	-0.146
GY	-0.114	.042*	.139*	0.282	-0.322	1

Significant traits are denoted by * for $p < .05$, ** for $p < .01$, and *** for $p < .001$. DTH = Days to heading, DTM = Days to maturity, GFP = Grain filling period, PH = Plant height, TKW = Thousand kernel weight, GY = Grain yield

According to the correlation, late maturing genotypes are excellent for heat-friendly situations whereas early maturing genotypes are best for heat-stressed environments. Grain yield was negatively correlated with days to heading (DH) and days to maturity (DM) in the late season, meaning that faster crop maturation reduces exposure to extended heat stress, resulting in higher grain yield (GY). In the normal season, grain yield had a negative correlation with heading days (HD) and a positive correlation with maturity days (MD) and grain filling duration (GFD), indicating that a longer grain filling period leads to a greater increase in grain yield (Upadhyay, 2020). Plant height also has negative correlation with grain yield in late season that shows due to heat stress plant gain their growing degree days earlier which results lowering height of the plant (Tiwari et al., 2017). Thousand kernel weight has negative correlation in both late and normal season indicating increase in weight of grain lowers number of grain lowering the yield of the crop (Nukasani et al., 2013). Grain filling period has significantly negative correlated with heading days and positively correlated with maturity days in both the seasons. It also has significantly positively correlated with grain yield in both seasons, which indicates crop yield significantly increases with increase in grain filling period of wheat (Okechukwu et al., 2016; Brdar et al., 2008). The correlation suggests that early-maturing genotypes are better suited for heat-stressed environments, while late-



maturing genotypes are more appropriate for heat-favorable conditions. Grain yield was negatively correlated with days to heading (DH), days to maturity (DM), and grain filling duration (GFD) in the late season, indicating that faster crop maturation reduces exposure to extended heat stress, resulting in higher grain yield (GY). In contrast, DH, DM, and GFD were positively correlated with GY in normal seasons, implying that a longer crop maturity period, particularly with an extended grain filling period, significantly contributes to increased grain yield. This indicates that late-maturing genotypes adapt well to favorable temperature conditions, and selecting for longer maturity periods may be beneficial for higher grain yield, except under intense and prolonged heat stress, particularly late in the growing season.

Broad sense heritability and genetic advance estimates of the studied traits

Heritability was found to be higher in normal sowing condition than late sown condition and ranged from 94% to 46% (Table 4). The highest mean broad sense heritability was found to be 91% of the trait plant height whereas lowest broad sense heritability was found to be 68% of the trait maturity days. Genetic advance as percentage of mean was found to be higher in normal season for all studied traits except for grain yield. Genetic advance as percentage of mean was categorized as low (0-10 %), moderate (10-20 %) and high ($\geq 20\%$). The highest mean genetic advance as percentage of mean was found to be 36 for the trait grain yield and lowest mean GAM was found for the trait maturity days which has value of 1.95. High mean genetic advance as percentage of mean was found for the traits thousand kernel weight (31.36) and grain yield (36) whereas moderate genetic advance as percentage of mean was found for the traits grain filling period (11.07) and plant height (10.47). Low genetic advance as percentage of mean was found for the traits heading days (7.39) and maturity days (1.95).

Table 4. Heritability and Genetic advance of twelve wheat genotypes in normal and late sown condition in Chitwan

Traits	Heritability			Genetic advance as % of mean		
	Normal	Late	Mean	Normal	Late	Mean
DTH	0.87	0.88	0.87	7.62	7.16	7.39
DTM	0.9	0.46	0.68	2.6	1.3	1.95
GFP	0.8	0.75	0.77	11.44	10.7	11.07
PH	0.94	0.89	0.91	16.54	4.4	10.47
TKW	0.85	0.74	0.79	38.06	25.07	31.56
GY	0.76	0.62	0.69	27.68	44.32	36

DTH = Days to heading, DTM = Days to maturity, GFP= Grain filling period, PH= Plant height, TKW= Thousand kernel weight, GY= Grain yield

Upadhyay et al., (2019) earlier reported high heritability estimates for DH, DM, GFP, PH, TKW and GY which are close to results of the present study. Maturity days have lower heritability in late season due to highly influenced by heat stress condition whereas in normal condition it has less influenced by environmental factors. Heritability estimates for various traits depend on the genetic makeup of the breeding materials being studied. Therefore, understanding these values in the materials of interest is crucial for breeders (Herbert et al., 1955). Higher heritability estimates typically imply simpler selection procedures (Mazurkiewicz et al., 2019). Generally, if a trait is influenced by non-additive gene action, it may exhibit high heritability but low genetic advance, whereas a trait governed by additive gene action would show high values for both heritability and genetic advance (Okechukwu et al., 2016). However, heritability values alone do not indicate the genetic progress achievable by selecting the best individual; instead, considering heritability estimates alongside genetic advance is considered more informative (Shenoda et al., 2021). Genetic advance in percentage of mean gives more precise result in comparison to only genetic advance. Genetic advance as percent mean was categorized as low (0-10%), moderate (10-20%) and high ($\geq 20\%$) (Herbert et al., 1955). In the present study moderate genetic advance as percent of mean was estimated for grain yield kg ha⁻¹ (11.98%) and other traits showed low genetic advances (<10%). This indicates observed characters among tested genotypes governed by non-additive gene action and thus heterosis breeding, family selection and progeny testing methods are used for improvement on such traits. High broad heritability and low genetic advance estimates observed in DH, DM indicate that Observed characters among tested genotypes governed by non-additive gene action and thus heterosis breeding, family selection and progeny testing methods is used for improvement on such traits. The high values of genetic advance and heritability for the trait TKW and GY indicates that the trait is under additive gene effects, and therefore selection for low kernel weight and higher grain yield will be effective (Upadhyay et al., 2019). Plant height, which showed the highest genetic advance and high to moderate heritability estimates, will be crucial for a heat tolerance breeding program. The traits having high values of heritability coupled with moderate genetic advance as percent of the mean namely, plant height and grain filling period suggest that selection for improvement of these characters may be satisfying. However, high heritability with high GAM as reported in GY suggest additive gene effects, thus the selection will be rewarding. Direct selection of grain yield can be done to improve heat tolerance in breeding program.



Conclusion

Heat tolerance is a quantitative trait that is promoted by several components. The significant impact of heat stress on wheat performance, particularly on grain yield, highlights the urgent need for breeding programs focused on heat tolerance. However, the notable genotypic effects observed indicate that there is considerable genetic variability within the wheat germplasm, which can be utilized in developing heat-tolerant varieties. Based on the study, genotypes MYT1718-24, MYT1718-06, MYT1819-22 had high yield potential under both conditions. Thus, these genotypes can be used in breeding programs for developing heat tolerance wheat varieties.

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Author's declaration and contribution

The authors have no conflict of interest to disclose. Conceptual framework, data collection and analysis were performed by Koshraj Upadhyay. Shambhu Katel commented on previous versions of the manuscript. Similarly, the final version of the manuscript was approved by all.

Data Availability Statement

Data are available upon request.

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ID: 399

Examination of Open Green Areas in Terms of Human Health and Psychology

Ruhugul Ozge Gemici

Selçuk Üniversitesi, Mimarlık ve Tasarım Fakültesi - Peyzaj Mimarlığı, Konya, Türkiye

Abstract

Open green areas undertake functions that improve and healing people's living conditions. This research was conducted to understand the role of open and green areas in urban life and to evaluate the contributions of these areas to the quality of life. The study was conducted with people living in Selçuklu district of Konya province. These people visited urban open green areas in Selçuklu district and spent time in those places. The survey method was used in the study. The survey results reveal that open green areas have significant and positive effects on human health and psychology. The majority of the participants stated that they visited open green areas with sufficient frequency and that these areas met both their physical and mental needs. These findings emphasize the positive effects of open green areas on human health and psychology and support the need to protect and increase these areas.

Keywords: *Open green areas, Konya, landscape architecture, psychology*





ID: 400

Examination of Environmental Awareness of Students Studying in Landscape Architecture Departments

Ruhugul Ozge Gemici

Selçuk Üniversitesi, Mimarlık ve Tasarım Fakültesi - Peyzaj Mimarlığı, Konya, Türkiye

Abstract

The discipline of landscape architecture plays an important role in many environmental issues such as increasing green areas in urban areas, supporting biodiversity, and managing water resources. This study was conducted to determine the environmental awareness levels of landscape architecture students in Turkey and to understand how educational programs affect this awareness. In the study, first of all, all universities and faculties providing undergraduate landscape architecture education in Turkey were examined, and then landscape architecture departments in different universities and faculties were included in the scope of the research. Surveys were administered to students studying in the landscape architecture departments of the specified faculties to measure their environmental awareness levels. In addition, it was analyzed how the courses taken by landscape architecture students affected their environmental awareness. Thus, effective strategies were developed and suggestions were presented to increase environmental awareness in landscape architecture education.

Keywords: *Environmental awareness, environmental sensitivity, landscape architecture*





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Keywords: *Environmental awareness, environmental sensitivity, landscape architecture*



Statistical Evaluation of Some Micro Elements (Li, Mn, Ni and Ba) Accumulated in Sediments of Turkish Straits Watersheds

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Abstract

Çanakkale and İstanbul Straits are known as the Turkish Straits and they are two of the most significant international marine habitats located in the north-western Türkiye. There are many fluvial and lacustrine components in the watersheds of both these straits. As many aquatic habitats, they are exposed to a significant pollution stress. This study was carried out to evaluate the lithium, manganese, nickel and barium accumulations in sediments of Çanakkale and İstanbul Straits Basins components from a statistical perspective. Eleven fluvial and four lacustrine ecosystems were defined in the watersheds and sediment samples were collected in dry and wet seasons of 2022 – 2023. Pearson Correlation Index (PCI), Principal Component Analysis (PCA) and Cluster Analysis (CA) were applied to data to categorize the investigated habitats and define the sources of investigated micro elements. According to the results of applied PCI, statistically significant positive correlations were determined among the investigated parameters. According to the results of applied PCA, two factors named as "Agricultural – Domestic factor (F1)" and "Industrial factor (F2)" explained 83% of the total variance. According to the results of applied CA, two clusters, named as "Relatively less contaminated zone (C1)" and "Relatively more contaminated zone (C2)", were formed.

Keywords: Çanakkale and İstanbul Straits, Micro elements, Statistical evaluation

Introduction

Multivariate statistical techniques play a crucial role in managing and understanding water resources. They are beneficial in validating spatiotemporal differences induced by geogenic and anthropic causes associated to seasonally change, these approaches have been frequently employed to define and evaluate surface stream water – sediment quality. They also help in assessing the risk levels of various pollutants, enabling targeted interventions to mitigate potential health hazards (Köse et al., 2014; 2018; Tokatlı, 2014; 2020).

Multivariate techniques like Principal Component Analysis (PCA) help to simplify complex datasets by reducing their dimensionality. Also, techniques such as Cluster Analysis (CA) is used to identify patterns and group similar water – sediment quality samples and used to classify the investigated locations in terms of their similar characteristics (Çiçek et al., 2013; 2017; Tokatlı et al., 2014; Tokatlı and Helvacıoğlu, 2020).

Freshwater sediments act as transporters of numbers of pollutants in aquatic ecosystems and provide valuable environmental information (Mutlu, 2021; Yüksel et al., 2024; Varol and Tokatlı, 2024). Therefore, analysing the elemental contents in surface sediments is crucial (Varol et al., 2022; Ustaoglu et al., 2022; Tokatlı and İslam, 2022).

İstanbul and Çanakkale straits that are known as Turkish Straits are two of the most significant international marine habitats located in the north – western Türkiye. There are many fluvial and lacustrine components in the watersheds of both these straits and as many aquatic habitats, they are exposed to a significant pollution stress (Tokatlı et al., 2023; 2024; Varol and Tokatlı, 2024). In this research, sediment qualities of Turkish Straits Watersheds were evaluated from a statistical perspective.

Material and Method

Fifteen locations were selected on the watersheds of Turkish Straits (Figure 1). Then surface sediment samples were collected in the wet (end of winter) and dry (end of summer) seasons of 2022 – 2023 by using an Ekman Grab (Hydrobios) according to the standard protocol (EPA, 2001a).

For determination of lithium (Li), manganese (Mn), nickel (Ni) and Barium (Ba) concentrations in sediments of İstanbul and Çanakkale straits watersheds, EPA methods (1998; 2001b) were applied. Accumulations of elements in sediments were measured by using an ICP – MS device (Agilent 7700) in the Thrace University (Edirne/Türkiye).

Pearson Correlation Index was applied to data by using the OriginPro Lab, Principal Component Analysis was applied to data by using the SPSS and Cluster Analysis was applied to data by using the PAST.



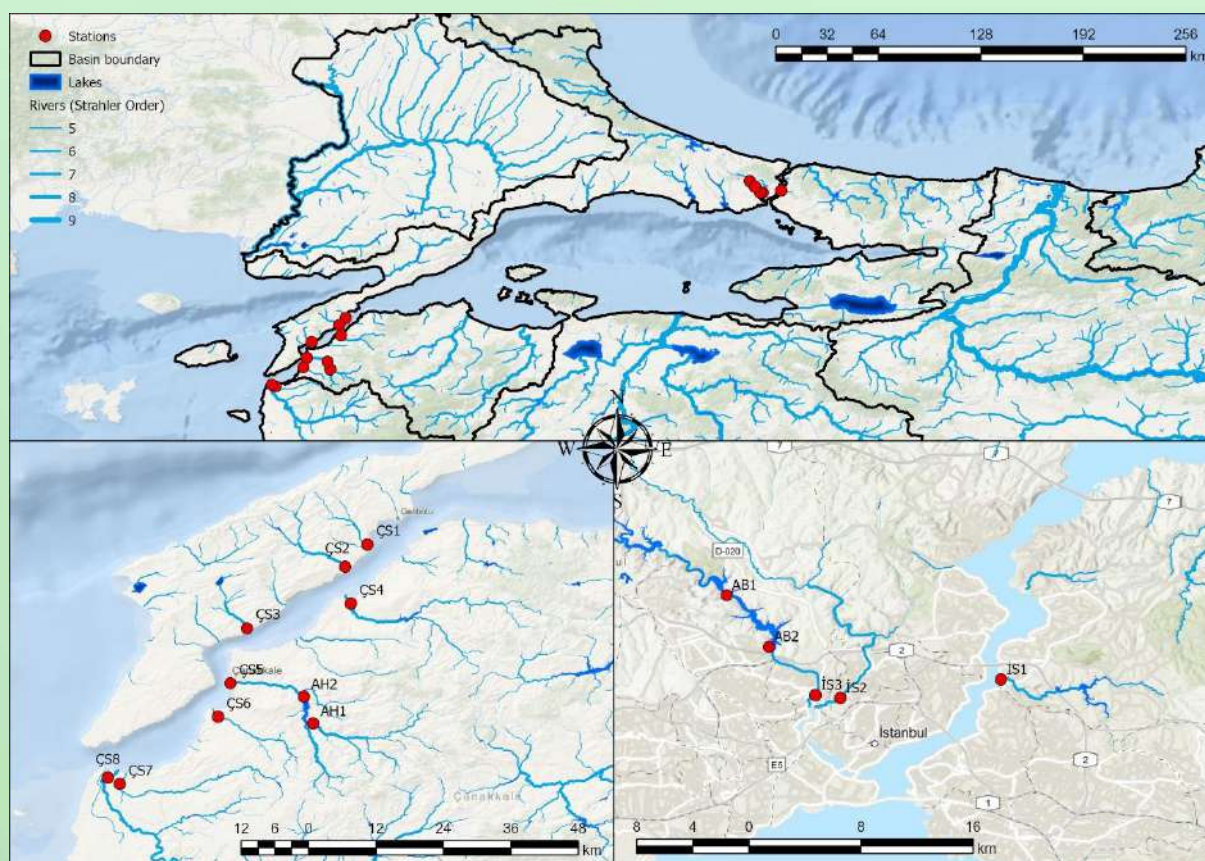


Figure 1. Study area and selected stations

Results and Discussion

The PCI was used to identify the significant relations among the lithium (Li), manganese (Mn), nickel (Ni) and Barium (Ba) contents in sediments of Turkish Straits Watershed. The recorded relations among the investigated elements with the correlation coefficients are shown in Figure 2. According to the results of applied PCI, significant positive correlations were recorded between the variables of Mn – Ni and Ba at the $p < 0.01$ significance levels and Ni – Ba at the $p < 0.05$ significance levels. The PCA was used to determine the effective factors on the sediment qualities of the Turkish Straits Watershed. The eigenvalues and the component plot with the rotated component matrix data are shown in Figure 3. As a result of applied PCA, 2 factors named as "Agricultural – Domestic factor (F1)" and "Industrial factor (F2)" explained 83% of the total variance. The CA was used to present the groups – clusters of similar sediment quality characteristics among the investigated locations on the Turkish Straits Watershed. The diagram of CA and the similarity coefficients of locations are shown in Figure 4. As a result of CA, 2 clusters, named as "Relatively less contaminated zone (C1)" and "Relatively more contaminated zone (C2)", were formed.

It is clearly known that geological structures of the basins and the anthropogenic activities conducted around the regions may alter the macro and micro element concentrations in freshwater sediments (Köse et al., 2023; Haque et al., 2023; Din et al., 2023; Mutlu et al., 2023).

According to the PCA results applied in our study, it is known that lithium in the F2 factor called "Industrial Factor" is widely used in industrial activities (Tokatlı et al., 2021; 2024; Varol and Tokatlı, 2022). It is also known that nickel, manganese and barium in the F1 factor called "Agricultural – Domestic Factor" are abundantly found in domestic waste, agricultural fertilizers and pesticides (Mia et al., 2023; Tokatlı et al., 2023).

As a result of applied CA, fluvial components of the Turkish Straits Watershed were formed a separate cluster, which was named as "Relatively More Contaminated Zone", while the lacustrine components were formed a separate cluster, which was named as "Relatively Less Contaminated Zone". Since fluvial components generally pass through residential areas, they are more exposed to domestic, agricultural and industrial pollutants than lacustrine components. Therefore, these regions are considered to form a separate cluster as "Relatively More Contaminated Zone" in our study.



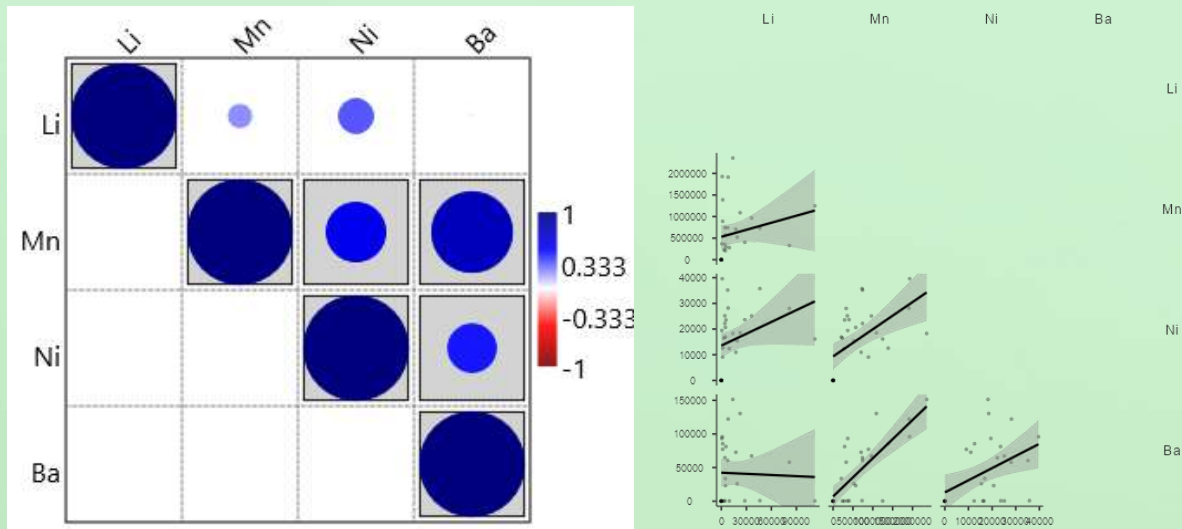


Figure 2. Results of PCI (left) and the regression diagrams (right)

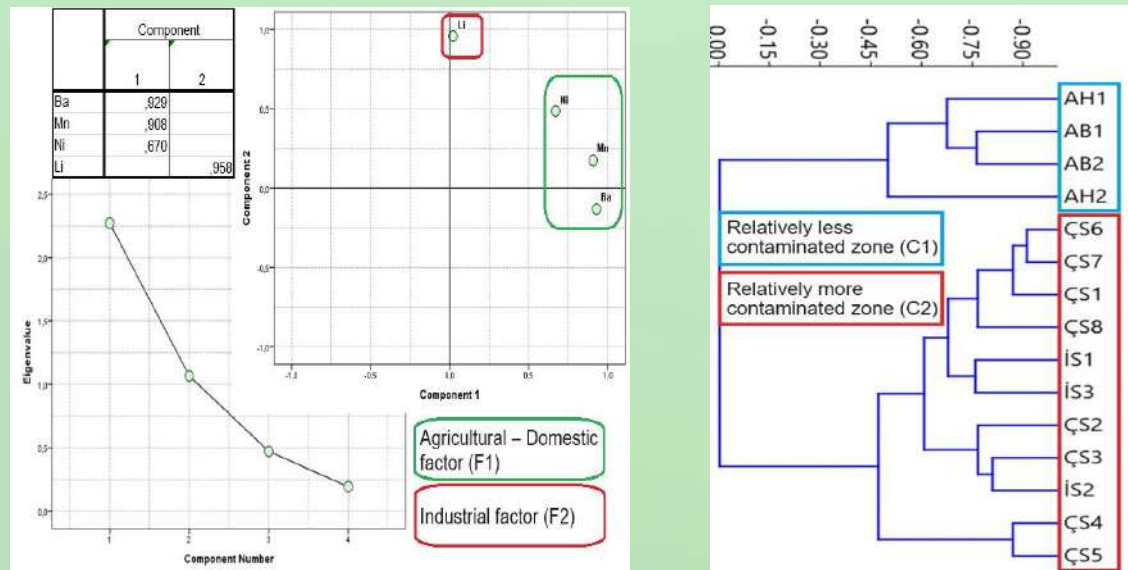


Figure 3. Results of PCA

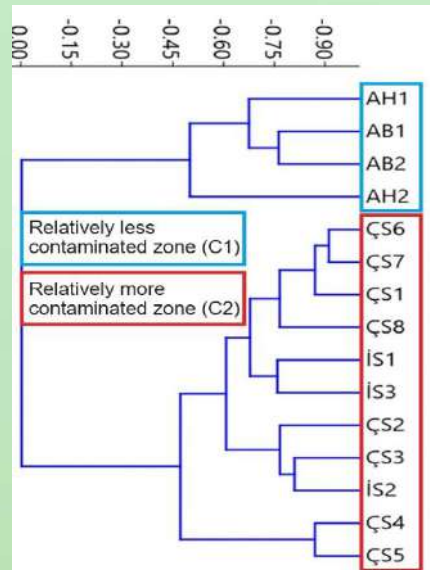


Figure 4. Results of CA

Conclusions

In this research, Pearson Correlation Index (PCI), Principle Component Analysis (PCA) and Cluster Analysis (CA) were used to evaluate the surface sediment quality of Turkish Straits Watershed. According to the results of applied PCI, statistically significant positive correlations were determined among the investigated variables, according to the results of applied PCA, 2 factors explained 83% of the total variance (agricultural – domestic factor – F1 and industrial factor – F2) and according to the results of applied CA, 2 statistically significant clusters were formed (relatively less contaminated zone – C1 and relatively more contaminated zone – C2). The data from the current study also reflect the importance and necessity of using multistatistical techniques and reflect that researchers can gain a more comprehensive understanding of freshwater quality.

Acknowledgements

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Chemical Oxygen Demand Levels in Streams of Çanakkale Strait Basin (Türkiye)

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Abstract

In this study, the spatial distributions of Chemical Oxygen Demand (COD) levels a significant pollution indicator in water of lotic ecosystems in the Çanakkale Strait (ÇS) watershed were determined. 7 fluvial habitats flowing into the ÇS (total of 20 stations from up-streams to down-streams) were defined in the basin. Surface water samples were collected in the spring season of 2023. Then they were tested for the COD parameter. The determined spatial mean values of COD levels in water of the investigated riverine habitats in ÇS watershed were 8.62 mg/L for Munipbey Stream, 4.93 mg/L for Bağlar Stream, 41.60 mg/L for Kayaaltı Stream, 19.83 mg/L for Umurbey Stream, 17.35 mg/L for Çanakkale Stream, 15.70 mg/L for Hamamlık Stream and 9.96 mg/L Küçük Menderes Stream. It has been determined that the COD levels of the investigated rivers increase from the up-stream to the down-stream stations and Kayaaltı, Umurbey and Çanakkale streams were recorded as the riskiest component for the ÇS watershed.

Keywords: Çanakkale Strait, Chemical Oxygen Demand, Water quality

Introduction

Increasing pollution in freshwater ecosystems is one of the most critical global problems of recent years. Although both natural and anthropogenic processes are effective in environmental pollution, human induced factors are known as the main contaminants for all the components of biosphere (Köse et al., 2020; İslam et al., 2022; Ustaoglu et al., 2022; Jannat et al., 2022; Mia et al., 2023; Haq et al., 2023; Yüksel et al., 2024; Muhammad et al., 2024). Chemical Oxygen Demand (COD) is a critical parameter in water quality assessment. It measures the amount of dissolved oxygen needed to chemically oxidize organic and inorganic materials in water. High COD levels suggest a high concentration of organic pollutants, which can deplete dissolved oxygen in water bodies, negatively impacting aquatic life and water quality. COD is used to gauge the short-term impact of wastewater effluents on the oxygen levels of receiving waters. It is essential for monitoring and managing the organic load in municipal and industrial wastewater treatment (Varol and Tokatlı, 2021; 2023; Tokatlı and Varol, 2021; Haque et al., 2023; Mutlu et al., 2023; Tokatlı et al., 2023).

Çanakkale Strait (ÇS) is located in the Marmara Region. It is known that this important ecosystem faces significant environmental problems caused by domestic wastewater and organic pollutants originating from settlements due to population growth in the Marmara Region (Rozakēs, 1987; Mercan, 2019; Tokatlı et al., 2023; 2024; Varol and Tokatlı, 2024). There are a total of 7 significant riverine ecosystems in the watershed of ÇS. Due to many anthropogenic pressure elements in their large basins, they release their organic pollution contents into the strait water. In this research, COD levels of 7 lotic ecosystems located in the watershed of ÇS were investigated.

Materials and Methods

Total of 20 sampling stations (ÇS1 – ÇS20) on 7 riverine habitats located on the ÇS watershed were selected. The maps of the Çanakkale Strait Basin and selected stations are given in Figure 1 and the names of investigated fluvial habitats are given in Table 1.

Surface water samples were collected in the spring season of 2023 into the pre-cleaned gamma sterile polyethylene bottles (APHA, 2005).

Chemical Oxygen Demand (COD) levels were measured by a “Hach DR3900” branded spectrophotometer device (APHA, 1999).



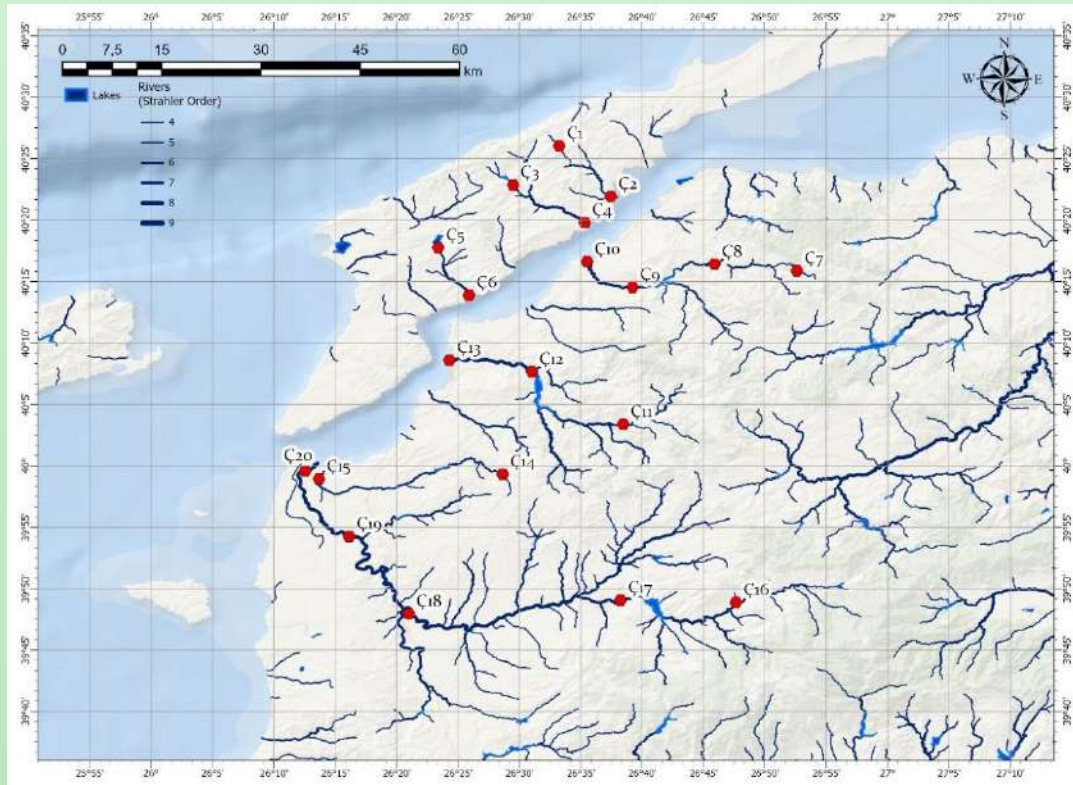


Figure 1. Study area and sampling stations

Table 1. Names of streams and sampling locations

Station Code	Name of Potamic	Sampling Location	Station Code	Name of Potamic	Sampling Location
Ç1	Munipbey	Upstream	Ç11	Çanakkale Stream	Upstream
Ç2	Creek	Downstream	Ç12		Midstream
Ç3	Bağlar	Upstream	Ç13		Downstream
Ç4	Creek	Downstream	Ç14	Hamamlık Creek	Upstream
Ç5	Kayaaltı	Upstream	Ç15		Downstream
Ç6	Creek	Downstream	Ç16	Küçük Menderes Stream	Upstream
Ç7	Umurbey Stream	Upstream	Ç17		Up-Midstream
Ç8		Up-Midstream	Ç18		Midstream
Ç9		Down-Midstream	Ç19		Down-Midstream
Ç10		Downstream	Ç20		Downstream

Results and Discussion

The data of measured COD parameter in fluvial habitats of Çanakkale Strait (ÇS) watershed are given in Figure 2. Significant spatial differences were detected among the measured COD levels in water of the ÇS watershed components. According to the results of this research, the recorded spatial mean values of COD parameter in water of the investigated fluvial ecosystems in ÇS watershed were 8.62 mg/L for Munipbey Stream, 4.93 mg/L for Bağlar Stream, 41.60 mg/L for Kayaaltı Stream, 19.83 mg/L for Umurbey Stream, 17.35 mg/L for Çanakkale Stream, 15.70 mg/L for Hamamlık Stream and 9.96 mg/L Küçük Menderes Stream.

Except for the sampling points located in the downstream basins of Kayaaltı (Ç6), Umurbey (Ç10) and Çanakkale (Ç13) streams, the water quality of the entire basin was recorded as 1. Class in terms of COD values (TSWQR, 2021). While the stations of Ç6 and Ç10 have 3. Class water quality in terms of COD values, station of Ç13 has 2. Class water quality (TSWQR, 2021).

The discharge point of domestic wastewater in Çanakkale Province city centre is known as Çanakkale Stream. Despite the advanced wastewater treatment plant operated by Çanakkale Municipality, values of the COD parameters in this location were determined to be at quite high levels (Mercan, 2019; Anonymous, 2021; Tokatlı et al., 2023). Although the downstream basin of the Çanakkale Stream has a lower COD value than the downstream basins of Kayaaltı and Umurbey streams, it has been determined that the pollution pressure over the Çanakkale Strait is much higher since the Çanakkale Stream flow is considerably higher than the other streams.



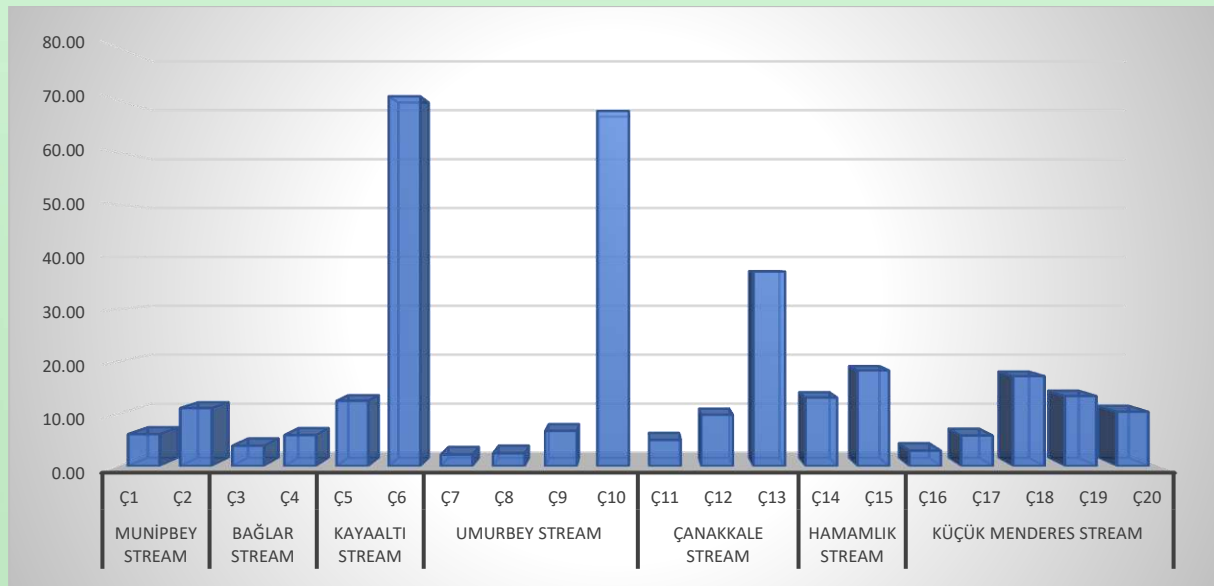


Figure 2. COD levels of investigated stations (mg/L)

Conclusions

In this research, COD levels of fluvial habitats flowing into the Çanakkale Strait (ÇS) were investigated and the pollution pressures of the rivers on this important strait were evaluated. The COD contents of the fluvial water bodies of ÇS basin were as follows: Kayaaltı > Umurbey > Çanakkale > Hamamlık > Küçükmenderes > Munipbey > Bağlar, in general. However, considering the flow rates of the investigated streams, it was determined that the riskiest component for ÇS watershed was the Çanakkale Stream and domestic wastewaters were thought as the most critical pollution pressure factor for the system.

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Antibiotic Resistance in *Salmonella enterica* Isolated from Water Sources in Kaduna State, Nigeria: Susceptibility Patterns and Resistance Genes Detection

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Abstract

The presence of antibiotic resistant bacteria and the genes responsible for resistance in water sources has gained attention of researchers over the years. This because of the risk of transfer of such genes to pathogens in humans, worsening the problem of antibiotic resistance. This study aimed at subjecting *Salmonella enterica* isolated from water of Kaduna state, Nigeria, to susceptibility tests using ten commonly used antibiotics namely: Ampicillin (10µg), Gentamicin (10µg), Amoxycillin (10µg), Tetracycline (30µg), Ciprofloxacin (5µg), Augmentin (30µg), Cefotaxime (30µg), Nalidixic acid (30µg), Chloramphenicol (30µg) and Sulphamethoxazole-trimethoprim (25µg), using standard methods. The isolates were further screened for antibiotic resistance genes (*tetA*, *tetB*, *sul1* and *blaTEM*) using Polymerase Chain Reaction (PCR) method. Of the six (6) isolates used in this study, 2 (33.3 %) were susceptible to all antibiotics tested. Three isolates were resistant to Tetracycline alone, and one was resistant to tetracycline, nalidixic acid and sulphamethoxazole-trimethoprim. Interestingly, this isolate was obtained from treated pipe borne water. The genes detected included the *tetA* and *sul1* genes, while the *tetB* and *blaTEM* were not amplified in any of the isolates. The presence of these organisms harboring these genes is of public health importance because water has been shown to serve as a reservoir of antibiotic resistance. Furthermore, this highlights the problem of antibiotic misuse in the study area. These findings indicate that focus should be placed on ensuring the safety of these water sources by the government and policy makers of Nigeria.

Keywords: Drinking water, Antibiotic resistance, genes, *Salmonella enterica*, Nigeria



Enhancing Animal Feed Efficiency Using Organic Acids: Effects on Poultry Production

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Abstract

Organic acids have been the common one used in animal feeds. Organic acids have contained both carboxylic and fatty acids in structure with acidic properties. There are selected organic acids used for feed additives in poultry feeds. The main aim of this review was to examine animal feed efficient using organic acids with focus on poultry production. The study identified the various forms of organic acids, their application in poultry production, beneficial and detrimental effects. The common organic acids used in poultry feeds are fatty acids with short chain structure such as formic acid, acetic acid, propionic acid, and butyric acid, while other acids in carboxyl form like citric acid, lactic acid, malic acid, and fumaric acid are also in use within the poultry sector due to their physical and chemical attributes. The study concluded that although organic acids are significant to poultry birds in terms of nutrient digestion, feed consumption, feed efficiency ratio, immunity, and overall growth and performance, they also have negative effects if not properly used in poultry feed. There is need for animal scientist to recommend specific level of organic acids in poultry feed to achieve the best result in overall growth and development of the poultry birds.

Keywords: *Animal, Poultry, Feed, Organic acids, Efficiency*

Introduction

There have been a vast development over the years in poultry production from backyard practice to technology based commercial industry. Coupled with increase in demand and production of poultry products with corresponding increase in consumer needs in terms of food safety which involved the use of animal protein, genetic modified materials and antimicrobial growth promoters to enhance poultry bird performance (Archana *et al.*, 2016). The marketing and use of antibiotics as growth promoters in animal feed have been banned by the European commission (Luckstadt, 2014). Animal scientist that specialized in feed have developed a means to overcome the limitation of low performance to ban on antibiotics, substance such as prebiotics, herbs, enzymes, and organic acids were deemed alternative solutions in poultry production (Bagal *et al.*, 2016). (Wang *et al.*, 2009) identified the use of organic acids for antimicrobial and feed preservation for commercial feeds for animals. There are various forms of dietary acids for poultry feeds, which can be organic or inorganic acids. Organic acids have been the common one used in animal feeds. Organic acids have contained both carboxylic and fatty acids in structure with acidic properties. There are selected organic acids used for feed additives in poultry feeds. The common organic acids used in poultry feeds are fatty acids with short chain structure such as formic acid, acetic acid, propionic acid, and butyric acid. The other component of organic acids commonly used in poultry are citric acid, lactic acid, malic acid, and fumaric acid due to their physical and chemical attributes applicable to poultry feeds (Kim *et al.*, 2014). (Khan and Iqbal, 2015) reported that organic acids used in the poultry industry are short chain fatty acids, antimicrobial in nature, and have high soluble ability in water. Propionic acid, citric acid, lactic acid, and formic acid are the widely used, because there is the thought that acidifiers are composed of single acid, but when a combined of any of these acids have more microbial effects (Šamudovská *et al.*, 2018).

The combination of organic acids such propionic acid and formic acid in broiler drinking water improves food conversion ratio, nitrogen retention, and body weight gain (Desai *et al.*, 2007). In the same vein, the mixture of formic, citric, propionic, and lactic acids aids body weight and broiler flock uniformity (Eftekhari *et al.*, 2015). According to (Sohail and Javid, 2016) organic acids health improve gut health and effective promoters of growth in poultry production. The need of modern poultry sector are increase in production levels and feed conversion efficiency which can be archived through the use of specific feed additives. Based on this background this study will therefore focus on how poultry feeds are enhanced through the application of organic acids to improve production and overall performance.

Organic acid effects on Animals

Organic acids serves alternative to antibiotics in animal feed. The European union also have stated that organic acids with the salt content in them are safe and approved for use in animal production as feed additives. They can



exist in either simple monocarboxylic acids such as formic, acetic, propionic and butyric acids or carboxylic acids with hydroxyl group such as lactic, malic, tartaric and citric acids or short chain carboxylic acids containing double bonds like fumaric and sorbic acids (Archana *et al.*, 2016). The organic acids disrupt microbial growth in the feed of animals, and also affects gastrointestinal tract due to microbial balance. The highlighted acids performs microbial activity which results in alteration of the gut micro plant attributes (Chen *et al.*, 2013). (Lückstädt, 2014) reported that propionic and formic acids are the two most effective organic acids used for several years in animal feed additives basically for preservation purpose.

Poultry production and organic acid

The use of organic had been observed to serve as protection to young chicks through feed conversion efficiency, nutrient use improvement, and competitive exclusion (Thirumeigmanam *et al.*, 2006). Weight gain and increase feed consumption were discovered with the addition of citric acids to broiler feed (Abdel-Fattah *et al.*, 2008). Fumaric, citric, lactic acids coupled with their salts in form organic acids have improved performance of poultry birds in terms of health status. (Adil *et al.*, 2010) reported the use of organic acids and salt components as safe measures to replace antibiotics, due to their safe nature and ability to serve as better feed additives in poultry and other animal diet.

Objectives

The main aim of this review was to examine the enhancement of animal feed efficiency using organic acids with focus on poultry Production. The purpose of this review is to;

- a. synthesis existing literatures: The goal of this review is to provide a thorough research into the use of animal feeds, organic acids, and effects on poultry production.
- b. Composing relevant data from reliable sources and evaluating reputable articles are part of planned results synthesis.

Materials and Methods

The reputable research platform Research Gate is used in this review. An analysis of the research gate database was done. The target data based focused on organic acids, utilization in poultry production, effects of organic acids on poultry, and other vital information on the subject. Valuable information were obtained from academic papers using the above keywords. The articles were then reviewed in specific forms which includes reports, conference proceedings, and journal articles. The only topics covered in the study were research papers organic acids, application of organic acids on poultry, feed efficiency on the use of organic farming in poultry production. Furthermore, the study employed several methodologies to identify relevant findings.

Findings and Discussion

Organic acid application in poultry production

The application of organic acids have been discussed in several research findings, (Mansoub *et al.*, 2011) observed the application of organic acids to improve chicks at tender age, and improve overall health performance at this early stage. (Lückstädt and Mellor, 2011) reported the application of organic acids to improve poultry nutrient utilization and feed conversion ratio. Organic acid as feed supplements had significant growth on weight gain and live weight as well (Aksu *et al.*, 2007). Higher live weight and day to day gain was observed due to addition of organic acids in animal feed (Al-Kassi and Mohssen, 2009). According to (Kaya and Tuncer, 2009) reported that no significant difference was observed in broilers weight gain due application of organic acid as supplement in their feed ration. Increase in body weight was discovered with the addition of organic acids in broiler feed (Adil *et al.*, 2010). Propionic acid addition in diet inclusion of broiler lead to improved overall performance with no side effects (Asma and Nagra, 2010). The inclusion of citric acid at specific percentage in broiler chicks had weekly growth while higher percentage had negative impact (Nourmohammadi *et al.*, 2010). Poultry birds consumes feed supplemented with organic acids in form of fumaric, lactic, and butyric had significant impact on body weight gain (Adil *et al.*, 2011). The combination of probiotics, organic acids, and oligosaccharides improve body weight of poultry birds (Armut and Filazi, 2012). Supplementation of citric acid in low nutrient diet enhance weight gain and immunity state (Das *et al.*, 2012).

Feed Efficiency using organic acids in poultry production

The feed efficiency using organic acids in poultry production had a lot of benefits which are in form of feed additives. The supplementation of organic acid with yeast component aids feed conversion efficiency and intake (Nicoletti *et al.*, 2010). (Saddeiy, 2013) observed difference in feed conversion ratio and feed consumption when the inclusion of different levels of organic acids as feed supplements. Feed intake and conversion ratio is increased with supplementation with organic acids in certain required proportion (Sarzamin *et al.*, 2013). Poultry intestinal microbes have been stabilized in the past using feed additives, which often leads to thinning of the gut region



resulting in increased nutrient assimilation. The antibiotics have long been supplemented in poultry feed to stabilize microbial flora, thereby leading to prevention of intestinal infection and overall performance (Khan *et al.*, 2016). Another approach to achieve more returns in terms of lower feed conversion is increase in nutrient digestion. Organic acids are often used as acidifiers in poultry feeds due to their nutrient digestion and other attractive attributes (Haq *et al.*, 2017). The also improve carcass quality of broiler chicks, nutrient utilization, feed conversion efficiency, and overall growth and performance. According to the findings of (Archana *et al.*, 2016) observed that increase in weight gain, feed consumption, and efficiency when organic acid is added to broiler feed rations. Mortality reduction effects and increase growth enhancement was observed due to certain required proportion of organic acid in broiler chickens with no effects on carcass output (Brzoska *et al.*, 2013). The findings of (Fascina *et al.*, 2012) revealed that mixture of broiler feeds with organic acids resulted in better carcass quality and improved overall performance. The use of acidifiers such as tartaric, citric, lactic, and formic and malic acids addition to broiler feeds at certain proportion increase body weight gain.

Beneficial effects of organic acids in poultry production

There are several advantages of using organic acids in poultry production. The lowering of PH in the intestinal tract of animals especially poultry birds is one benefits of organic acids because it favours microbial activity and eradicate pathogen microbes. Organic acids are deepen in poultry feed and drinking water to enhance better growth, digestion of nutrient, and immunity levels (Haq *et al.*, 2017). Organic acids aside the maintaining of PH level also correct and improve the actions of proteolytic enzymes during overall protein digestion in the stomach and enhance consumption of feed (Archana, 2016). Authors like (Armut and Filazi, 2012) and (Gonzales *et al.*, 2013) reported in their findings the positive effects of organic acids which can be used in place of antibiotics suitable as feed additives for poultry birds. Due to the safe use of organic acids and their salt component as feed additives in animal production by the European Union (EU), the inclusion of dietary organic acids in broiler feed resulted in villus height (Cengiz *et al.*, 2012). (Haque *et al.*, 2010) in their findings discovered that inclusion of citric acid in animal feed improves lymphocytes density in the lymphoid organs, thus implies non-specific immunity. Poultry birds with greater density lymphocytes have stronger immune status to fight immunogens in their system (Khan *et al.*, 2008). The dietary supplementation of organic acid like phenylacetic acid increase the lymphocyte percentage in a short duration for layers birds (Wang *et al.*, 2009), while (Houshmand *et al.*, 2012) reported usage of organic acids as supplement increase antibodies action against Newcastle disease in broiler birds. (Achana *et al.*, 2016) also discovered in their study that organic acids reduce production of poisonous materials by bacteria, alteration of the structure of the intestinal wall, and reduction pathogen colonization, therefore improving growth performance, prevention of epithelial cells, and enhance broiler chick carcass quality.

Detrimental effects of organic acids in poultry production

The organic acid also have negative effects on the poultry feed when included not just to mention the positives alone. Organic acids penetrates the cell wall of microorganism in the intestinal tract causes normal cell functioning and can cause death of these microbes which are important in the stomach of poultry bird. According to (Mani-Lopez *et al.*, 2012) the process of bactericidal mechanism are explained in several forms. The organic acids moves along the bacterial walls and then translates into a conjugated based form with a reduction in cell PH. The reduction then leads to stressful environment which leads to cellular dysfunction and reduction multiplication nature. The consumption of broiler chickens on organic acids reduce harmful bacterial such as coliforms and Clostridia but have contained higher bacterial which are beneficial in form of ileum and lactobacilli compared to the organic acids with antibiotic growth promoters which are harmful (Khan, 2016). (Kil *et al.*, 2011) reported in their findings that observed that organic acid may also prevent bacterial transfer from the feed or the environment due to their PH lowering attributes in the gastrointestinal tract of animals such as poultry birds. Organic acids also serve as feed preservatives (Ewing, 2009). (Adil *et al.*, 2011) in their study discovered reduction in feed intake among broiler when feed with organic acids supplements, but improvement in feed conversion ratio. The inclusion of citric acids in boiler feed within certain concentration leads to reduced feed intake (Kopecky *et al.*, 2012). (Jian-Hui, 2013) also reported that application of acidifier in poultry feed with a number of days resulted in feed intake and feed conversion ratio respectively. (Haq *et al.*, 2017) observed that multiplication of pathogenic microbes in the gastrointestinal damages the villus and make the intestinal walls thick due to cell proliferation which makes the penetration of nutrients difficult resulting is reduced growth performance. This multiplication is caused due to inclusion of excess organic acids in the feed of poultry feed.

Conclusion

The study concluded that although organic acids are significant to poultry birds in terms of nutrient digestion, feed consumption, feed efficiency ratio, immunity, and overall growth and performance, they also have negative effects if not properly used in poultry feed. There is need for animal scientist to recommend specific level of organic acids in poultry feed to achieve the best result in overall growth and development of the poultry birds.



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Evaluation of The Current Situation of Goose Breeding in Türkiye at the Aspect of Production and Consumption

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Abstract

This research was conducted to evaluate the current status of goose breeding in Turkey in terms of production and consumption. For this purpose, 147 enterprises were selected from all over Turkey and especially from regions where goose breeding is intensive, taking into account the density of geese. An online survey was applied to the selected enterprises. In the research, 45% of the goose breeders reported that they only raise geese and 55% reported that they raise turkeys, ducks and chickens in addition to geese. 35% of the participants stated that raising geese was their main source of income. In this research, the participants stated that the number of breeding geese held was 7 or more with a rate of 88.5%. It was revealed that 93% of the goose chicks were obtained from the enterprises' own resources. It was determined that 57% of the varieties used by goose breeders were white, 35% were grey, 26% were piebald and 2% were black. In this study, it was determined that 63% of the geese were raised in open areas and 37% were raised in closed areas. In terms of feeding, it was found that 81% of geese graze on pasture and 99.5% of geese grazing on pasture receive supplementary feeding. 88% of supplementary feeding was done with concentrated feed. 88.5% of the participants reported that disinfection was applied in goose shelters. It was concluded that the breeding period of geese is 3-4 years at 73% and the number of eggs obtained annually is 20 or more at 72%. It was known that 79% of goose breeders find goose production profitable, 49% send geese to slaughter at 6-8 months of age. 68% of the participants reported that they produce goose meat to meet the needs of their families and sell it, 29% to sell it and 3% to meet the needs of their families. As a result, although goose breeding is largely done under extensive conditions, intensive and semi-intensive enterprises have been opened in recent years. The fact that goose products have become sought-after products among the public with the studies conducted is an indication that the sector has growth potential.

Keywords: Survey, Goose breeding, Production and Consumption

Türkiye’de Kaz Yetiştiriciliğinin Mevcut Durumunun Üretim ve Tüketim Boyutunda Değerlendirilmesi

Özet

Bu araştırma, Türkiye’de kaz yetiştiriciliğinin mevcut durumunun üretim ve tüketim boyutunda değerlendirilmesi amacıyla yürütülmüştür. B amaçla Türkiye genelinden ve özellikle kaz yetiştiriciliğinin yoğun yapıldığı bölgelerden, kaz yoğunluğu dikkate alınarak 147 işletme seçilmiştir. Seçilen işletmelere online yöntemle anket uygulanmıştır. Yapılan araştırmada kaz yetiştiriciliği yapmalarının, % 45’i sadece kaz yetiştirdiğini ve % 55’i ise kaz dışında hindi, ördek, tavukta yetiştirdiğini bildirmiştir. Katılımcıların %35’i kaz yetiştirmenin ana geçim kaynağı olduğunu belirtmiştir. Bu araştırmada katılımcılar, elde tutulan damızlık kaz miktarını %88,5 oranla 7 adet ve üzeri olduğunu söylemiştir. Kaz palazlarının %93’ünün işletmecilerin kendi kaynaklarından elde ettikleri sonucu ortaya çıkmıştır. Kaz yetiştiricilerin kullandıkları varyetelerin %57’sinin beyaz, %35’inin gri, % 26’sının alaca ve %2’sinin ise siyah ırklar olduğu tespit edilmiştir. Bu çalışmada kazların %63’ünün açıkta ve %37’sinin ise kapalı alanda yetiştirildiği tespit edilmiştir. Besleme açısından bakıldığında kazların %81’inin merada otladığı ve merada otlayan kazların %99,5’ine ek yemleme yapıldığı bulunmuştur. Ek yemlemenin %88’i kesif yem ile yapılmıştır. Katılımcıların %88,5’i kaz barınaklarında dezenfeksiyon uygulandığını bildirmiştir. Kazlarda damızlıkta kullanım süresinin %73 oranla 3-4 yıl olduğunu ve yıllık elde edilen yumurta sayısının %72 oranda 20 adet ve üzeri olduğunu sonucuna varılmıştır. Kaz yetiştiricilerinin %79’u kaz üretiminin karlı olduğunu, %49’u kazları 6-8 aylık yaşta kesime gönderdiğini bilinmiştir. Katılımcıların %68’i kaz etini ailenin ihtiyacını karşılamak ve satmak, %29’u satmak ve %3’ü ise aile ihtiyacını karşılamak amacıyla ürettiğini bildirmiştir. Sonuç olarak kaz yetiştiriciliği büyük oranda ekstansif koşullarda yapılmasına rağmen son yıllarda entansif ve yarı entansif işletmeler açılmıştır. Yapılan çalışmalar ile kaz ürünlerinin halk arasında aranan ürünler haline gelmesi sektörün büyüme potansiyelinin olduğunu bir göstergesidir

Anahtar Kelimeler: Anket, Kaz yetiştiriciliği, Üretim ve Tüketim



Evaluating the Impact of Cooking and Fermentation Processes on the Nutritional Quality and Health Benefits of Seafood

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Abstract

Seafood has long been recognized for its significant role in promoting human health, and it is rich in essential nutrients such as omega-3 fatty acids, high-quality proteins, vitamins, and minerals. Seafood consumption has been linked to numerous health benefits, including enhanced cardiovascular health, reduced inflammation, and improved cognitive function. Fish and shellfish, like salmon, clams and shrimp, are particularly high in protein plus vitamins and minerals, like vitamin B12, selenium and zinc. Clams and wild-caught salmon are highly nutritious seafood choices with notable health benefits. A 3-ounce (85-gram) serving of cooked clams delivers over 3,500% of the Daily Value (DV) for vitamin B12, 99% for selenium, 21% for zinc and 13% for iron. Conversely, a half-fillet (154-gram) serving of wild-caught salmon provides 196% of the DV for vitamin B12, 131% for selenium, 85% for vitamin B6 and 21% for potassium. These findings emphasize the remarkable nutritional benefits of both clams and salmon, illustrating their important role in a balanced diet. Seafood is low in fat, low in calories, and rich in essential minerals, vitamins, and protein. Effective preservation of seafood is crucial for maintaining its quality and extending its shelf life. This paper explores preservation techniques: cooking methods and fermentation. Cooking methods- boiling, steaming, grilling and preservation methods- canning, freezing, drying, pickling, and curing affect seafood's chemical and microbial properties, enhancing its safety and shelf life by killing pathogens and inactivating spoilage enzymes. Fermentation, on the other hand, leverages microbial activity and pH changes to preserve seafood. By combining these techniques, seafood preservation can be optimized, balancing safety, quality, and longevity. This article provides a comprehensive understanding of how these methods impact seafood preservation, facilitating the development of tailored strategies for maintaining seafood quality.

Key Words: Seafood, Nutrition, Cooking, Fermentation, Human health



Effect of dietary supplementation of *Monothea buxifolia* leaf powder on the growth performance of broiler chickens

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Abstract

The aim of this study was to investigate the effect of dietary supplementation of *Monothea buxifolia* leaf powder on the growth performance of broiler chickens. A total of 250 -1-day old broiler chicks (Ross 308) were randomly distributed into five treatments with five replicates and each replicate consists of ten birds. Prior to the arrival of birds, basal diet adequate in all nutrients was formulated according to the requirement of birds by Nutritional Research Council in 1994. Birds in treatment one was fed basal diet without *Monothea buxifolia* leaf powder, those in treatment two, three, four and five were fed same diet with *Monothea buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g respectively. The experiment lasted for 42 days and birds had unrestricted access to clean water and feed. A completely randomized experimental design was adopted and all management practices was strictly adhered to. Result on the phytochemical content of *Monothea buxifolia* leaf powder flavonoids (863.2 mg/g), phenols (511.8 mg/g) and terpenoids (102.3 mg/g) were the most prominent compounds followed by saponins (72.56 mg/g), tannins (62.34 mg/g), alkaloids (41.88 mg/g) and steroids (30.41 mg/g). Average daily weight gain and average daily feed intake values which varied from 41.24 – 51.37 g/b and 103.7 – 107.5 g/b were higher among birds fed *Monothea buxifolia* leaf powder (treatment two, three, four and five) relative to treatment one ($P<0.05$). Similarly, feed conversion ratio whose value ranged from 2.09 – 2.50 were significantly ($P<0.05$) influenced by the treatment. In conclusion, feeding broilers *Monothea buxifolia* leaf powder up to 400 g/kg diet does not pose any detrimental effect on the performance of birds.

Key Words: *Monothea buxifolia*, phytochemicals, growth, performance, food safety, dose

Introduction

Using antibiotics in sub therapeutic dosages was for a long time a general tool for the control of diseases, however, their misuse in animal husbandry has contributed to the development of multiple resistance of pathogens, deposit of drug residues in edible animal product and the environment, and the potential transfer of antibiotic resistance to human pathogens has directed research towards alternative solutions such as the use of medicinal or herbal plants (Daniel, 2020; Peter, 2021). Plants are natural reservoir of medicinal agents almost free from the side effects normally caused by synthetic chemicals (Fennel et al., 2004). They also contain a wide variety of free radicals scavenging molecules including phenols, flavonoids, vitamins, terpenoids that are rich in antioxidant activity (Cai and Sun, 2003). Medicinal plants are known to contain phytochemicals which can be found in stems, roots, leaves, stem bark, flowers amongst others, possess numerous pharmacological properties, antimicrobial, anti-fungal, antioxidant, gastro-protective, cytotoxic, hypolipidemic, anti-nociceptive, antidiuretic, immune-stimulatory, anti-inflammatory and antiviral (Alagbe, 2023; John, 2024).

Monothea buxifolia is one of the numerous underexplored medicinal plant belonging to the family Sapotaceae (Maryam et al., 2020). The plant is widely distributed in Pakistan, Afghanistan, Oman, Saudi Arabia and some parts of India (Ihsan et al., 2020). Extracts from the leaves, stem and roots of the plant can be used for the traditional treatment of digestive disorders, urinary tract disease, fever, sexually transmitted infections, diabetes, peptic ulcers, piles, yaws, dysmenorrhea, infertility, and helminthic infections (Irfan et al., 2016; Jan et al., 2013). Uses of its root, root bark and bark of stem are extensive, particularly for their astringent, haemostatic, hypotensive, vulnerary and diaphoretic activities (Rehman et al., 2013). The leaves contain, flavonoids, terpenoids, glycosides, phenolic compound, tannins and anthraquinones at different concentrations which contributes to their several therapeutic or biological functions, anti-inflammatory, antioxidant, cytotoxic, phytotoxic, anti-pyretic, central nervous system depressant, and hepato-protective (Ullah et al., 2016). This is possible because concentration of plant constituents of the same plant organ can vary from one geographical location to another depending on the age of the plant, differences in topographical factors, the nutrient concentrations of the soil, extraction method (Alagbe, 2023; Ojediran et al., 2024). Ethanolic and methanolic extracts from the leaves of *Monothea buxifolia* possesses antimicrobial properties and have been reported to inhibit the activities of *Escherichia coli*, *Klebsiella spp*, *Salmonella spp* and *Staphylococcus spp* (Ullah et al., 2016).

Previous studies by notable researchers have shown that phytochemicals exerts positive influence on the growth performance, immune response and microbial population in the gastrointestinal tract of birds (Oloruntola et al.,



2016; Kanduri et al., 2013; Hashemi and Davoodi, 2010; Rabelo et al., 2003; Seidavi and Simoes, 2015). However, outcome of their findings have not been consistent, this could be due to differences in inclusion levels, specie of plant used as well as their chemical constituents (Adewale et al., 2021). There is little or no report on the effect of *Monothecha buxifolia* leaf powder on the growth performance of broiler chickens. This research is timely as it will help to address the increasing cases of antimicrobial resistance, provide optimum levels for birds and help to promote food safety.

Materials and methods

Experimental area

The experiment was carried out at the Poultry Section, Sumitra Research Institute, Gujarat, India between the month of January to March, 2023. The institute is located between 23° 13' N and 72° 41' E.

Collection and preparation of *Monothecha buxifolia* leaf powder

Freshly harvested leaves of *Monothecha buxifolia* were harvested from Orathur village in Kancheepuram district, India. The collected leaves were washed with running tap water and air dried in an open shade for 10 days after authentication at the department of taxonomy, Sumitra Research Institute, Gujarat and assigned a reference number (GB/056F/2023). The dried leaves were grounded into powder with electric blender and packed into a labeled polythene bag before it was sent to the laboratory for further analysis.

Management of experimental animal and design

This study was carried out according to the guidelines of animal protocol approved by the Research and Ethics Committee of the department of Animal Nutrition and Biochemistry, Sumitra Research Institute, Gujarat, India. 250 – 1-day old broiler chick (Ross 308) mixed sex with an average initial body weight of 51.2 ± 0.02 g randomly distributed to five treatments with five replicates consisting of 10 birds each. Birds were reared in a battery cages equipped with nipple drinkers and manual feeders kept in a semi-closed pens. Prior to the arrival of bird's, battery cages were properly disinfected and a basal diet which is adequate in all nutrient was formulated according to Nutritional Research Council's guidelines (1994) for broilers. A completely randomized experimental design was adopted with birds in treatment 1 fed basal diet without *Monothecha buxifolia* leaf powder while those in treatment 2, 3, 4 and 5 were fed same diet with *Monothecha buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g/kg diet. Birds had unrestricted access to clean water and feed. Weight gain and feed intake were taken into consideration throughout the experiment which lasted for 42 days.

Determination of phytochemical contents in *Monothecha buxifolia* leaf powder

Quantification of flavonoids, alkaloids, saponins, steroids, tannins and terpenoids contents in *Monothecha buxifolia* leaf powder was carried out according to procedures recently published by Alagbe (2024). Each phyto-constituents were recorded at different optical densities using GC/MS Tripod (Model 821W-011J, China).

Proximate content of experimental diet

Proximate content of experimental diet was carried out using near infra- red automated kit (NIR -7000, USA) which uses SensorVu windows® based PC software. All operations were carried out according the manufacturers recommendation.

Statistical analysis

All the data obtained were subjected to one-way analysis of variance (ANOVA) using SPSS version 25. The differences among the treatment means were determined ($P < 0.05$) by Duncan multiple range test of the same software.

Results and discussion

Phytochemical content of *Monothecha buxifolia* leaf powder is presented in Table 2. Flavonoids had the highest concentration of 863.2 mg/g followed by phenols (511.8 mg/g), terpenoids (102.3 mg/g), saponins (72.56 mg/g), tannins (62.34 mg/g), alkaloids (41.88 mg/g) and steroids (30.41 mg/g). The presence of these phyto-constituents showed that *Monothecha buxifolia* leaf possesses several medicinal or pharmacological properties (Singh et al., 2022; John, 2024). Daniel et al. (2024); Adewale et al. (2021) reported that the concentration of phyto-constituents in medicinal plants are influenced by age of plant, geographical location, species, processing methods amongst others. Concentration of flavonoids and phenolic compound recorded in this study was higher than those reported for *Dysphania ambrosioides* (2.29 mg/g, 15.24 mg/g) and *Crassocephalum crepidioides* leaves (1.62 mg/g, 13.07 mg/g) by Falowo et al. (2023). Phenols and flavonoids have been suggested to have antioxidant properties (Dhan et al., 2007) and these antioxidants exert their activity by scavenging the free oxygen radicals" thereby giving rise to a fairly „stable radical“.



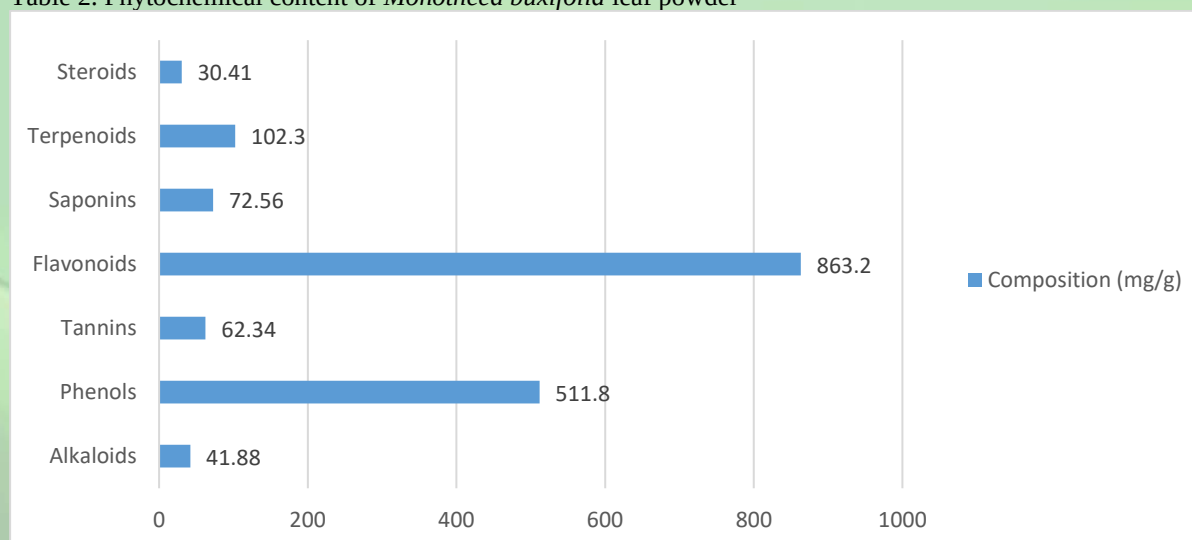
Table 1. Ingredient and chemical composition of experimental diet (as fed basis)

Ingredients	Starter mash (0-28 d)	Finishers mash (29 – 42 d)
Corn	50.00	52.00
Wheat bran	5.60	8.00
Soya bean	34.00	30.00
Fish meal	6.20	5.00
Di-calcium phosphate	2.50	3.00
Limestone	1.20	1.50
DL-methionine	0.25	0.20
Lysine	0.25	0.20
^{1,2} *Mineral-vitamin premix	0.25	0.25
Salt	0.30	0.35
Total	100.0	100.0
Chemical composition		
Dry matter	91.29	91.04
Crude protein	23.04	21.22
Crude fibre	4.20	5.06
Ether extract	3.92	3.55
Methionine	0.50	0.62
Methionine +cysteine	0.92	0.98
Lysine	1.17	1.19
Ash	6.92	7.11
Calcium	1.43	1.61
Phosphorus	0.61	0.72
Metabolizable energy (kcal/kg)	2907.1	3204.8

¹2.5 kg Mineral/vitamin premix for starter contains: Vit. A, 12000000 IU; Vit.D3 1800000 IU; Vit.E, 15000 mg; Vit.K3, 1000 mg; Vit.B1, 1200 mg; Vit.B2, 5100 mg; Vit. B6, 1500 mg; Vit.B12, 10mg; biotin, 50mg; pantothenic acid, 10000 mg; nicotinic acid, 30000 mg; folic acid, 1000 mg; choline chloride, 250000 mg; Mn, 60000 mg; Zn, 50000 mg; Fe, 30000 mg; Cu, 10000 mg; I, 1000 mg; Se, 100mg; Co, 100mg

²2.5 kg Mineral/vitamin premix for finisher contains: Vit. A, 12000000 IU; Vit.D3 2000000 IU; Vit.E, 10000 mg; Vit.K3, 2000 mg; Vit.B1, 1000 mg; Vit.B2, 5000 mg; Vit. B6, 1500 mg; Vit.B12, 10mg; biotin, 50mg; pantothenic acid, 10000 mg; nicotinic acid, 30000 mg; folic acid, 1000 mg; choline chloride, 250000 mg; Mn, 60000 mg; Zn, 50000 mg; Fe, 30000 mg; Cu, 10000 mg; I, 1000 mg; Se, 100mg; Co, 100 mg

Table 2. Phytochemical content of *Monotheca buxifolia* leaf powder



The free radicals are metastable chemical species, which tend to trap electrons from the molecules in the immediate surroundings. These radicals if not scavenged effectively in time, they may damage crucial bio molecules like lipids, proteins including those present in all membranes, mitochondria and, the DNA resulting in abnormalities leading to disease conditions (Uddin et al. 2008). Other properties include; antimicrobial (Dandan, 2009), anticarcinogenesis (Aritra and Sumana, 2012), anti-inflammatory (Daljit and Gurinder, 2007), cardio-protective (Alagbe, 2024) and immune-stimulatory (Gupta et al., 2003). Saponins and terpenoids have been suggested to possess hypolipidemic and anticancer properties (Kris-Etherton et al., 2002). Alkaloids have pharmacological applications as analgesics, antimalarial and central nervous system stimulants (Madziga et al., 2010; John, 2024). The result obtained in this study is in agreement with the reports of Maryam et al. (2020); Ullah et al. (2016).



Effect of *Monothea buxifolia* leaf powder on the growth performance of broiler chicken is presented in Table 3. Average daily weight gain, average daily feed intake and feed conversion ratio were significantly ($P<0.05$) influenced by the treatments. Birds fed *Monothea buxifolia* leaf powder had higher values compared to the control in T1 ($P<0.05$). Results obtained suggests that *Monothea buxifolia* leaf powder was able to modulate the activities of digestive enzymes thus leading to efficient nutrient utilization among birds. This action is triggered by the presence of phytochemicals in the test ingredient (*Monothea buxifolia* leaf) (Omokore and Alagbe, 2019; Agubosi et al., 2022). Outcome also suggests that *Monothea buxifolia* leaf possess antibacterial properties thus preventing dysbiosis which could also translate to a better feed conversion ratio in birds (Musa et al., 2021). The average daily weight gain range observed in this study with the dietary supplementation of *Monothea buxifolia* leaf powder 41.24 – 51.37 g/b was similar to the result of a study by John (2024); Alagbe (2019) who discovered that average daily weight gains of broilers fed *Rhamnus prinoides* leaf extract varied from 40.08 – 55.71 g/b. The result was higher than those presented by Agubosi et al. (2021) when sunflower oil was supplemented in the diet of broiler chicken at 0.3 %. Findings of this study on average daily feed intake (103.1 – 107.5 g/b) were lower than 81.18 – 82.30 g/b reported by Oloruntola et al. (2021); Kholoud et al. (2021) when phyto-additives were fed to broiler chickens but similar to 99.60 – 114.8 g/b recorded by Al-Mufarrej et al. (2019) when clove powder was supplemented in the diet of broilers. Feed conversion ratio values which varied from 2.09 – 2.50 was similar to the results of a study by Dibaji et al. (2014) who found that feed conversion ratio of broilers fed symbiotic ranged from 2.00 – 2.20. This result was lower than those reported by Golomytis et al. (2014) when quercetin was fed to broiler chickens.

Table 3.: Effect of *Monothea buxifolia* leaf powder on the growth performance of broiler chicken

Variables	T1	T2	T3	T4	T5	SEM
Number of birds per treatment	50.00	50.00	50.00	50.00	50.00	-
Duration of experiment (days)	42.00	42.00	42.00	42.00	42.00	-
Initial body weight (g/bird)	51.2	51.22	51.03	51	51.01	0.01
Final body weight (g/bird)	1783.1	2206.7	2207.5	2208.3	2208.5	61.82
¹ Weight gain (g/bird)	1731.9	2155.4	2156.5	2157.3	2157.5	58.07
² Average daily weight gain (g/bird)	41.24	51.33	51.34	51.36	51.37	0.02
³ Total feed intake (g/bird)	4328.7	4506.7	4511.2	4513.2	4515.1	91.14
⁴ Average daily feed intake (g/bird)	103.1	107.3	107.4	107.5	107.5	0.05
⁵ Feed conversion ratio	2.50	2.09	2.09	2.09	2.09	0.01

Means on the same row having different superscripts are significantly different ($P<0.05$); SEM: standard error of mean; T1: basal diet without *Monothea buxifolia* leaf powder; T2, T3, T4 and T5: basal diet supplemented with *Monothea buxifolia* leaf powder at 100 g, 200 g, 300 g and 400 g per kg diet respectively. ¹Final body weight – initial body weight; ²Average daily weight gain /42 days; ³Feed served – left over; ⁴Total feed intake/42 days; ⁵Average daily feed intake/average daily weight gain.

Conclusion

In conclusion, *Monothea buxifolia* leaf powder contains several phyto-constituents with medicinal value with flavonoids, phenols and terpenoids dominating as major bioactive compounds. This compounds performs multiple biological activities such as, anti-inflammatory, anti-pyretic, antioxidant, antifungal, cytotoxic, gastro-protective, immuno-stimulatory functions amongst others. Dietary supplementation of *Monothea buxifolia* leaf powder to broilers up to 400 g/kg diet had no negative effect on their growth performance.

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The effect of *Adhatoda vasica* as a herbal supplement on the performance, nutrient digestibility, and blood profile of weaned pigs

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Abstract

A 60-day trial was conducted to gain insight into how *Adhatoda vasica* as a herbal supplement affected the performance, nutrient digestibility, and blood profile of weaned pigs. 40 crossbred male pigs (Yorkshire × Landrace) with an initial body weight of 10.21 ± 0.03 kg were grouped into four treatment groups of ten pigs each. Upon arrival, the animals were quarantined for two weeks and fed a basal diet that is balanced in all nutrients, according to NRC (2012). Pigs in treatment 1 were fed a basal diet without *Adhatoda vasica* leaf powder, whereas those in treatments 2, 3, and 4 were provided the same food supplemented with *Adhatoda vasica* leaf powder at doses of 200 g, 400 g, and 600 g/kg. A completely randomised design approach was used, and the animals had unlimited access to clean, fresh water and food. The concentration of phyto-constituents in *Adhatoda vasica* leaf powder was found to be greater in flavonoids (102.1 mg/g) and lowest in steroids (30.41 mg/g). The average daily weight gain was higher for pigs fed treatments 3 and 4, intermediate for treatment 2, and lowest for treatment 1. The method of treatment significantly altered average daily feed intake, feed conversion ratio, and mortality ($P < 0.05$). The treatment had a significant effect ($P < 0.05$) on digestibility of dry matter, ether extract, crude protein, and crude fibre. There were significant differences ($P < 0.05$) in red blood cell, pack cell volume, mean platelet volume, mean corpuscular volume, mean corpuscular haemoglobin, white blood cell, and total protein levels among treatments, with the exception of aspartate amino transferase, alanine amino transferase, and alkaline phosphatase ($P > 0.05$). However, all levels fell within the recommended range for healthy pigs. Finally, *Adhatoda vasica* leaf powder can be added to pigs' diets without affecting their growth or health.

Key Words: *Adhatoda vasica*, phytochemicals, pigs, blood, nutrient, herbs

Introduction

With the rise of antimicrobial resistance and the more frequent identification of multidrug resistance strains, as well as a lack of research into the development of new antimicrobial agents, scientists are increasingly interested in tests of active substances derived from plants due to their ease of availability, safety, and cost effectiveness (Albert, 2021). The use of medicinal plants in animal nutrition has increased due to their positive properties such as bactericidal, fungicidal, antiviral, antioxidant capacity, growth promoting efficacy, immune stimulating effects, stimulation of digestive enzyme secretion, and nutrient absorption (Cross et al., 2007; Wojcikowski et al., 2004). A medicinal plant, as defined by the World Health Organisation in 2000, is any plant that contains chemicals that can be employed for purposes of medicine or that serve as substrates for chemo-pharmaceutical semi-synthesis. Such a plant's parts, such as leaves, roots, rhizomes, stems, barks, flowers, fruits, grains, or seeds, are used in the control or treatment of a disease condition, and thus include medically active chemical components or phytochemicals (Singh et al., 2022). Phytochemicals are naturally occurring substance that serve as the foundation for modern pharmaceuticals. Alkaloids, flavonoids, saponins, terpenoids, tannins, and phenolic chemicals, among others, have several biological or pharmacological actions in animals (Alagbe, 2022).

Adhatoda vasica, a possible medicinal plant, is an evergreen perennial shrub from the Acanthaceae family that grows throughout Asia, including India (Rahman et al., 2004; Gupta et al., 1977). In folk medicine, the leaves and roots are traditionally used in the treatment of various respiratory disorders like bronchitis, asthma, whooping cough, tuberculosis, skin infections, gives relief in pyorrhoea and bleeding gums, malarial, quick ejaculation, headache, hypertension, dysentery, premature ageing, memory improvement, blood cleansing, chronic venous, insufficiency, mental function, minor burns, scars, scleroderma, skin ulcers, varicose veins and wound healing (Petel and Venkata, 1984). The plant contains pyrroloquinazoline alkaloids such as vasicine, vasicol, adhatonine, vasicinone, vasicinol, and vasicinolone, which are its main ingredients. These bioactive compounds have demonstrated a wide range of medicinal and pharmacological activity, including anti-malarial, anti-inflammatory, antioxidant, antidiabetic, antibacterial, and anti-cancer properties (Chakrabarty and Brantner, 2001). *Adhatoda vasica* leaf and extracts of roots has been shown to hinder the activity of *Escherichia coli*, *Klebsiella pneumoniae*, *Pseudomonas aeruginosa*, *Enterococcus faecalis*, *Staphylococcus aureus*, *Bacillus subtilis*, *Penicillium notatum*, *Candida albicans*, and other bacteria (Vinothapoo and Sundar, 2010).



The potential functions or works of medicinal plants or herbs in animals for growth promotion include changes in the intestinal microbiota, increased digestibility and nutrient absorption, immune response improvement, and morphological and histological changes of the gastrointestinal tract (Hashemi et al., 2008; Hashemi et al., 2009). However, little or no research is available on the effects of *Adhatoda vasica* as a herbal supplement on weaned pig performance, nutritional digestibility, and blood profile. This study is crucial because it will assist to protect antibiotics for future usage in animal agriculture and ensure food security.

Materials and methods

Experimental Area

This experiment had been carried out at Sumitra Research Institute's livestock section in Gujarat, India, between 28° 18' N and 70° 35' E, from September to November 2021. The examination followed the rules and animal methodology established by the institute's Animal Department.

Collection of *Adhatoda vasica* leaves and their processing

Mature leaves of *Adhatoda vasica* were gathered in Orathur village, Kancheepuram district, Tamil Nadu, India, and sent to the Sumitra Research Institute's Nomenclature Department in Gujarat for certification by a licensed taxonomist. The leaves were then air-dried for ten days before being ground into powder with an electric blender and stored in an airtight container for future study. 500 grammes of grinded *Adhatoda vasica* were sent to the department of biochemistry at Sumitra Research Institute in Gujarat for quantitative analysis of its phyto-constituents.

Experimental design and animal management

40 crossbred male pigs (Yorkshire × Landrace) with an initial body weight of 10.21 ± 0.03 kilogrammes were obtained from a renowned breeder farm in Gujarat, separately kept in sections measuring 1.5 m by 2.2 m by 0.5 m (length × width × height) and confined for two weeks. During the adjustment period, pig's were dewormed with Albendazole plus® (1 tablet per kg weight), and fed with basal diet rich in all nutrients needed for pig's according to NRC in 2012. Thereafter, animals weight were balanced before being randomly assigned to four treatment groups. Treatment one was fed basal diet without *Adhatoda vasica* powder while treatment two, three and four were fed same diet with *Adhatoda vasica* powder at 200 grams, 400 grams and 600 grams per kilogram diet. Proper management was thoroughly observed during the 60 days' experimental period and a completely randomized design was adopted. Animals had unlimited access to fresh water and feed. Feed intake, and body weight gain was recorded per pen. Weight was recorded on weekly basis before feeding the animals with an automatic digital scale. Body weight gain was estimated by subtracting initial body weight from the final body weight expressed in kilogram. Total feed intake was calculated as the difference between the left over and feed served.

Blood collection and analysis

On the 60th day of the experiment, 5 mL of blood samples were collected from the Jugular vein of five randomly selected rabbits per treatment for haematological and serum biochemical analysis. Blood for haematology (2.5 mL) was collected into bottles with anticoagulant while those for serum indices were placed in bottles without anticoagulant (2.5 mL). Labotronics haematology analyzer (Model- LB -20 HEA) was used to analyze: red blood cell, haemoglobin, pack cell volume, white blood cell and its differentials using triangle laser scattering, flow cytometry differentiation, impedance and cyanide free technique. For precision in the results, the kit is adjusted to a processing speed of 60 test per hour and operating temperature (10 to 30°C) before final outcome were displayed on the monitor.

Serum biochemical indices was carried out using Labdex automatic biochemistry analyzer (Model LX101ABA) adjusted to a sample volume (2 -70 µL), reagent volume (20 – 350 µL), wavelength of about 1000 nm and absorbance (0 to 3 Abs) after calibration to ensure precision in results.

Digestibility trial

Digestibility study was carried out at the end of the trial. Four pigs were randomly selected from each treatment and housed individually before the commencement of the experiment. A known quantity of feed was served to each pigs mixed with chromium oxide (an indigestible marker) daily for five days. Daily fresh excreta were collected and dried at a temperature of 65 °C for 3 days before it was taken to the laboratory for the determination of dry matter, crude protein, crude fibre, ether extract.

Evaluation of phyto-constituents in *Adhatoda vasica* leaf powder

Phyto-constituents were analyzed according to the procedures recently published by Alagbe (2024). 200 grams of *Adhatoda vasica* leaf powder was analyzed using GC-MS 6800 gas chromatography/mass spectrometer. To ensure precision, gas chromatography chamber where the sample is first injected is maintained at an inlet temperature of



450 °C, column temperature (4 – 450 °C, pressure range (0 – 100 psi $\pm$ 0.002 psi) and heating rate up to 1201/min while the mass spectrometer unit is adjusted at an ion source temperature (100 – 350 °C), stability ($\pm$ 0.10 amu/48 hours), mass range (1.5 – 1000 amu), scan rate (up to 10000 amu/sec) and ionization energy (5 eV – 250 eV). Each phyto-constituents were quantified at different optical density (alkaloids, 500 nm), flavonoids (460 nm), terpenoids (370 nm), alkaloids (550 nm), tannins (480 nm), steroids (250 nm), saponins (360 nm) and phenols (670 nm).

Proximate composition of experimental diet

Proximate composition of experimental diet was determined using diode array based near infra-red reflectance and trans reflectance analyzer (Model NIRSTM DA 1650). 200 g of feed sample is placed in the collector after the machine was calibrated following the manufacturers lay down procedures. To maintain further precision, it was adjusted at an optical bandwidth (8.75 nm), spectral resolution (1.0 nm), absorbance ranges (up to 2 AU), wavelength accuracy (less than 0.05 nm), photometric noise (400 – 700 nm less 50 micro au; 700 – 2500 nm less than 20 micro au).

Analysis of data

All data on growth performance, nutrient digestibility, and blood metabolites were analysed using one-way ANOVA in Statistical Package for Social Sciences (version 25). Differences between treatment means ($P < 0.05$) were assessed using the Duncan multiple range test in the same statistical program.

Results and discussion

Table 1. Ingredients and chemical makeup of the experimental diet

Ingredients	Diet 1	Diet 2	Diet 3	Diet 4
Corn	53.00	53.00	53.00	53.00
Rice bran	11.00	11.00	11.00	11.00
Soybean meal	20.50	20.50	20.50	20.50
Groundnut meal	5.00	5.00	5.00	5.00
Fish meal (Imported: 72%)	5.00	5.00	5.00	5.00
Limestone	1.50	1.50	1.50	1.50
Bone meal	3.00	3.00	3.00	3.00
Methionine	0.25	0.25	0.25	0.25
Lysine	0.20	0.20	0.20	0.20
**Mineral/Vitamin Premix	0.25	0.25	0.25	0.25
Salt	0.25	0.25	0.25	0.25
Toxin binder	0.05	0.05	0.05	0.05
	0.00	2.00	4.00	6.00
Total	100.0	100.0	100.0	100.0
Calculated analysis				
Crude protein (%)	16.50	16.50	16.50	16.50
Crude fibre (%)	4.34	4.34	4.34	4.34
Ether extract (%)	3.21	3.21	3.21	3.21
Ash (%)	2.87	2.87	2.87	2.87
Calcium (%)	1.46	1.46	1.46	1.46
Phosphorus (%)	0.51	0.51	0.51	0.51
Nitrogen free extract (%)	48.64	48.64	48.64	48.64
Metabolizable energy (MJ/kg)	10.00	10.00	10.00	10.00
Determined analysis (% dry matter)				
Crude protein	18.33	18.33	18.33	18.33
Crude fibre	4.00	4.00	4.00	4.00
Ether extract	3.80	3.80	3.80	3.80
Ash	3.10	3.10	3.10	3.10
Calcium	1.55	1.55	1.55	1.55
Phosphorus	0.63	0.63	0.63	0.63
Nitrogen free extract	50.17	50.17	50.17	50.17
Metabolizable energy (MJ/kg)	10.60	10.60	10.60	10.60

**Mineral-vitamin premix (2.5 kg) contains; Thiamine, 8000 mg, riboflavin, 12,000 mg, pyridoxine, 5000 mg, cyanocobalamine, 5000 mg, niacin, 20,000 mg, D-panthotenate, 10,000 mg, folic acid, 500 mg, biotin, 2000 mg, cholecalciferol, 3,000,000 iu., tocopherol acetate, 25,000 iu., ascorbic acid, 62,000 mg, manganese, 56mg, iron, 70,200 mg, 300 mg, iodine, 200 mg, selenium, 85 mg, choline chloride, 46,000 mg



Table 2 shows that the largest concentration of phyto-constituents in *Adhatoda vasica* leaf powder was flavonoids (102.1 mg/g), subsequently followed by phenols (87.61 mg/g), terpenoids (61.53 mg/g), saponins (51.88 mg/g), tannins (47.12 mg/g), alkaloids (36.04 mg/g), and steroids (30.41 mg/g). The findings demonstrate that *Adhatoda vasica* leaf powder has therapeutic properties or exerts numerous biological effects in animals, including antimicrobial, antifungal, antioxidant, immune-stimulatory, hepatoprotective, and others (Singh et al., 2022; Adewale et al., 2022). They can also be used historically to treat a variety of diseases because they are less harmful, beneficial to the environment, and require no withdrawal period when administered (John, 2024; Shittu and Alagbe, 2022). The phyto-constituent results obtained in this study are consistent with those reported by Kokati et al. (2013) and Harsukhet et al. (2020). The phenolic component content found in this study was higher than that found in *Bryophyllum pinnatum* leaves (18.4 mg/g), *Terminalia bellerica* leaves (29.6 mg/g), and *Xanthium strumarium* leaves (71.6 mg/g) reported by Yadav and Munin (2011). Iqbal et al. (2011) found higher levels of alkaloids, flavonoids, and saponin in the leaves of *Ranunculus arvensis* (0.025 mg/g, 17.69 mg/g, 24.1 mg/g), *Equisetum raven*s (0.039 mg/g, 10.34 mg/g, 16.07 mg/g), *Carathamus lanatus* (0.017 mg/g, 5.617 mg/g, 25.1 mg/g), and *Fagonia critica* (0.022 mg/g, 9.86 mg/g, 8.223 mg/g). Regional location, species, plant age, and processing methodologies have all been shown to alter phyto-constituents in medicinal plants (John, 2024; Alagbe, 2022).

Table 2: Phyto-constituent in *Adhatoda vasica* leaf powder

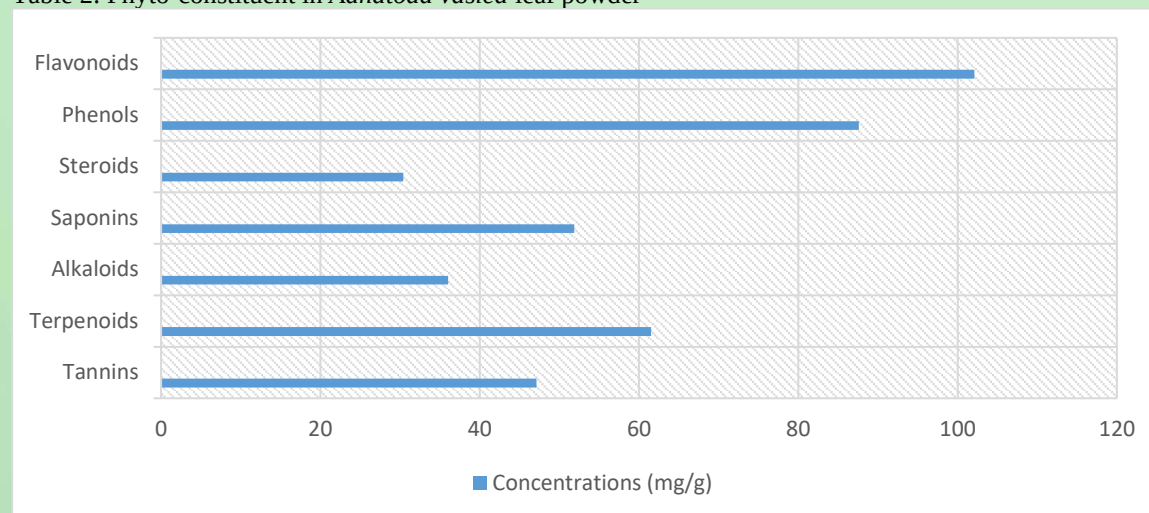


Table 3 shows how *Adhatoda vasica* leaf powder affects the growth performance of weaned pigs. Pigs fed diet 3 (basal diet + 400 g *Adhatoda vasica* leaf powder/kg) gained similar daily weight ($P>0.05$) to those fed diet 4 (basal diet + 600 g *Adhatoda vasica* leaf powder/kg), but significantly higher ($P<0.05$) than those fed diet 2 (basal diet + 200 g *Adhatoda vasica* leaf powder/kg) and diet 1 (basal diet without *Adhatoda vasica* leaf powder/kg). The average daily weight gain found in this investigation with dietary supplementation of diet 3 *Adhatoda vasica* leaf powder (0.33 - 0.51 kg) was comparable to the outcomes of John et al. (2024) and Olujimi et al. (2024), who recorded an average daily weight gain range of 0.24 - 0.50 kg in weaned pigs fed *Cordyline fruticosa* leaf powder. This result was higher than that obtained by Upadaya and Kim (2015) when essential oil and yeast culture were added to the feed of weaned pigs.

The results indicate that supplementation with of *Adhatoda vasica* leaf powder may enhance pig performance through elevating digestive enzyme secretion, decreasing the number of undesirable microbes in the digestive tract, modifying intestinal morphology functions, and ultimately positively affecting animal productivity (Shittu et al., 2022; John, 2024). In this study, pigs fed *Adhatoda vasica* leaf powder (diets 2, 3, and 4) had higher average daily feed intake compared to diet 1 ($P<0.05$). The result could be due to enhanced flavours due to the presence of phyto-constituents such as flavonoids, which have been demonstrated to enhance gut structure and influence barrier porosity to protect from endotoxin damage. This also clarifies the reason no mortality was observed among animals fed *Adhatoda vasica* leaf powder (Li et al., 2012; Mizumoto et al., 2012).

Adhatoda vasica leaves have been shown in studies to have both local and systemic anti-inflammatory properties as a result of immunomodulatory action (Subhashini et al., 2011). The results of this investigation are consistent with the findings of Guoqi et al. (2018), who supplemented weaned pig diets with plant essential oil. The feed conversion ratio range observed in this experiment with dietary supplementation of *Adhatoda vasica* leaf powder (2.10 - 2.84) was similar to the results of a study by Zeng et al. (2015) and Li et al. (2012), who discovered that dietary supplementation of essential oil improved feed conversion ratio in weaned pigs. This result was lower than those presented by John (2024) who found out that feed conversion ratio ranged from 1.73 – 2.40 in weaned pigs fed *Cordyline fruticosa* leaf powder.

Table 3: effect of *Adhatoda vasica* leaf powder on the growth performance of weaned pigs



Variables	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Number of animals	10	10	10	10	-
Experimental days	60.0	60.0	60.0	60.0	-
Average Initial body weight (kg)	10.23	10.21	10.21	10.21	0.02
Final body weight (kg)	30.17 ^c	35.04 ^b	40.12 ^a	40.82 ^a	0.06
Weight gain (kg)	19.94 ^c	24.83 ^b	29.91 ^a	30.61 ^a	0.04
^a Average daily weight gain (kg)	0.33 ^c	0.41 ^b	0.50 ^a	0.51 ^a	0.001
Total feed intake (kg)	56.8 ^b	63.12 ^a	63.34 ^a	63.21 ^a	0.72
^b Average daily feed intake (kg)	0.95 ^b	1.05 ^a	1.05 ^a	1.05 ^a	0.01
^c Feed conversion ratio	2.84 ^a	2.54 ^b	2.11 ^c	2.10 ^c	0.01
Mortality (%)	1.00	-	-	-	0.001

^aweight gain/60 days; ^btotal feed intake/60days; ^caverage daily feed intake/average daily weight gain; SEM – standard error of mean; diet 1: basal diet without *Adhatoda vasica* leaf powder; diet 2: basal diet supplemented with 200 g *Adhatoda vasica* leaf powder per kg; diet 3: basal diet supplemented with 400 g *Adhatoda vasica* leaf powder per kg; diet 4: basal diet supplemented with 600 g *Adhatoda vasica* leaf powder per kg.

Effect of *Adhatoda vasica* leaf powder on the nutrient digestibility of weaned pigs is presented in Table 4. Dry matter, crude protein and ether extract digestibility of pigs fed diet 3 was similar ($P>0.05$) to those fed diet 4 but significantly higher ($P<0.05$) than the other treatments. Crude fibre value was significantly ($P<0.05$) influenced by the treatments. Dry matter, crude protein and ether extract digestibility recorded in this experiment with the dietary supplementation of *Adhatoda vasica* leaf powder which varied from 69.83 – 85.06 %, 57.88 – 70.28 % and 49.04 – 60.93 % respectively is similar to the result of a study by Maenner et al. (2011) who found out that dry matter, crude protein and ether extract of weaned pigs ranged from 68.84 – 89.02 %, 60.08 – 71.20 % and 40.00 – 62.00 %. Outcome on crude fibre values is also in agreement with the findings of Wan et al. (2017). Potential pathways for improved nutrient digestibility by *Adhatoda vasica* leaf powder supplementation include the ability to enhance desire to eat, saliva formation, intestinal generation of mucus, bile acid production, and activity of digestive enzymes (Mojca, 2020). It may also promote uterine health by increasing calcium stores and pancreatic secretions, hence improving nutrition digestion (John, 2024; Smith et al., 2011). Flavonoids can also help the small intestine absorb nutrients more effectively (Musa et al., 2020; Muritala et al., 2022).

Table 4. effect of *Adhatoda vasica* leaf powder on the nutrient digestibility of weaned pigs

Variables expressed in percentage	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Dry matter	69.83 ^c	76.08 ^b	84.10 ^a	85.06 ^a	0.51
Crude protein	57.88 ^c	63.60 ^b	70.21 ^a	70.28 ^a	0.47
Crude fibre	35.22 ^b	40.60 ^a	44.93 ^a	45.09 ^a	0.15
Ether extract	49.04 ^c	56.11 ^b	60.50 ^a	60.93 ^a	0.26

SEM – standard error of mean; diet 1: basal diet without *Adhatoda vasica* leaf powder; diet 2: basal diet supplemented with 200 g *Adhatoda vasica* leaf powder per kg; diet 3: basal diet supplemented with 400 g *Adhatoda vasica* leaf powder per kg; diet 4: basal diet supplemented with 600 g *Adhatoda vasica* leaf powder per kg.

Effect of *Adhatoda vasica* leaf powder on haematological indices of weaned pigs is presented in Table 5. Red blood cell, haemoglobin, pack cell volume, mean platelet volume, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentrations follow similar pattern as pigs fed diet 2 (basal diet + 200 g *Adhatoda vasica* leaf powder/kg) were similar ($P>0.05$) to ones given diet 3 (basal diet + 400 g *Adhatoda vasica* leaf powder/kg) and diet 4 (basal diet + 600 g *Adhatoda vasica* leaf powder/kg) but significantly higher ($P<0.05$) than those in diet 1 (basal diet without *Adhatoda vasica* leaf powder). The improvement in this values could be attributed to the presence of phyto-constituents (as presented in Table 2) capable of supplying the required nutrients to animals and were within the tolerable level for their optimum performance. Haemoglobin (142.7 – 158.1 g/L), pack cell volume values (29.18 – 33.14 %) and red blood cell [(5.61 – 7.18 ($\times 10^{12}$ /L))] observed in this experiment was within the normal range 95.99 – 154.22 g/L, 20.88 – 35.86 % and [4.19 – 7.00 ($\times 10^{12}$ /L)] reported by (Czech et al., 2018). The results obtained suggests that the animals have sufficient oxygen in the blood to convey absorbed nutrients round the body (Grace and Alagbe, 2019). The mean platelet volume achieved in this experiment falls within the usual range (7.05 - 13.08 fl) reported by Casas et al. (2015). Mean platelet volume is a key indicator of platelet size and function in the body (Omokore and Alagbe, 2019). Elevated mean platelet volume values imply an inflammatory disease or other health issues (Alagbe, 2021). The mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentrations ranged from 35.89 to 46.11 fl, 20.80 to 27.17 pg, and 211.3 to 270.1 g/L, respectively, and were within Lindsay's (1977) baseline values. The results for mean corpuscular volume, mean corpuscular haemoglobin, and mean corpuscular haemoglobin concentrations show that the animals were not anaemic (Pampori and Iqbal, 2007). White blood cells produce antibodies and protect the body from pathogens (Mitruka and Rawnsley, 1977). Thrall (2007) and Czech et al. (2018) reported values ranging from 6.36 to 26.30 ($\times 10^9$ /L).

Table 5. Effect of *Adhatoda vasica* leaf powder on haematological indices of weaned pigs

Variables measured	Diet 1	Diet 2	Diet 3	Diet 4	SEM



Red blood cell ($\times 10^{12}/L$)	5.61 ^b	7.06 ^a	7.12 ^a	7.18 ^a	0.02
Haemoglobin (g/L)	142.7 ^b	152.7 ^a	156.3 ^a	158.1 ^a	4.93
Pack cell volume (%)	29.18 ^b	31.40 ^a	32.80 ^a	33.14 ^a	0.08
Mean platelet volume (fl)	9.65 ^b	11.00 ^a	11.06 ^a	11.62 ^a	0.03
Mean corpuscular volume (fl)	35.89 ^b	45.11 ^a	46.07 ^a	46.11 ^a	0.04
Mean corpuscular haemoglobin (pg)	20.80 ^b	26.82 ^a	27.10 ^a	27.17 ^a	0.02
Mean corpuscular haemoglobin concentration (g/L)	211.3 ^b	262.7 ^a	268.9 ^a	270.1 ^a	9.06
White blood cell ($\times 10^9/L$)	7.18 ^c	11.32 ^b	17.02 ^a	17.18 ^a	0.03

SEM – standard error of mean; diet 1: basal diet without *Adhatoda vasica* leaf powder; diet 2: basal diet supplemented with 200 g *Adhatoda vasica* leaf powder per kg; diet 3: basal diet supplemented with 400 g *Adhatoda vasica* leaf powder per kg; diet 4: basal diet supplemented with 600 g *Adhatoda vasica* leaf powder per kg.

The effect of *Adhatoda vasica* leaf powder on blood biochemical parameters in weaned pigs is shown as shown in Table 6. Pigs fed diets 4 and 5 had greater total protein, albumin, and globulin values, while diet 2 had intermediate values and diet 1 had lower levels ($P < 0.05$). The values obtained in this investigation were within the normal range of 24.49 - 43.61 g/L, 20.0 - 35.00 g/L, and 35.0 - 80.0 g/L, as published by Cooper et al. (2014) and Perri et al. (2017) for albumin, globulin, and total protein. This outcome shows that the pigs were not underweight or inflamed (Musa et al., 2022). Aspartate amino transferase, alanine amino transferase and alkaline phosphatase values which varied from 31.67 – 40.11 (U/L), 103.6 – 115.8 (U/L) and 25.90 – 27.92 (U/L) were not significantly ($P > 0.05$) altered by the treatment. The result obtained suggests that dietary supplementation of *Adhatoda vasica* leaf powder up to 600 g/kg was not toxic to the animals and integrity of the liver was not compromised or damaged (Clark and Coffey, 2008). The values found in this investigation were comparable to those reported by Fang et al. (2016) when essential oil was fed to weanling pigs.

Table 6. Effect of *Adhatoda vasica* leaf powder on serum biochemical indices of weaned pigs

Variables	Diet 1	Diet 2	Diet 3	Diet 4	SEM
Total protein (g/L)	46.12 ^c	57.49 ^b	73.80 ^a	74.05 ^a	0.93
Albumin (g/L)	26.00 ^c	30.41 ^b	41.80 ^a	42.05 ^a	0.41
Globulin (g/L)	20.12 ^c	27.08 ^b	32.00 ^a	32.09 ^a	0.32
Aspartate amino transferase (U/L)	31.67	39.08	40.05	40.11	0.04
Alanine amino transferase (U/L)	103.6	110.4	112.6	115.8	4.31
Alkaline phosphatase (U/L)	25.90	26.17	27.88	27.92	0.86

SEM – standard error of mean; diet 1: basal diet without *Adhatoda vasica* leaf powder; diet 2: basal diet supplemented with 200 g *Adhatoda vasica* leaf powder per kg; diet 3: basal diet supplemented with 400 g *Adhatoda vasica* leaf powder per kg; diet 4: basal diet supplemented with 600 g *Adhatoda vasica* leaf powder per kg.

Conclusion

In the final analysis, *Adhatoda vasica* leaf powder contains numerous phyto-constituents with medicinal effects, which are harmless and do not require a withdrawal time. The results of this investigation demonstrated that *Adhatoda vasica* leaf powder can be supplied in the feed of weaned pigs at a dose of up to 600 g/kg without adversely affecting animal performance or health.

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Effect of fertigation on tissue nutrient status of Kinnow mandarin.

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Abstract

A field experiment was conducted at Division of Fruit and Horticultural Technology, Indian Agricultural Research Institute (IARI), New Delhi, during 2010-2011, on 5-year-old plants, to find out the effect of fertigation on nutrient acquisition of Kinnow. The data on leaf nutrient status were collected after two fertigation cycles and at the end of experiment. Standard dose of fertilizers were 600g of N, 300g of P, and 400g of K per tree per year, scheduled in three splits during the period of February (300g N, 75g P and 100g K), April (150g N, 112.5g P and 150g K) and August (150g N, 112.5g P and 150g K) respectively. The treatments were T₁: Ring irrigation with standard N, P, K as soil application; T₂: Drip with 100 per cent N, P, K as soil application; T₃: Fertigation with 100 per cent N and P, K as soil application; T₄: Fertigation with 75 per cent N and P, K as soil application; T₅: Fertigation with 50 per cent N and P, K as soil application; T₆: Fertigation with 100 per cent N, P, K; T₇: Fertigation with 75 per cent N and 100 per cent P, K fertigation and T₈: Fertigation with 75 per cent N, P, K. Fertigation treatments resulted in significant variation in leaf nutrient content in the leaves of Kinnow during the both sampling intervals. Higher nitrogen (2.85%), phosphorus (0.17%), manganese (61.33 ppm) and copper (14.85 ppm) were recorded with fertigation with 100 per cent N, P, K, while higher potassium (1.84%) and zinc (64.83 ppm) were in leaves of the plants fertigated with 50 per cent N and 100 per cent P, K as soil application. There was no significant effect of fertigation on leaf iron content during both sampling stages. Fertigation with 75 per cent N and 100 per cent P & K (450 g N, 300g P and 400 g K) can be recommended for application in three splits during February (225N:75P:100K), April (112.5N: 112.5P: 150 K) and August (112.5N: 112.5P: 150 K) for young Kinnow orchards.

Key Words: Kinnow, fertigation, tissue nutrient



Application of hydrogen in food processes improves the sensory and physicochemical properties and extends the shelf life of the product

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Abstract

Food is prone to many spoilage phenomena, causing undesirable changes in its quality, loss of nutritive value, and shortening its shelf life. Our team studied the effect of hydrogen application in different food processes on the quality attributes of products. In food drying, including hydrogen in the drying atmosphere allowed for the protection of the nutritional and sensory properties of the product (apricot and apple). Additionally, incorporating hydrogen in the atmosphere of the food package allowed for the protection of the physico-chemical and nutritional properties of various foods, including strawberries, fish, and fresh cheese, with an extended shelf life. The results show that the use of hydrogen in food processes can be useful for the preservation of freshness and quality attributes of foods.

Key Words: Hydrogen, Food, hydrogen-rich water, Quality

Gıda proseslerinde hidrojenin uygulanması, ürünün duyuşal ve fizikokimyasal özelliklerini iyileştirir ve raf ömrünü uzatır

Özet

Gıdalar birçok bozulma olayına eğilimlidir ve bu da kalitesinde istenmeyen değişikliklere, besin değerinin kaybına ve raf ömrünün kısılmasına neden olur. Ekibimiz, farklı gıda süreçlerinde hidrojen uygulamasının ürünlerin kalite nitelikleri üzerindeki etkisini inceledi. Gıda kurutmada, kurutma atmosferine hidrojen eklenmesi, ürünün (kayısı ve elma) besinsel ve duyuşal özelliklerinin korunmasını sağladı. Ek olarak, gıda paketinin atmosferine hidrojen eklenmesi, çilek, balık ve taze peynir gibi çeşitli gıdaların fiziko-kimyasal ve besinsel özelliklerinin, uzatılmış raf ömrüyle korunmasını sağladı. Sonuçlar, gıda süreçlerinde hidrojen kullanımının gıdaların tazeliğinin ve kalite niteliklerinin korunması için yararlı olabileceğini göstermektedir.

Anahtar Kelimeler: Hidrojen, Gıda, hidrojen açısından zengin su, Kalite

Introduction

The deterioration of the quality of fresh food is a natural phenomenon that happens due to many chemical and biological factors, including microbiological and enzymatic activities. Oxidative reactions are one of the primary sources of food quality deterioration. The oxidative destruction of antioxidants, unsaturated fatty acids, vitamins, and pigments can shade the color and deteriorate the flavor and taste, which in turn shortens the shelf life of the food. Our team found that including hydrogen gas in some processes can help protect the nutritional and sensory properties of the food product and extend its shelf-life.

Food Drying

In the drying process, the inclusion of hydrogen gas in the atmosphere could preserve the color and antioxidants of fruits such as apricots (Alwazeer & Örs, 2019) and apples (Alwazeer, 2018) and herbs such as mint green tea leaves. This technique was called Reducing Atmosphere Drying (RAD). The color indices of the hydrogen-included atmosphere (RAD_{mix}) dried apricot slices were the closest to the fresh sample, while the freeze-dried slices were characterized by light and dully notes of color compared to a fresh sample. The antioxidant activity, total phenolic content, and total flavonoid content of RAD-dried apricot samples were the closest to fresh samples compared with hot air oven and vacuum-dried samples (Alwazeer & Örs, 2019). In another study, both apple and apricot slices were dried using RAD_{mix} (4% H₂, %5 CO₂, 91% N₂), which was compared with nitrogen (100%) and hot air drying.



Results showed that the color parameters (L^* , a^* , b^*) of RAD apple slices were the closest to the fresh ones besides the freeze-dried samples. However, the high increase in the L^* value and the high decrease in the b^* value of freeze-dried samples are reflected by the lightness of the yellowness of the sample color, which is considered undesirable for dried apples and apricots (Alwazeer, 2018).

Food Packaging

The packaging process aims to preserve the food product from external deteriorative conditions. The preservation of crops and foods under the atmosphere, different from air, is a technique that aims to prolong the shelf life of a product. This technique is called modified atmosphere packaging that generally uses a gaseous mixture of carbon dioxide (CO_2), nitrogen (N_2), and oxygen (O_2) (Alwazeer, 2019). Our team revealed that the inclusion of hydrogen gas (H_2) with CO_2 and N_2 could preserve the nutritional and sensory qualities of fruits, such as strawberries, and dairy products, such as fresh cheese and fish. This technique was called Reducing Atmosphere Packaging (RAP), which extended the shelf life of these food products. Different formulations of RAP were tested for preserving fresh cheese: [RAP 1 (90% CO_2 /6% N_2 /4% H_2), RAP 2 (50% CO_2 /46% N_2 /4% H_2)], modified atmosphere packaging (MAP) [MAP 1 (90% CO_2 /10% N_2), MAP 2 (50% CO_2 /50% N_2)] during cold storage at +4°C for 7 weeks. Results showed that the color and acidity of RAP1 cheese samples were the closest to the fresh sample. At the end of storage, the lowest mesophilic-aerobic bacteria counts were found for RAP1 samples, while the yeast-mold counts were the lowest for all RAP samples (Alwazeer et al., 2020).

In another product, rainbow trout fish was packaged under a hydrogen-included atmosphere (RAP) [RAP1 (50% CO_2 / 46% N_2 / 4% H_2) and RAP2 (60% CO_2 / 36% N_2 / 4% H_2)] beside MAPs [MAP1 (50% CO_2 / 50% N_2), MAP2 (60% CO_2 / 40% N_2)] and control (air). The fish samples were stored at 2°C for 15 days. RAP-packaged fish samples showed better results regarding TBARS and TVB-N (Bulut et al., 2023).

Rice milk

Our team revealed that when HRW was used for the preparation of rice milk from four varieties, the essential mineral content (Na, Mg, K, Ca, and Se), essential amino acids (Ile, Leu, and Met), desirable aroma, and sensory notes were improved (Zor et al., 2024).

Minced meat

Our team found that incorporating hydrogen-producing magnesium into minced beef meat allowed to control the microbial growth, restricted the formation of thiobarbituric acid reactive substances, restricted the formation of biogenic amines, limited the formation of the off-volatile compounds, and protected the whole quality of the product (Çelebi et al., 2024).

Butter

Recently, our team revealed that the incorporation of hydrogen gas into melted butter could improve microbial and chemical stability, enhance color (increasing yellowness), minimize the formation of biogenic amines (BAs), and produce no off-flavor or undesirable volatile compounds (Alwazeer et al., 2024). The results of the physicochemical parameters showed that the values of the butter samples incorporated with H_2 were similar to those of the control samples 30 days before. This technique was characterized by its application at normal conditions of temperature (40°C) and pressure (1 atm) without adding any catalyst.

Conclusion

The integration of hydrogen in the food process can provide many advantages to the product. The preservation of the color, physicochemical properties, and microbial stability were reported in different hydrogen-processed food products. The use of hydrogen brings many advantages to both producers and consumers, such as its antioxidant properties, non-toxicity, natural notes, and low-cost equipment needs. The use of hydrogen needs, of course, precaution due to its explosion property with air.

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Application of Hydrogen in Food Processes Enhances Product Safety

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Abstract

Food is prone to many spoilage phenomena, causing undesirable changes in its quality, loss of nutritive value, and shortening its shelf life. Our team studied the effect of hydrogen application in different food processes on the quality attributes of products. In food drying, including hydrogen in the drying atmosphere allowed for the protection of the nutritional and sensory properties of the product (apricot and apple). Additionally, incorporating hydrogen in the atmosphere of the food package allowed for the protection of the physico-chemical and nutritional properties of various foods, including strawberries, fish, and fresh cheese, with an extended shelf life. The results show that the use of hydrogen in food processes can be useful for the preservation of freshness and quality attributes of foods.

Key Words: Hydrogen, Food, Safety, Biogenic amines, Heavy metals

Gıda Proseslerinde Hidrojenin Uygulanması Ürün Güvenliğini Artırır

Özet

Biyojenik aminler ve ağır metaller, gıda ürünlerinde yaygın biyolojik ve kimyasal risklerdir. Biyojenik aminler, hem fermente edilmiş hem de yüksek proteinli gıdalarda ciddi sağlık sorunları oluşturur. Ekibimiz, tereyağı yıkama sürecinde, sebzelerin fermantasyonunda ve paketlenmiş balık ve kıymanın hidrojen içeren atmosferinde hidrojen açısından zengin su kullanmanın, depolama süresi boyunca biyojenik amin oluşumunu sınırladığını ortaya koydu. Öte yandan, ağır metaller gıdaların kanserojen kirleticileridir. Ekibimiz, kültürlü tereyağı gibi gıdaların yıkama sürecinde hidrojen açısından zengin su kullanımının, nihai ürünlerdeki ağır metal içeriğini azalttığını ortaya koydu. Sonuçlar, hidrojenin gaz veya hidrojen açısından zengin su formlarında uygulanmasının, nihai ürünün biyojenik amin ve ağır metal güvenliğini artırdığını göstermektedir.

Anahtar Kelimeler: Hidrojen, Gıda, Güvenlik, Biyojenik aminler, Ağır metaller

Introduction

Food products are susceptible to various chemical and biological risks, which can pose significant health hazards for consumers. Microorganisms play a crucial role in the quality and safety of food products. While the growth of beneficial microorganisms such as lactic acid bacteria is desirable, the proliferation of spoilage microorganisms in fermented food products such as butter or high-protein foods such as fish and meat can lead to the formation of hazardous compounds known as biogenic amines (BAs) (Alwazeer, 2023). This emphasizes the complex nature of food spoilage and the importance of our research in addressing this issue. Our team found that the inclusion of hydrogen in the food package could restrict the formation of biogenic amines in fish. Two hydrogen-included atmospheres [[RAP1 (50% CO₂/46% N₂/4% H₂) and RAP2 (60% CO₂/36% N₂/4% H₂)] were used for packaging freshwater and seawater fish, i.e., rainbow trout and horse mackerel, respectively. Results showed that RAP samples contained the lowest levels of BAs. Hydrogen-included atmosphere samples had two folds lower BA than MAP samples [MAP1 (50% CO₂/50% N₂) and MAP2 (60% CO₂/40% N₂)] (Sezer et al., 2022). In dairy, washing raw butter with hydrogen-rich water could also restrict the formation of biogenic amines in the product during the storage period. The use of hydrogen-rich water (HRW) in the washing phase of raw butter showed a restriction of the formation of BAs in the product during 90 days of storage at 4C. while the use of normal drinking water in washing raw butter prompted the formation of BAs in the final product (Bulut et al., 2022).

In another product, our team evaluated the effect of using HRW in the fermentation of beetroot instead of regular water on the formation of BA during the fermentation phase. Results showed that the levels of BAs decreased by 15.15% and 18.35% (tyramine), 16.67% and 13.44% (2-phenylethylamine), 27.65% and 22.7% (histamine), 17.09% and 21.76% (tryptamine), and 21.64% and 19.5% (putrescine)



for beet and brine, respectively, when HRW was used in fermented beetroot (pickle) preparation instead of NW (Alwazeer, Bulut, et al., 2022).

Another risk that can occur in food products is the presence of heavy metals. Heavy metals can contaminate food products through the use of contaminated raw materials or equipment and additives with high levels of heavy metals. This highlights the need for effective strategies to mitigate such risks. Our team discovered that washing food with hydrogen-rich water could decrease the heavy metal content; for example, raw butter washed with hydrogen-rich water showed reduced heavy metal content. When cultured raw butter was washed with HRW instead of regular water, the heavy metal content in the final product decreased by 14-74% for arsenic, cadmium, and mercury (Alwazeer, Ceylan, et al., 2022). Our team revealed that HRW can alleviate the toxicity of heavy metals such as nickel and mercury in animals (Köktürk, Atalar, et al., 2022; Köktürk, Yıldırım, et al., 2022).

Conclusion

The above-discussed results showed the importance of considering hydrogen use in food processing for controlling biogenic amine formation and lowering the final product's heavy metal content. Hydrogen is a food additive E949 and is considered a natural antioxidant without any harm to humans and the environment (Alwazeer, 2024a, 2024b). The integration of hydrogen into food processing does not require expensive additional equipment.

However, precautions should be taken when using hydrogen in the food industry. Safety measures such as hydrogen leak measurement sensors and safety courses for workers should be implemented to prevent potential explosions.

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The effect of sodium fluoride on the reproductive system

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Abstract

Previous studies have shown that daily exposure to sodium fluoride (NaF) has a direct effect on the reproductive organs, which in high doses and over the long term can lead to infertility associated with increased oxidative stress and changes in enzyme activity. In the present study, we tested the effects of this toxic substance on selected adult male rat genitalia and sperm count and morphology for just one month. In the present study, we investigated how the effect of this toxic substance, for only one month, would be on some reproductive organs of adult male white rats, as well as on the number and morphology of spermatozoa. The control group of male rats did not show any pathological changes in the normal structure of the tissues of the reproductive system. Twenty male rats were used and divided into two groups. The first group was used as an untreated (normal) control. The second group received NaF at a concentration of 150 ppm via mineral drinking water for a period of thirty days every day. The animals weights and reproductive organs were calculated at the end of the experiment, and showed no significant difference in weight. The results showed, in the second group, atrophy and a stop of growth in the genital organs, as well as an almost total destruction of the connective tissue with deformation and decrease of the number of spermatozoids. The combined results indicate that daily exposure to sodium fluoride leaves side effects on the tissue of the genital tract of rats, which leads to sterility, even if it is in a very small amount, which leads us to search more for solutions that treat this damage.

Key Words: Sodium fluoride 1, Reproductive organs 2, Spermatozoa 3, Oxidative stress 4, Infertility 5





ID: 418

Challenges and Opportunities for Tea Brand Marketing in Domestic Market: (A Case Study in Kadugannawa Area, Central Province, Sri Lanka)

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Abstract

Tea production is one of the main sources of foreign exchange for Sri Lanka. The total domestic demand for tea exceeds the recorded figures. The quality of locally available tea varies widely, with most of the tea sold in bulk form, and only small quantities available as value-added products, either in branded or unbranded packages. The success of tea brand marketing in the local market depends on consumers' acceptance of these brands. This study was conducted to identify the challenges in tea brand marketing concerning the marketing mix, supply and demand, and to explore opportunities for brand marketing. A case study was undertaken in the Kadugannawa area, Central Province of Sri Lanka, to understand the expectations of tea producers and retailers regarding the introduction of tea brand marketing in the local market. Data was collected using a structured questionnaire, and a descriptive approach was used to analyze the data. The results revealed several challenges to tea brand marketing, including low product quality, weak brand awareness, low demand, and high competition in the domestic market, limited product diversification, and high prices relative to product quality. From the producers' perspective, marketing good quality tea, maintaining a strong product line, and using effective marketing strategies were considered the most important objectives of brand marketing, representing both challenges and opportunities in the market.

Key words: *Marketing mix, Supply, Demand, Product line, Marketing strategies*



Pod Characteristics of Pea Varieties at Different Planting Times

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Abstract

The pea plant, which has an important place in human nutrition, is of great importance in our culinary culture thanks to both its flavor and nutritional value. The pod structure of the pea determines its agronomic and industrial use potential. Therefore, pod characteristics of Elena, Deren and Irmak 01 pea varieties grown in Kahramanmaraş conditions with five different planting times were investigated. In the research, pea varieties were planted at five different times, one month apart from November to March, taking into account climate and soil conditions. In the study, pea varieties were planted at five different times, starting from November and including March, once a month, taking into account the climate and soil conditions. First pod height, pod number, pod length, pod width, grain number per pod, pod weight and pod grain weight of the pea varieties used were examined. At the end of the research, first pod height, pod length, pod width, number of grains per pod, and pod grain weight showed statistically significant differences according to the pea varieties used. The effect of planting times on the other traits, except pod width, was found as significant. As a result of the study, it was recorded that the first pod height varied between 21.4-79.33 cm, pod number varied between 3-14.2 pieces, pod length varied between 5.48-7.38 cm, pod width varied between 8.99-11.49 mm, grain number varied between 4.86-6.98 pieces per pod and grain weight varied between 0.64-1.26 g. It was determined that higher pod weight was achieved in Deren and Irmak 01 varieties, and pod weight was higher in December, January and February plantings than in other planting times.

Key words: pea, pod characters, grain weight of pod

Farklı Ekim Zamanlarındaki Bezelye Çeşitlerinin Bakla Özellikleri

Özet

İnsan beslenmesinde önemli bir yere sahip olan bezelye bitkisi, mutfak kültürümüzde hem lezzeti hem de besin değeri sayesinde büyük önem taşımaktadır. Bezelyenin bakla yapısı agronomik ve endüstriyel kullanım potansiyelini belirler. Bu nedenle, Kahramanmaraş koşullarında beş farklı ekim zamanı uygulanarak yetiştirilen, Elena, Deren ve Irmak 01 bezelye çeşitlerinin bakla özellikleri incelenmiştir. Araştırmada iklim ve toprak şartları dikkate alınarak Kasım ayından itibaren ayda bir kez olmak üzere, Mart ayı dahil beş farklı zamanda bezelye çeşitlerinin ekimi yapılmıştır. Kullanılan bezelye çeşitlerinin, ilk bakla yüksekliği, bakla sayısı, bakla boyu, bakla eni, baklada tane sayısı, bakla ağırlığı, bakladaki tane ağırlığı incelenmiştir. Araştırma sonunda ilk bakla yüksekliği, bakla boyu, bakla eni, baklada tane sayısı, bakladaki tane ağırlığı özellikleri kullanılan bezelye çeşitlerine göre istatistiki önemli farklılıklar göstermiştir. İncelenen özelliklerden bakla eni hariç, diğer özellikler üzerine ekim zamanlarının etkisi önemli bulunmuştur. Yürütülen çalışma sonucunda, ilk bakla yüksekliği 21,4-79,33 cm, bakla sayısı 3-14,2 adet, bakla boyu 5,48-7,38 cm, bakla eni 8,99-11,49 mm, baklada tane sayısı 4,86-6,98 adet, baklada tane ağırlığı 0,64-1,26 g arasında değiştiği kaydedilmiştir. Deren ve Irmak 01 çeşitlerinde, Aralık, Ocak ve Şubat aylarında yapılan ekimlerin, diğer ekim dönemlerine göre daha yüksek bakla tane ağırlığına sahip olduğunu göstermiştir.

Anahtar kelimeler: bezelye, bakla özellikleri, bakla tane ağırlığı



Secondary Bacterial Symbionts in Aphids

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Abstract

Aphids are important agricultural pests that feed on plant sap and can reach high population densities in short time, causing plant quality and yield losses. Almost all aphids host symbiont bacteria that allow them to easily adapt to their environment. It is known that the primary symbiont *Buchnera aphidicola* synthesizes some essential amino acids and vitamins that its host needs, while the secondary symbiont bacteria have a wide range of effects, including protecting the host under stress conditions and resistance against natural enemies. Aphids have become a model system for studying insect-bacteria interactions. To date, secondary bacterial symbionts have been identified in many aphid species, and a significant literature bank has been provided on this interaction in natural populations. Knowing the role and importance of symbiont bacteria in aphid metabolism is very important in the control of these pests. This study reports that secondary symbionts hosted on aphids play important roles in aphid metabolism, therefore bacterial symbionts can be used effectively in controlling the aphids.

Key Words: Aphid, Biological control, *Hamiltonella*, *Serratia*, Symbiont

Afitlerde İkincil Bakteriyel Simbiyontlar

Özet

Afitler, bitki özsuğu ile beslenen, kısa süre içerisinde yüksek popölasyon yoğunluklarına ulaşarak bitkide kalite ve verim düşüşlerine sebep olan önemli bir tarım zararlısıdır. Hemen hemen bütün afitler bulundukları ortam koşullarına kolayca adapte olmalarını sağlayan simbiyont bakterilere ev sahipliği yapar. Bunlardan birincil simbiyont *Buchnera aphidicola* nın konağının ihtiyacı olan bazı temel amino asitleri ve vitaminleri sentezlediği, ikincil simbiyont bakterilerin ise stres koşulları altında konağını koruma ve doğal düşmanlara karşı dirence kadar çok geniş kapsamlı etkileri olduğu bilinmektedir. Afitler, böcek-bakteri etkileşimlerinin çalışılmasında model bir sistem haline gelmiştir. Bugüne kadar birçok afit türünde sekonder bakteriyel simbiyontlar belirlenmiş ve doğal popölasyonlardaki bu etkileşim hakkında önemli literatür bankası sağlanmıştır. Afet metabolizmasında simbiyont bakterilerin rolü ve öneminin bilinmesi bu zararlılarla mücadelede oldukça önemlidir. Bu çalışmayla afitlerde konaklayan sekonder simbiyontların afet metabolizmasında önemli roller üstlendiği dolayısıyla afitlerle mücadelede bakteriyel simbiyontların etkin olarak kullanılabileceği bildirilmektedir.

Anahtar Kelimeler: Afet, Biyolojik mücadele, *Hamiltonella*, *Serratia*, Simbiyont

Introduction

It has long been known that the majority of insect species form symbiotic relationships with microorganisms that undertake various functions, including nutrition, protection from pathogens, protection against stress conditions and development of resistance (Buchner, 1965; Gonzalez-Gonzalez et al. 2024). Among insect groups, the most studied group in insect symbiosis are the phloem-feeding aphids (Hemiptera: Aphididae), which have a high ability to adapt to a wide range of environmental conditions, including stress conditions. There is more interest in a few species among aphids, and studies on these species are more common in the literature. Research has mostly focused on *Acyrtosiphon pisum* (Harris), *Sitobion avenae* (Fabricius) and *Aphis fabae* (Scopoli) species from the Aphidinae subfamily, which reveals the need for research on more aphid species (Zytynska et al. 2021; Manzano-Marin et al. 2023; Zepeda-Paulo et al. 2024). Recent studies have revealed the role of symbiotic bacteria in the survival of aphids in harsh conditions (Csorba et al. 2024). Bacterial symbionts may play a role in ecological speciation by directly affecting how aphids use different plant species (Ferrari et al. 2011). All aphids harbour the obligate (primary) symbiont bacterium *Buchnera aphidicola*, which increases its host's chances of survival by synthesizing certain essential amino acids and vitamins that they cannot get in sufficient quantities from the phloem sap. In addition, some aphids also harbor facultative (secondary) symbionts that are not essential for the survival



and reproduction of their host but provide various ecological advantages to the host against biotic and abiotic environmental conditions (Heyworth & Ferrari, 2015; Shih et al. 2023).

Secondary symbiotic bacteria of aphids

Insects (Arthropoda: Insecta) owe their being the most diverse and highly successful animals on Earth to their long-term and stable ecological relationships with bacteria. Like other insects, aphids can quickly increase their population density by adapting to almost any environment in a very short time, thanks to the symbionts they contain. There are two types of bacterial endosymbionts that are present in insects: (1) facultative or secondary symbionts and (2) obligate or primary symbionts. *Buchnera aphidicola* is the primary endosymbiont present in almost all aphid species. Facultative bacteria are not essential for aphids, but they perform very important functions. The ecological relationship between these bacteria and aphids is mostly based on defense and immune behaviors. Secondary bacteria identified in aphids; *Serratia symbiotica*, *Hamiltonella defensa*, *Regiella insecticola*, *Erwinia aphidicola*, *Pseudomonas aeruginosa*, *Wolbachia pipientis*, *Rickettsiella* sp., *Rickettsia* sp., *Spiroplasma* sp., *Arsenophonus* sp., *Photobacterium* sp., *Xenorhabdus* sp., *Candidatus* sp., *Fukatsuiia*, *Sodalis*, *Erwinia haradaeae* and *Bacteroidota* (Oliver et al. 2010; Csorba et al. 2022; Manzano-Marín et al. 2023). In recent years, studies - especially Next Generation Sequencing (NGS) - have shown that the diversity of secondary symbiont bacteria is gradually increasing. For example, a new symbiotic relationship with a bacterium related to *Erwinia* and *Sodalis* was reported by Jousselin et al. (2016). Then, the secondary symbiotic bacteria *Pectobacterium* was initially described in aphids by Liu et al. (2023) based on the findings of genetic distance analysis. Zepeda-Paulo et al. (2024) studied the microbiome of the woolly apple aphid *Eriosoma lanigerum* (Hausmann) a serious pest of apple orchards that has not been studied much in aphid-facultative symbiont research. In 16S rRNA gene Illumina sequencing-based taxonomic assignment showed a high representation of reads assigned to a recently recognized bacterial taxon -not previously described in aphids- identified as *Symbiopectobacterium purcellii* (Zepeda-Paulo et al. 2024).

Facultative bacteria are present in different proportions in natural aphid populations, and although they are mostly transmitted vertically from mother to offspring, they can occasionally be transmitted horizontally (Russel et al. 2003; Baumann et al. 2006; Zepeda-Paulo et al. 2024). According to some researchers, temperature can have an impact on symbionts' vertical and horizontal transmission frequencies (Anbutsu et al. 2008; Osaka et al. 2008; Liu et al. 2019).

Bacterial secondary symbionts are known to facultatively colonize their hosts. They do not live there permanently but occur less frequently inside the body of the host (Oliver et al. 2010; Dion et al. 2011). Unlike *B. aphidicola*, which is found in specialized cell groups called bacteriocytes or mycetocytes located adjacent to the ovaries (Braendle et al. 2003), secondary symbionts generally settle freely in secondary bacteriocyte cells, sheath cells around primary bacteriocyte cells (Burke & Moran, 2011) and hemolymph. (Oliver et al. 2010; Dion et al. 2011). For example, *Hamiltonella defensa*, *Serratia symbiotica*, *Regiella insecticola* and *Rickettsiella* are found in the cytoplasm of secondary bacteriocytes and sheath cells and in the hemolymph (in pea aphid) (Fukatsu et al. 2000; Moran et al. 2005). As an another example, earlier research has shown that the endosymbiont *Serratia symbiotica* may colonise the gut (Renoz et al. 2019), bacteriocytes, and hemolymph of *A. pisum* (Harris), among other tissues (Skaljac et al. 2018). According to Skaljac et al. (2019), the movement of *S. symbiotica* into its host plant is facilitated by the colonisation of the aphid's mouthparts, especially the stylets. Sometimes, symbionts can replace each other within the host. For example, after the obligatory symbiont *Buchnera* is eliminated with antibiotics at benign temperatures, *Serratia* in pea aphids moved into the bacteriocytes that *Buchnera* had left behind, allowing the stressed aphid to live and reproduce. However, it has been noted that *Serratia* suppresses *Buchnera* and affects the aphid's performs when these two symbiotic bacteria are present together (Koga et al. 2003). As this example shows, interspecies interactions (competition, mutualism, etc.) between different symbiont bacteria in the same host affect the host quality of life in different ways.

The role of secondary symbionts in aphid metabolism

It is stated that facultative symbionts play important roles such as protecting the host against predators, developing host resistance against biotic and abiotic factors, and varying body color (Koga et al. 2003; Brinza et al. 2009; Zhang et al. 2015). In addition, although it may not be able to synthesize some essential amino acids and vitamins like *Buchnera*, it is reported that it potentially plays a role in aphid nutrition by assisting *Buchnera* (Pérez-Brocal et al. 2006; Burke et al. 2009). For instance, the bacterial community of the Bamboo woolly aphid *Pseudoregma bambucicola* (Takahashi) was evaluated in a study by Liu et al. (2023). The three species that dominated the symbiotic community, according to these investigators, were *Wolbachia*, *Pectobacterium*, and *Buchnera*. The capacity of *Pectobacterium* to facilitate *P. bambucicola*'s feeding on hard bamboo stems implies that the two organisms have a symbiotic connection.



Aphids are among the poikilothermic insects that are most susceptible to the negative effects of high temperatures. Genetic diversity among aphids and the specificity of the symbiotic bacterial species they host may contribute to differences in adaptive capacity and tolerance to heat stress (Burke et al. 2010; Brisson et al. 2010; Montllor et al. 2002). As temperatures rise, aphids face numerous challenges that can disrupt their normal functioning and threaten their survival. For example; disruption of aphid metabolism, cellular damage in aphids, protein denaturation, oxidative stress, and disruption of cellular membranes and indirectly negatively impacts upon aphid physiology, compromising key functions such as feeding, reproduction, and immune responses (Csorba et al. 2024). Bacterial symbionts play important roles in the ability of aphids to cope with heat stress. Majeed et al. (2022) have reported that *Buchnera aphidicola*, the primary symbiont of aphids, contributes to the synthesis of heat shock proteins (HSPs). Symbionts increase the resilience of insects to heat stress by promoting the synthesis of HSPs.

Many studies have emphasized that the most common endosymbiont bacterium, *Serratia symbiotica* (Jousselin et al. 2016), after the obligate symbiont *B. aphidicola*, increases the success of its host under heat stress and contributes to aphid defense (Burke et al. 2009). *Serratia* may also affect other trophic relationships, as demonstrated by Wang et al. 2024, by influencing the physiology and behaviour of major predators in order to promote host aphid defence. The results of their study demonstrate that the facultative symbiont *Serratia* enhances aphid fitness by disrupting with ladybeetle larvae's predation approach.

Studies have emphasized that symbiont bacteria are directly involved in the symbiont-aphid-parasitoid/predator interaction. For example, in the presence of facultative symbionts, the primary wasp parasitoid *Aphidius ervi* Haliday is less effective on the pea aphid *A. pisum* (Harris) (in the presence of predators) (Purkiss et al. 2022). On the other hand, according to Inchauregui et al. (2023), the facultative symbiont *R. insecticola* in the body of *A. pisum* (Harris) does not provide defense against the pathogenic fungus *Batkoa apiculate*.

Facultative symbionts protect aphids against pathogen attacks. It has been reported that an X-type facultative bacterium, a member of Enterobacteriaceae, protects aphids against the fungal pathogen *Pandora neoaphidis* and increases their resistance to the parasitoid *Aphidius ervi* Haliday (Heyworth and Ferrari, 2015). It is reported in the literature that *Hamiltonella defensa*, one of the secondary symbionts, contains a lysogenic bacteriophage that protects its host against the parasitic wasp *Aphidius ervi* Haliday, and *Regiella insecticola* provides resistance to some fungal pathogens (Jousselin et al. 2016). Additionally, it has been demonstrated, also in a lab setting, that when *R. insecticola* is present in the body of *Aphis fabae* Scopoli, the percentage of nymphs parasitized by the main wasp parasitoid *Aphidius colemani* (Dalman) is significantly lower than when the bacterium is absent from the aphid control group (Vorburger et al. 2010). Various abiotic factors such as temperature and drought can alter the course of the symbiont-aphid-parasitoid/predator interaction. Studies conducted under field conditions indicate that the resistance of *H. defensa* to primary wasp parasitoids in the Black Bean aphid, *Aphis fabae* Scopoli, may vary depending on the temperature regime to which the previous aphid generation was exposed. It has been reported by Gimmi et al. (2023) that the symbiont *H. defensa* increases the resistance of aphids to heat; furthermore, under such stress conditions, the defense capacity of the aphid against parasitoids may decrease. The English grain aphid *Sitobion avenae* (Fabricius) possesses the facultative symbiotic bacteria *H. defensa* and *R. insecticola*, which have been shown to delay the infection process with pathogenic fungal species *Beauveria bassiana* and *Metarhizium brunneum*. However, it has been reported that the absence of these symbionts causes a decrease in the fecundity of aphids infected with pathogenic fungi (Ali et al. 2022).

Result

The facultative symbionts play a major role in increasing the fitness of the host aphid by controlling physiological responses in the host as well as by disturbing the predators' strategies of predation. In order to get a deeper understanding of the diversity and function of endosymbionts across a variety of host plant species, this work highlights the need of investigating symbionts using the entire microbiome of insect hosts as well as numerous aphid samples. Also, there may be opportunities to develop strategies for integrated pest management based on the biological control of aphids by focusing on their symbionts.

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The Effect of *Aphis gossypii* Glover (Hemiptera: Aphididae) Honeydew on Fungal Growth

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Abstract

Honeydew is a sugar-rich, sticky substance secreted by many plant-feeding hemiptera and some lepidoptera. Aphids, on the other hand, feed on nitrogen-poor, carbohydrate-rich phloem sap and excrete excess carbohydrate as honeydew through their siphunculi. The aphids, constituting the main material of the study were sampled from the *Catalpa bungei* tree located in the central campus of Niğde Ömer Halisdemir University and then preparation procedures were carried out for species identification under laboratory conditions. According to the identification key organized according to the host plant, the samples were identified as *Aphis gossypii* Glover, (1877). The honeydew of *A. gossypii*, known as the cotton aphid, was collected from the host plant and the effects of two different concentrations of the honeydew (10 and 20 g/L) on fungal growth were determined using both solid and liquid media. Different *Trichoderma* species and *Beauveria bassiana* molds were used to examine fungal growth. Fungal growth in the prepared nutrient media was determined as the amount of biomass (gram). The honeydew content (phenolic substance, sugar and amino acid amounts) was determined and supported by FTIR analyses. The growth of fungal species in the PDA medium, which was preferred as the control medium, and the medium containing dilute honeydew was compared. It has been determined that fungal growth is better in the medium containing honeydew, and therefore honeydew increases fungal growth. With this study, it is predicted that aphid honeydew can support the growth of both fungal agents used in biological control and plant pathogens.

Key Words: Aphid, *Beauveria*, Biological control, Honeydew, *Trichoderma*

Aphis gossypii Glover (Homoptera: Aphididae) Balsı Maddesinin Fungal Gelişme Üzerindeki Etkisi

Özet

Balsı madde (Honeydew), bitki özsuyla ile beslenen birçok hemiptera ve lepidoptera tarafından salgılanan, şeker bakımından zengin, yapışkan bir maddedir. Çalışmanın ana materyalini oluşturan afitler, Niğde Ömer Halisdemir Üniversitesi merkez kampüste bulunan *Catalpa bungei* türü ağacından örneklenmiş ardından laboratuvar koşullarında tür tanımlaması için preparasyon işlemleri yapılmıştır. Konak bitkiye göre düzenlenen teşhis anahtarına göre alınan örnekler *Aphis gossypii* Glover, (1877) olarak belirlenmiştir. Pamuk biti olarak bilinen *A. gossypii* nin balsı maddesi konak bitki üzerinden toplanmış ve balsı maddenin iki farklı konsantrasyonunun (10 ve 20 g/L olarak) fungal gelişmeye etkisi hem katı hem sıvı ortamlar kullanılarak belirlenmiştir. Fungal gelişmeyi incelemek için farklı *Trichoderma* türleri ve *Beauveria bassiana* küfleri kullanılmıştır. Hazırlanan besi ortamlardaki fungal gelişme biyokütle miktarı (gram) olarak belirlenmiştir. Balsı madde içeriği (fenolik madde, şeker ve amino asit miktarları) belirlenmiş ve FTIR analizleri ile desteklenmiştir. Kontrol besiyeri olarak tercih edilen PDA besiyeri ile seyreltik balsı madde içeren besiyeri ortamında fungus türlerinin gelişmesi karşılaştırılmıştır. Balsı madde içeren besiyerinde fungal gelişmenin daha iyi olduğu dolayısıyla balsı maddenin fungal gelişmeyi artırdığı belirlenmiştir. Bu çalışmayla afit balsı maddelerinin hem biyolojik kontrolde kullanılan fungal ajanların hem de bitki patojenlerinin gelişmesini destekleyebileceği öngörülmektedir.

Anahtar Kelimeler: Afıt, Balsı madde, *Beauveria*, Biyolojik mücadele, *Trichoderma*



Investigation of the effects of vegetable oil based nanoemulsions as colloidal delivery system on different food matrices

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Abstract

It is known that using nanoemulsions as preservatives in food products is appropriate. However, there are very few studies on nanoemulsions against microorganisms in foods. In addition, there are insufficient studies in the literature on the comparative effect of nanoemulsions on different food matrices. This project focused on the application of nanoemulsion-based delivery systems to improve the quality, safety, nutritional profile, and sensory properties of muscle foods such as meat and fish. Red meat, chicken, and sea bass (*Dicentrarchus labrax*), which has high economic value and is widely cultivated, were used in the study. Nanoemulsions obtained using olive and sunflower oil as vegetable oils were applied to meat samples. In the study, meat samples treated with nanoemulsions were stored in the refrigerator at $2\pm 2^\circ\text{C}$, and sensory, chemical, and microbiological analyses were performed at regular intervals to determine quality parameters. The data obtained from the study showed that nanoemulsion application preserved the quality of meat materials stored in cold storage. In sensory evaluation, it was determined that nanoemulsion removes the classic odor of meat. Nanoemulsion treatment groups were preferred by panelists compared to the control group. During storage, the values of chemical parameters were generally found to be lower in nanoemulsion-applied groups. Among the treatment groups, it was observed that olive oil-based nanoemulsion groups gave better results than sunflower-based nanoemulsion groups in all three materials. The fastest bacterial growth was observed in the control group and it was determined that nanoemulsions had a significant inhibitory effect on bacteria. It was determined that the nanoemulsion prepared using sunflower and olive oil preserved the quality by delaying the spoilage in meat, chicken, and fish. Therefore, the use of nano-fixed oil is recommended to reduce microorganism spoilage, delay lipid oxidation, and ultimately increase the shelf life of meat products stored in the refrigerator.

Key Words: Nanoemulsion, cold storage, quality assessment, shelf life, meat material

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Bitkisel yağ bazlı nanoemülsiyonların kolloidal salınım sistemi olarak kullanılmasının farklı gıda matrislerindeki etkilerin incelenmesi

Özet

Gıda ürünlerinde nanoemülsiyonların koruyucu madde olarak kullanımının uygun olduğu bilinmektedir. Ancak gıdalarda mikroorganizmalara karşı nanoemülsiyonlar ile ilgili yapılan çok az sayıda çalışma bulunmaktadır. Ayrıca nanoemülsiyonun farklı gıda matrisleri üzerinde nanoemülsiyonların karşılaştırmalı etkisi ile ilgili literatürlerde yetersiz çalışmalar mevcuttur. Bu projede et ve balık gibi kaslı gıdaların kalitesini, güvenliğini, beslenme profilini ve duyuşal özelliklerini iyileştirmek için nanoemülsiyon tabanlı dağıtım sistemlerinin uygulanması üzerine odaklanılmıştır. Çalışmada kırmızı et, tavuk eti ve ekonomik değeri yüksek ve kültürü yaygın olarak yapılan levrek balığı (*Dicentrarchus labrax*) kullanılmıştır. Bitkisel yağlar olarak zeytin ve ayçiçek yağı kullanılarak elde edilen nanoemülsiyonlar et örneklerine uygulanmıştır. Araştırmada nanoemülsiyonlarla muamele edilen et örnekleri $2\pm 2^\circ\text{C}$ 'de buzdolabında depolanarak düzenli aralıklarla duyuşal, kimyasal ve mikrobiyolojik analizler yapılarak kalite parametreleri belirlenmiştir. Çalışmadan elde edilen veriler göstermiştir ki nanoemülsiyon uygulamasının soğukta depolanan et materyallerinin kalitesini koruduğu tespit edilmiştir. Duyuşal olarak değerlendirmede nanoemülsiyonun etin kendine has klasik kokusunu uzaklaştırdığı belirlenmiştir. Nanoemülsiyon muamele grupları kontrol grubuna kıyasla panelistler tarafından tercih edilmiştir. Depolama boyunca kimyasal parametrelerin değerleri nanoemülsiyon uygulanan gruplarda genellikle daha düşük bulunmuştur. Muamele grupları arasında ise her üç materyalde de zeytin yağı bazlı nanoemülsiyon gruplarının ayçiçek bazlı nanoemülsiyon gruplarına göre daha iyi sonuçlar verdiği gözlenmiştir. En hızlı bakteriyel gelişim kontrol grubunda gözlenmiş olup nanoemülsiyonların bakteri üzerine önemli derecede inhibe etkisi olduğu tespit edilmiştir. Ayçiçek ve zeytin yağı kullanılarak hazırlanan nanoemülsiyonun et, tavuk ve balıklarda bozulmayı geciktirerek kaliteyi koruduğu tespit edilmiştir. Bu nedenle, mikroorganizma bozulmasını azaltmak, lipid oksidasyonunu geciktirmek ve sonuçta buzdolabında depolanan et ürünlerinin raf ömrünü artırmak için nano sabit yağ kullanımı önerilmektedir.

Anahtar Kelimeler: Nanoemülsiyon, soğukta depolama, kalite değerlendirme, raf ömrü, et materyali
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Formulations and characterizations of vegetable oil-based nanoemulsions prepared for use as colloidal delivery systems

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Abstract

Although the food industry has a high potential to benefit from nanotechnology, it is still very limited. However, in recent years, the world food industry has started to search for ways to benefit from this technology and nanotechnology-based techniques have been introduced to the food industry to provide solutions to food safety-related problems. Nanoparticles have great importance in extending the shelf life of foodstuffs due to their antimicrobial properties without causing any change in flavor or color. Nanotechnology is a technology focused on the characterization, production, and processing of biological and non-biological structures smaller than 100 nm. Nanoparticles have great importance in extending the shelf life of foodstuffs due to their antimicrobial properties without causing any change in flavor or color. Recently, there has been increasing interest in the application of innovative nanoscience-based technologies to improve the health, safety, and quality of food products. A major breakthrough in this area has been the use of nanoemulsions. Because nanoemulsions can be easily formulated with existing food ingredients and technologies. In particular, oil-in-water nanoemulsions consisting of small oil droplets (<200nm) dispersed in water are used as delivery systems for various hydrophobic substances in foods, such as nutraceuticals, antioxidants, antimicrobials, colorants, and sweeteners. Encapsulation of hydrophobic substances in nanoemulsions can greatly increase their water dispersibility, chemical stability, bioavailability, and bioactivity. As a result, they have several advantages over traditional emulsions for certain applications, including increased resistance to aggregation and gravitational separation during storage, as well as higher bioavailability after ingestion. For these reasons, nanoemulsions are particularly suitable for encapsulating hydrophobic bioactive substances and subsequently incorporating them into food and beverage products. Therefore, the aim of this project includes the formulation, production, and characterization of nanoemulsion-based delivery systems for use in food products. In current study, characterization studies of nanoemulsions prepared using vegetable oils (sunflower and olive oil) were carried out and their physical properties such as viscosity, thermodynamic stability, droplet size, and surface tension were determined.

Key Words: Nanoemulsion, formulation, characterization, food products, antimicrobial

Kolloidal salınım sistemi olarak kullanılmak üzere hazırlanan bitkisel yağ bazlı nanoemülsiyonların formülasyonları ve karakterizasyonları

Özet

Gıda endüstrisinin nanoteknolojiden faydalanma potansiyeli yüksek olmasına rağmen halen çok sınırlı ölçülerdedir. Ancak son yıllarda dünya gıda sanayi bu teknolojiye faydalanma yollarının arayışı içine girmiş ve nanoteknolojiye dayalı teknikler gıda güvenliği ile ilişkili sorunlara çözüm sunmak için gıda endüstrisine tanıtılmıştır. Nanoparçacıklar gıda maddesinde, lezzet ve renk değişimine yol açmadan antimikrobiyal özellikleri sayesinde raf ömrünün uzatılmasında büyük öneme sahiptir. Nanoteknoloji 100 nm'den daha küçük biyolojik ve biyolojik olmayan yapıların karakterizasyonu, yapımı ve işlenmesi üzerinde yoğunlaşmış bir teknolojidir. Nanoparçacıklar gıda maddesinde, lezzet ve renk değişimine yol açmadan antimikrobiyal özellikleri sayesinde raf ömrünün uzatılmasında büyük öneme sahiptir. Son zamanlarda, gıda ürünlerinin sağlığını, güvenliğini ve kalitesini iyileştirmek için yenilikçi nanobilim temelli teknolojilerin uygulanmasına ilgi artmaktadır. Bu alandaki büyük bir hamle, nanoemülsiyonların kullanılması olmuştur. Çünkü nanoemülsiyonlar, mevcut gıda bileşenleri ve teknolojileri ile kolayca formüle edilebilirler. Özellikle, suda dağılmış küçük yağ damlacıklarından (<200nm) oluşan su içinde yağ nanoemülsiyonları nutrasötikler, antioksidanlar, antimikrobiyaller, renklendiriciler ve tatlandırıcılar gibi gıdalardaki çeşitli hidrofobik maddeler için dağıtım sistemleri olarak kullanılmaktadır. Nanoemülsiyonlar içinde hidrofobik maddelerin kapsüllenmesi suda dağılılabirliklerini, kimyasal stabiliteilerini, biyoyararlanımlarını ve biyoaktivitelerini büyük ölçüde artırabilir. Sonuç olarak, belirli uygulamalar için geleneksel emülsiyonlara göre bazı avantajlara sahiptirler. Bunlara depolama sırasında topaklaşma ve yer çekimsel ayrılmaya karşı daha fazla direnç ve ayrıca yutulduktan sonra daha yüksek biyoyararlılık dahildir. Bu nedenlerden dolayı, nanoemülsiyonlar hidrofobik biyoaktif maddeyi kapsüllemek ve daha sonra bunları yiyecek ve içecek ürünlerine dahil etmek için özellikle uygundur. Bu nedenle, bu projenin amacı, nanoemülsiyon bazlı dağıtım sistemlerinin gıda ürünlerinde kullanımı amaçlı formülasyonu, üretimi ve karakterizasyonunu içermektedir. Çalışmamızda bitkisel yağlar (ayçiçek ve zeytin yağı) kullanılarak hazırlanan nanoemülsiyonların karakterizasyon çalışmaları yapılmış olup viskozite, termodinamik stabilite, damlacık büyüklüğü ve yüzey gerilimi gibi fiziksel özellikleri belirlenmiştir.

Anahtar Kelimeler: Nanoemülsiyon, formülasyon, karakterizasyon, gıda ürünler, antimikrobiyal



Introduction

Although the food industry has a high potential to benefit from nanotechnology, it is still very limited. However, in recent years, the world food industry has begun to seek ways to benefit from this technology and nanotechnology-based techniques have been introduced to the food industry to provide solutions to food safety-related problems. Nanoparticles have great importance in extending the shelf life of food products due to their antimicrobial properties without causing any change in flavor or color (Josef & Morrison, 2006; Chaudhry et al., 2008).

In the food industry, despite the use of various preservation techniques, microbiological spoilage and food poisoning can occur in foods due to the effect of microorganisms. This situation constitutes a significant problem for the food industry. Synthetic or non-synthetic substances such as natural antioxidants and antimicrobials are widely used to prevent or control the formation of these unwanted microorganisms. In terms of the negative effects of synthetic preservatives on food and human health and the development of antibiotic-resistant strains, there is an increase in studies on the use of natural additives, which directs researchers to new searches. Nanotechnology is a technology focused on the characterization, production and processing of biological and non-biological structures smaller than 100 nm. Nanoparticles are of great importance in extending the shelf life of foodstuffs thanks to their antimicrobial properties without causing flavor and color changes. Recently, interest in the application of innovative nanoscience-based technologies to improve the health, safety and quality of food products has increased. A major breakthrough in this area has been the use of nanoemulsions. Because nanoemulsions can be easily formulated with existing food ingredients and technologies. In particular, oil-in-water nanoemulsions consisting of small oil droplets (<200 nm) dispersed in water are used as delivery systems for various hydrophobic substances in foods such as nutraceuticals, antioxidants, antimicrobials, colorants and sweeteners. As is known, the consumption of meat products is important for consumers. However, especially fish meat spoils quite quickly due to its high moisture content and weak connective tissue compared to the connective tissue of land animals. In addition to fish meat, the consumption of red meat and chicken meat also plays a key role in a balanced diet. Despite being composed of very important nutrients, these meat products can also spoil easily. In particular, the growth of total aerobic bacteria as well as total aerobic psychrophilic bacteria can be observed during the cold storage period. In this respect, nanoemulsion is considered as a new approach as a colloidal dispersion system of material rich in phenolic compounds, fatty acids and vitamins, which are of economic importance to the food industry.

In general, many different types of food-grade bioactive substances, including fat-soluble vitamins, antioxidants, antimicrobials, nutraceuticals, triglyceride oils, flavor oils, and essential oils, can be encapsulated within nanotechnology-based delivery systems. Nanoemulsions are one of the most widely used delivery systems for this purpose, as they can be prepared using existing processing technologies and their properties can be easily manipulated (McClements & Rao, 2011; Salvia-Trujillo et al., 2015).

Encapsulation of hydrophobic substances in nanoemulsions can greatly increase their water dispersibility, chemical stability, bioavailability, and bioactivity (Nakajima, 2005). Nanoemulsions differ from conventional emulsions by their smaller droplet diameters ($d < 200$ nm) (McClements & Rao, 2011; Salvia-Trujillo et al., 2015). As a result, they have some advantages over conventional emulsions for certain applications, including greater resistance to agglomeration and gravitational separation during storage, as well as higher bioavailability after ingestion (Salvia-Trujillo et al., 2015). For these reasons, nanoemulsions are particularly suitable for encapsulating hydrophobic bioactive substance and subsequently incorporating them into food and beverage products (McClements et al., 2007; Sanguansri & Augustin, 2006; Weiss et al., 2008). Recently, a number of comprehensive reviews have been conducted on the potential applications of nanoemulsions in the food and beverage industry (Acevedo-Fani et al. 2017a, 2017b; Dasgupta et al., 2019; McClements & Rao, 2011). However, there is a lack of information regarding the characterization of nanoemulsions prepared using sunflower and olive oils. Therefore, the aim of this study is to include a series of studies that will form the basis for the production of nanoemulsion-based delivery systems for formulation into food products.

Material and Method

Various vegetable oils (sunflower and olive oil) used in the study were obtained from commercial markets and nanoemulsions were prepared from vegetable oils in two different stages as oil and water phases according to the method used by Hammouda et al. (1999). 14% oil, 3% ethanol, 3% biosurfactant (tween 80) and 1% carvacrol and thymol were mixed and kept in an oven at 86 °C for 1 hour. Then, pure water (79%) was added to this mixture and mixed in an ice-filled bathtub in an ultrasonic homogenizer for 15 minutes. The viscosity, thermodynamic stability,



nanoemulsion droplet size and surface tension parameters of these nanoemulsions were determined. These analyses were carried out from the central laboratories of Middle East Technical University (METU).

Droplet Size: Nanoemulsions are transparent or translucent emulsions with droplet sizes ranging from 20 to 600 nanometers (Tadros et al., 2004; Fernandez et al., 2004; Zhi et al., 2005). In our study, the nanoemulsions created were sent to the METU central laboratory and their droplet sizes were determined.

Viscosity: Viscosity aids the emulsification process by increasing the resistance of droplets to coagulation. The viscosity of an emulsion slows down the coagulation of droplets by slowing down their diffusion movement, thus affecting the stability of the emulsion and drop size (Cooper & Gunn, 1950). High viscosity emulsions may have low stability, while low viscosity emulsions may have high stability (Martin, 1993).

Thermodynamic stability: The systems with the lowest stability in nanoemulsions are called thermodynamically unstable systems. Therefore, it is important to determine the roles of each of the immiscible phase systems in this system. First of all, since emulsions exhibit a large interfacial area, it is understood that any decrease in interfacial tension will reduce the tendency to coalesce and promote stability.

Surface Tension: Surface tension occurs as a result of the attractive force between molecules that are close to each other on the surface and inside (Martin, 1993). When the tension occurs between two immiscible liquids, it is called interfacial tension. According to surface tension theories; if there is a substance added to the system that reduces the interfacial tension; two immiscible liquids can form an emulsion (Cosgrove, 1963). The substance added to this system that reduces the interfacial tension is usually emulsifiers. Emulsifier molecules are located at the water-oil interface depending on their characteristics. While the hydrophilic part of the emulsifier is directed to water; the hydrophobic part is directed to oil. If the hydrophilic properties of the emulsifier are more dominant than its hydrophobic properties; the emulsifier molecule will be directed at the oil-water interface (Milton, 2004). Therefore, it is necessary to determine the surface tension in the nanoemulsions formed.

Statistical Analysis: In the study, SPSS 22.0 statistical package program was used and the obtained data were evaluated with Duncan multiple comparison test (Duncan, 1955). The significance level was taken as $p < 0.05$.

Results and Discussion

Characterization studies of nanoemulsions prepared using vegetable oils were carried out and physical properties such as viscosity, thermodynamic stability, droplet size and surface tension were determined and the results are given in the table below (Table 1).

Table 1. Physical properties of oil-in-water nanoemulsions

	Droplet size (nm)	Viscosity (N s/m ²)	Thermodynamic stability	Surface tension (N/m)
Nanoemulsion based on sunflower oil	375.76±0.12 ^a	196±1.68 ^a	+++	40.35±0.38 ^a
Nanoemulsion based on olive oil	326.36±0.12 ^b	213±1.26 ^b	+++	38.19±0.61 ^b

X±Sx: Mean ; ± Standart deviation; ^{a,b} shows differences ($p < 0.05$) between nanoemulsion groups

Statistical differences were observed between the groups in terms of droplet size, viscosity and surface tension of the prepared nanoemulsions. The group with the lowest droplet size was nanoemulsions prepared using olive oil. Özogul et al. (2016) found the droplet sizes of nanoemulsions prepared using sunflower, hazelnut, canola, soybean, corn and olive oils to be 212, 185, 299, 250, 250 and 275 nm, respectively. Durmuş et al. (2020) reported that the group with the lowest droplet size was the olive oil group (O15) prepared with 15% concentration (308.36 nm), and the largest value belonged to the olive oil group (O45) prepared with 45% concentration (541.43 nm). The oils used at 10% in our study were also in similar or close ranges and were supported by the literature.

The thermodynamic stability of nanoemulsions prepared using olive oil was similar to the studies of other researchers. Yazgan et al. (2017) reported that the surface tension of sunflower oil-based nanoemulsions was 41.53 nm, while Özogul et al. (2016) reported that the surface tension of nanoemulsions prepared from olive oil was 30.16 nm. Durmuş et al. (2020) observed the lowest viscosity in the O15 group (2.13×10^{-3} Pas) and the highest viscosity in the O45 group (9.11×10^{-3} Pas).

Yuvka (2014) determined the droplet size of nanoemulsions formed from thyme and rosemary essential oils as 112.82 and 63.02 nm, respectively. Joe et al. (2012) reported that the droplet size of nanoemulsions formed using commercial oils such as sunflower, castor, coconut, peanut, and sesame oils varied between 72.52 and 875.22 nm. Although the physical properties of the nanoemulsion we obtained in our study showed similar results with some researchers, they also showed different results with others. It is thought that the reason for this is the type of oils used in creating the nanoemulsion, the surfactant, and the methods used to obtain the nanoemulsion.

These results were also found to be compatible with the literature and it was concluded that it can be used in foods.



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IFPD: An R Package for Indonesia Food Prices Data

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Abstract

The IFPD package aims to introduce food price data in Indonesia to the world where the food price data in Indonesia no longer has missing values because LOCF imputation has been carried out so that it can be directly used in time series or panel analysis.

Key Words: IFPD package, World, Missing values, LOCF imputation

IFPD: Endonezya Gıda Fiyatları Verileri için bir R Paketi

Özet

IFPD paketi, Endonezya'daki gıda fiyat verilerinin artık eksik değerlere sahip olmadığı, LOCF hesaplamasının yapıldığı ve böylece verilerin doğrudan zaman serisi veya panel analizinde kullanılabileceği şekilde dünyaya tanıtılmasını amaçlamaktadır.

Anahtar Kelimeler: IFPD paketi, Dünya, Eksik değerler, LOCF tahmini

Introduction

The National Strategic Food Price Information Center has provided food price data in Indonesia both numerically and visually, such as **Figure 1** (PIHPS Nasional, 2024). However, the data still has missing values at several points in time and cannot be directly analyzed by researchers. One technique that is suitable for missing values in the time series data is the last observation carried forward (LOCF) as conducted by Mubarak in 2022-2023 for the price of rice in Banda Aceh, stock prices in PT ANTAM Tbk, PT BTPN Syariah Tbk, PT Astra Internasional Tbk, PT Bank Syariah Indonesia Tbk, Gold Price in United States, United Kingdom, Indonesia, Saudi Arabia, and Turkey (Auliah et al., 2023; Mubarak, Aslanargun, & Şıklar, 2022; Mubarak, Aslanargun, & Sundara, 2022; Mubarak et al., 2021, 2023; Murfadiyah et al., 2023; Nasution et al., 2023; Wahyuni et al., 2023).



Figure 1. Display of National Strategic Food Price Information Center (PIHPS)



This IFPD package aims to introduce food price data in Indonesia to the world where the food price data in Indonesia no longer has missing values because LOCF imputation has been carried out so that it can be used directly in time series or panel analysis. In addition, food price data in Indonesia does not yet have a package in R programming. Even though there are already many packages related to data collection in R programming such as lidR (Roussel et al., 2020), ODMMeans (Heredia et al., 2024), MoveR (Heredia et al., 2024), easyclimate (Cruz-Alonso et al., 2023), PbIso (Armistead et al., 2023), neonPlantEcology (Mahood et al., 2024), etc.

IFPD Package

In the IFPD package version 0.1.0, there are several variables that can be seen in **Table 1**. The types of food recorded include rice, chicken, beef, eggs, shallots, garlic, chilies, cayenne pepper, cooking oil, granulated sugar, with several classifications. Furthermore, food price data in each province is represented by food prices in each capital city. For example, food prices in Aceh are represented by food prices in Banda Aceh, food prices in Bali are represented by food prices in Denpasar, and so on (**Table 2**).

Table 1. Variables in the IFPD package

Variabel	Explanation
Tanggal	Date
Beras	Price of rice
Beras Kualitas Bawah I	Price of lower quality rice I
Beras Kualitas Bawah II	Price of lower quality rice II
Beras Kualitas Medium I	Price of medium quality rice I
Beras Kualitas Medium II	Price of medium quality rice II
Beras Kualitas Super I	Price of super quality rice I
Beras Kualitas Super II	Price of super quality rice II
Daging Ayam	Price of chicken meat
Daging Ayam Ras Segar	Price of fresh purebred chicken meat
Daging Sapi	Price of beef
Daging Sapi Kualitas 1	Price of 1st quality beef
Daging Sapi Kualitas 2	Price of 2nd quality beef
Telur Ayam	Price of chicken eggs
Telur Ayam Ras Segar	Price of fresh purebred chicken eggs
Bawang Merah	Price of shallots
Bawang Merah Ukuran Sedang	Price of medium shallots
Bawang Putih	Price of garlic
Bawang Putih Ukuran Sedang	Price of medium garlic
Cabai Merah	Price of red chili
Cabai Merah Besar	Price of big red chili
Cabai Merah Keriting	Price of curly red chilies
Cabai Rawit	Price of Tabasco chili pepper
Cabai Rawit Hijau	Price of green Tabasco chili pepper
Cabai Rawit Merah	Price of green Tabasco chili pepper
Minyak Goreng	Price of cooking oil
Minyak Goreng Curah	Price of bulk cooking oil
Minyak Goreng Kemasan Bermerk 1	Price of branded packaged cooking oil 1
Minyak Goreng Kemasan Bermerk 2	Price of branded packaged cooking oil 2
Gula Pasir	Price of sugar
Gula Pasir Kualitas Premium	Price of premium sugar
Gula Pasir Lokal	Price of local sugar

Also, this study uses food data between January 1, 2020 to December 29, 2023. The data is daily data on food prices in traditional markets. However, these data have missing values at some times. So, this study solves this problem by using the last observation missing value (LOCF) imputation method which follows equation 1. For example, Table 4 is the imputation result applied to Table 3. Table 3 is a sample of food price data in Banda Aceh (Aceh) where Beras is the price of rice, BKB I is the Price of lower quality rice I, BKB II is the Price of lower quality rice II, BKM I is the Price of medium quality rice I, BKM II is the Price of medium quality rice II, BKS I is the Price of super quality rice I and BKS II is the Price of super quality rice II.

$$B_i^* = \begin{cases} \text{if complete data then } B_i^* = B_i \\ \text{if missing data then } B_i^* = B_{i-e} \end{cases} \quad (1)$$

where B_i^* is the result of imputation of rice prices and B_{i-a} is a recursive process of finding data lags until no missing values occur.



Table 2. Names of provinces and capital cities in the IFPD package

Province	City	Province	City
Aceh	Banda Aceh	Kepulauan Riau	Tanjung Pinang
Bali	Denpasar	Lampung	Lampung
Banten	Serang	Maluku	Ambon
Bengkulu	Bengkulu	Maluku Utara	Sofifi
DI Yogyakarta	Yogyakarta	Nusa Tenggara Barat	Mataram
DKI Jakarta	Jakarta	Nusa Tenggara Timur	Kupang
Gorontalo	Gorontalo	Papua	Jayapura
Jambi	Jambi	Papua Barat	Manokwari
Jawa Barat	Bandung	Riau	Pekanbaru
Jawa Tengah	Semarang	Sulawesi Barat	Mamuju
Jawa Timur	Surabaya	Sulawesi Selatan	Makassar
Kalimantan Barat	Pontianak	Sulawesi Tengah	Palu
Kalimantan Selatan	Banjarbaru	Sulawesi Tenggara	Kendari
Kalimantan Tengah	Palangkaraya	Sulawesi Utara	Manado
Kalimantan Timur	Samarinda	Sumatera Barat	Padang
Kalimantan Utara	Tanjung Selor	Sumatera Selatan	Palembang
Kepulauan Bangka Belitung	Pangkal Pinang	Sumatera Utara	Medan

Table 3. Sample data in the IFPD package

Tanggal	Beras	BKB I	BKB II	BKM I	BKM II	BKS I	BKS II
2020-01-01	-	-	-	-	-	-	-
2020-01-02	10600	9850	10000	10250	10300	11900	11150
2020-01-03	10600	9850	10000	10250	10300	11900	11150
2020-01-06	10750	10000	10150	10400	10400	12150	11400
2020-01-07	10750	10000	10150	10400	10400	12150	11400
2020-01-08	10750	10000	10150	10400	10400	12150	11400
2020-01-09	10750	10000	10150	10400	10400	12150	11400
2020-01-10	10750	10000	10150	10400	10400	12150	11400

Table 4. Sample data in the IFPD package after imputation

Tanggal	Beras	BKB I	BKB II	BKM I	BKM II	BKS I	BKS II
2020-01-01	-	-	-	-	-	-	-
2020-01-02	10600	9850	10000	10250	10300	11900	11150
2020-01-03	10600	9850	10000	10250	10300	11900	11150
2020-01-04	10600	9850	10000	10250	10300	11900	11150
2020-01-05	10600	9850	10000	10250	10300	11900	11150
2020-01-06	10750	10000	10150	10400	10400	12150	11400
2020-01-07	10750	10000	10150	10400	10400	12150	11400
2020-01-08	10750	10000	10150	10400	10400	12150	11400

The imputation process on January 1, 2020 did not occur in **Table 4** because there was no data available at the previous time. Furthermore, in **Table 4**, there are food prices on January 3 and 4, 2024 which are the same as food prices on January 2, 2024 due to the imputation process.

Conclusion

The IFPD package aims to introduce food price data such as rice, chicken, beef, eggs, shallots, garlic, chilies, cooking oil, granulated sugar, with several classifications in Indonesia to the world where the food price data in Indonesia no longer has missing values because LOCF imputation has been carried out so that it can be directly used in time series or panel analysis.

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Physiological features of yield formation of sunflower breeding samples in arid conditions of the Ukrainian steppe

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Abstract

The conducted investigations allowed to determine physiological factors and properties of plants that determine the level of formation of the weight of seeds of the head and the yield of sunflower. The weight of seeds of the head is determined by the amount of soil moisture consumption per unit of net productivity. Between the indicators of soil moisture consumption per unit of net productivity at the stage of formation of the head - the beginning of flowering, a direct negative correlation interdependence was established. Sunflower varieties with a minimum consumption of soil moisture per unit of net productivity of photosynthesis of 1.01-1.05 m³/g/m² per day form in arid conditions of the Steppe of Ukraine the maximum level of weight of seeds of the head of 58.7-78.7 g, which ensures obtaining a high yield within 2.68-3.49 t/ha¹. The conducted assessment of genotypes by indicators of soil moisture consumption per unit of net productivity made it possible to create highly productive varieties of sunflower Emelard, Igolya, Orlik.

Key Words: sunflower, net of photosynthesis productivity, consumption coefficient of soil moisture per unit of net of photosynthesis productivity, budding stage, early flowering stage, seeds weight of plant, yield.

Introduction

The main regions of sunflower cultivation in Ukraine are located in the steppe zone and are characterized by dry weather conditions during the growing season.

The varieties and hybrids of sunflower have a high level of adaptation to growing in arid conditions. The root system of sunflower plants is able to absorb moisture from deep soil layers (El-Bially et. al., 2022). However, over the past decades in the Steppe of Ukraine, the amount of precipitation during the growing season of sunflower has decreased and falls within the range of 80 to 110 mm. The deficit of moisture content in the soil limits and restricts the level of formation of the productivity of sunflower varieties and hybrids in such weather conditions of the growing season (Aksyonov, 2010; Aksyonov and Gavriluk, 2013). Guaranteed and stable yield of sunflower is possible with the creation of highly productive varieties and hybrids that are adapted to growing in drought conditions and understanding the physiological properties of productivity formation.

Studying and understanding the processes of formation of high productivity of plants under conditions of moisture deficiency is the key to creating drought-resistant sunflower source material (Salem et. al., 2021; Ramadan et. al., 2023). The studies show that in dry conditions, the activity of plant growth and development is largely determined by photosynthesis processes. The photosynthesis processes ensure the accumulation of dry matter in the vegetative and generative organs of plants, ensure the level of formation of plant productivity. The influence of photosynthesis processes on the formation of generative organs in the conditions of abiotic stress of plants during drought is one of the main points in the formation of the productivity of varieties and hybrids (Gao et al., 2018; Oikawa and Ainsworth, 2016).

At the same time, drought, moisture deficiency in the soil during the vegetation period of plants can suppress the processes of vegetative development of sunflower, reduce the area of the leaf surface of plants, and reduce the rate of photosynthesis. A decrease in the level of aboveground biomass of sunflower plants contributes the formation of photosynthetic products in the plant to a lesser extent. A decrease of the photosynthetic capacity of leaves and the amount of dry matter accumulation by vegetative organs of the plant limits reproductive growth and can lead to a significant decrease of the productivity of sunflower plants (Cao et al., 2009; Saudy et al., 2023).

The conducted studies did not establish a direct correlation between the elements of productivity and net productivity of photosynthesis and the amount of moisture in the soil. Plant productivity of sunflower varieties and hybrids depended on the greater extent on individual traits of photosynthesis and growing conditions that contributed to a change in the intensity of photosynthesis processes (Aksyonov, 2007).

Regarding the moisture deficit in the soil, studies show that sunflower genotypes have different reactions to the moisture content in the soil depending on the stage of plant development. Deficiency of moisture content in the soil during the



drought period in the stage of sunflower flowering can reduce the level of formed yield in the agroecosystem. At the same time, the moisture deficit in the soil in the stage of initial seed formation does not contribute to the decrease of yield. In this case, the decrease of the number of seeds in the head is compensated by an increase of the weight of the seeds in the head and the yield level is stabilized (Jensen et al., 2010; Karam et al., 2007).

Establishing and evaluating the physiological characteristics of sunflower genotypes allows in the breeding process to create varieties and hybrids with a high level of productivity for growing in the conditions of moisture deficit. In the breeding of varieties and hybrids, breeders use several strategies for assessing physiological characteristics in order to create drought-resistant genotypes. One of the directions in creating such genotypes is the assessment of only the lower leaf canopy of plants, reducing transpiration, reducing water consumption on forming a unit of yield. This approach in breeding allows to create genotypes with a high level of drought resistance, but with a low level of productivity (Birck et al., 2017; Rauf and Sadaqat, 2008). Therefore, for creation of varieties and hybrids in drought conditions, a breeder must understand the physiological characteristics that ensure the creation of highly productive genotypes and consider the formation of plant productivity in a complex relationship with the intensity of photosynthesis and the moisture content in the soil.

Therefore, the study and establishment of physiological characteristics for the comprehensive assessment of the criteria of photosynthetic activity and moisture reserves in the soil in the specific phases of sunflower plant development in relation to droughty periods of vegetation in the steppe zone, allowing the creation of highly productive genotypes, determine the prospects and practical significance of the studies.

The purpose of this research work was to establish the physiological properties of the formation of high plant productivity, identify genotypes with high productivity potential for cultivation in the steppe zone of Ukraine.

Materials and method

The studies were carried out at the Luhansk National University and the Dnipro State Agrarian and Economic University.

The assessment of plants by morphological characteristics was carried out in the field on experimental plots. Field experiments were laid in a 7-field crop rotation. The soil of the experimental plot is ordinary chernozem, medium-deep, low-humus, heavy loamy soil with a humus content of 3.2-3.6%.

During the growing season of sunflower, we carried out phenological observations of plants, a description of plants by morphological characteristics, determination of soil moisture content, and calculations based on the net productivity of photosynthesis. Determination of the content of soil moisture reserves, the area of the leaf surface of plants, and the content of dry matter in a sunflower plant were performed at stages 6-8 of ontogenesis at the stage of head formation - the beginning of flowering of plants.

Sunflower samples that had different qualitative morphological characteristics of plants and a vegetation period of 100-110 days were included in the research.

The studies were conducted in accordance with generally accepted methods in plant growing. Statistical processing of the research results was performed in accordance with Dospekhov (1985), Aksyonov et al. (2023), using the Microsoft Office Excel 2010 application.

Results and discussion

The results of the conducted studies showed that during the period of plant development from the stage of head formation to flowering, sunflower samples 52 and 129 had the highest consumption of the moisture from the soil: 38.1 and 43.5 m³/ha, respectively (Table 1).

Table 1. Traits indicators of sunflower plants, (average for 2016-2023).

Sample	CMA	NPP	CSMN	WHS
33	20.9	16.8	1.24	52.9
44	22.4	10.4	2.15	45.7
52	38.1	9.6	3.97	36.0
65	21.9	17.3	1.26	51.0
129	43.5	11.2	3.88	38.8
Malakhit	19.7	16.0	1.23	54.2
Emerald	12.4	11.9	1.04	60.2
Igolya	10.2	10.1	1.01	78.7
Orlik	13.2	12.6	1.05	58.7
Least significant difference 0.05	2.5	2.2	0.12	3.4

CMA: Consumption of soil moisture during the accounting period: phase of head formation - beginning of head flowering, m³/ha; NPP: Net productivity of photosynthesis (NPP) of plants: phase of head formation - beginning of head flowering, g/m² per day; CSMN: Consumption of soil moisture per unit of NPP in the phase of head formation - beginning of head flowering, m³/g/m² per day; WHS: Weight of head seeds, g



The minimum consumption of soil moisture during the period of head formation and the beginning of flowering of 10.2-13.2 m³/ha was observed at the sunflower varieties Emerald, Igolya, Orlik. Sunflower sample 52, with a high level of the consumption of soil moisture, was characterized by the lowest net photosynthetic productivity – 9.6 g/m² per day. The newly obtained varieties of the sunflower Emelard, Igolya, and Orlik, with the minimum consumption of moisture from the soil in this stage of plant development –12.4; 10.2, and 13.2 m³/ha, had low net productivity of photosynthetic of 11.9; 10.1, 12.6 g/m² per day, respectively. The maximum net productivity of photosynthetic of 16.8 and 17.3 g/m² per day was characteristic of samples 33 and 65 with the average consumption of soil moisture of 20.9 and 21.9 m³/ha.

In the comprehensive assessment of plant development, the consumption indicators of soil moisture and net productivity of photosynthetic determined different levels of the ratio between these indicators. The high level consumption of soil moisture with low productivity of photosynthetic determined the maximum high ratio between these indicators of plant development at samples of sunflower 52 and 129. The ratio between the consumption moisture and net productivity of photosynthetic was 3.97 m³/g/m² per day at sample 52 and 3.88 m³/g/m² per day at sample 129. A decrease the productivity of the photosynthesis process to 9.6 and 11.2 g/m² per day at samples 52 and 129 did not lead to the decrease in the consumption of soil moisture per unit of net productivity of photosynthetic due to the maximum consumption of the water by plants during the period of plant development from head formation to the beginning of flowering.

The lowest consumption of soil moisture per unit of net productivity of photosynthetic was 1.04; 1.01; 1.05 m³/g/m² per day were characteristic for the varieties of the Emelard, Igolya, and Orlik, which consumed a minimal amount consumption of moisture from the soil and had minimal rates of photosynthesis in the arid conditions of the Steppe.

The sunflower varieties with lower consumption of soil moisture per unit of net productivity of the photosynthetic formed a greater weight of seeds in one head. The maximum weight of seeds in one head was noted at the varieties Emerald (60.2 g), Igolya (78.7 g), Orlik (58.7 g). Increase the consumption of soil moisture per unit of net productivity of the photosynthetic had a negative effect on the formation of the weight of seeds in the head and contributed to decrease of the seeds weight in the head. The sunflower samples 52 and 129 with the maximum consumption soil moisture per unit of NPP of 3.97 and 3.88 m³/g/m² per day formed the minimum weight of seeds in one head of 36.9 g and 38.8 g in the droughty conditions. The varieties and samples of sunflower with a greater weight of seeds in the head had lower values of soil moisture consumption at stages 5-8 of ontogenesis and consumed less the soil moisture per unit of net productivity photosynthetic.

The conducted correlation analysis of the development indicators of sunflower plants did not show a correlation between the moisture consumption during the study period and the net productivity of photosynthesis, the correlation coefficient was $r = -0.21$ (Table 2).

Table 2. Correlation matrix of the relationship between the developmental traits of sunflower plants, (average for 2016-2023).

Correlation coefficient					
Consumption of soil moisture and net productivity of photosynthesis	Consumption of soil moisture and consumption of soil moisture per unit of NPP	Consumption of soil moisture and weight of head seeds	Net productivity of photosynthesis and consumption of soil moisture per unit of NPP	Net productivity of photosynthesis and weight of head seeds	Consumption of soil moisture per unit of NPP and weight of head seeds
- 0.21	0.95	- 0.87	- 0.50	0.03	- 0.91

Increasing or decreasing in moisture consumption during the period of head formation – beginning of flowering did not contribute and not fully affect the increasing of the photosynthetic productivity. The strong positive correlation was found between the soil moisture consumption and soil moisture consumption per unit of net productivity of photosynthetic, the correlation coefficient $r = 0.95$. Correlation analysis shows a negative direct relationship between soil moisture consumption per unit of net productivity of photosynthetic and the weight of head seeds: $r = -0.91$. The increasing weight of head seeds in sunflower genotypes was due the decreasing of the consumption of soil moisture per unit of net productivity of photosynthetic. Sunflower genotypes that form the maximum weight of head seeds in droughty conditions had less dependence from the consumption of soil moisture at the stage of plant development: head formation – beginning of flowering. The maximum weight of seeds in the head of 58.7-78.7 g at the varieties Emelard, Igolya, Orlik was determined the reduced consumption of the moisture from the soil: 10.2-13.2 m³/ha and the reduced consumption of the soil moisture per unit of net productivity of photosynthesis: 1.01-1.05 m³/g/m² per day in the phase of head formation - the beginning of flowering.



The weight of the seeds of the head determined the level of formation of the yield in samples and varieties of sunflower. Over the years of research, the newly obtained varieties of sunflower Emelard, Igolya, Orlik in droughty conditions of the growing season with a minimum consumption of soil moisture per unit of net productivity of photosynthesis of 1.01-1.05 m³/g/m² per day formed the highest yield of 2.68-3.49 t/ha with a fat content in the seeds of 49.4-51.4% (Table 3).

The varieties that require the less quantity of moisture and consume the less quantity of moisture per unit of net productivity of the photosynthetic have the ability to forming the high levels of yield in relation to droughty conditions of vegetation periods.

Such varieties formed the yield on 0.19-1.0 t/ha higher than the control variety Sur. At the sunflower samples 52 and 129 with the highest amount of soil moisture consumption per unit of net productivity photosynthetic of 3.97 and 3.88 m³/g/m² per day, the productivity in droughty conditions of steppe was formed at the lowest level of 1.60-1.70 t/ha.

Table 3. Yield of the created varieties and samples of sunflower by estimate the consumption of moisture per unit net productivity of photosynthesis, t/ha, (average for 2016-2023).

Variety, sample	Duration of period vegetation	Duration of interphase period "seedling-flowering"	Plant Height, sm	Yield, t/ha	Content of seed fat, %
Sur (control)	107	55	139.2	2.49	49.1
33	104	50	142.3	2.24	53.0
44	104	50	145.6	1.97	52.4
52	107	55	157.1	1.60	52.3
65	105	51	152.9	2.15	51.9
129	110	57	127.9	1.70	52.9
Malakhit	102	51	115.4	2.41	49.1
Emerald	102	50	98.1	2.79	50.4
Igolya	110	55	110.2	3.49	51.4
Orlik	102	50	107.8	2.68	49.4
Smallest significant difference, 0.05	1.1	1.0	4.7	0.12	0.6

By the absence of a direct effect of net productivity of photosynthetic on the formation of the weight of seeds in the head and the yield of sunflower genotypes, the indicators of soil moisture consumption of plants and the consumption of soil moisture per unit of net productivity photosynthetic at the fifth stage of ontogenesis can be reliable criteria for assessing genotypes for drought resistance and adaptability of genotypes for growing in arid conditions of the Steppe of Ukraine.

Thus, the level of formation of the yield of sunflower genotypes in the arid conditions of the Steppe of Ukraine is largely determined by a lower consumption of soil moisture per unit of net productivity of photosynthetic in the phase of plant development: formation of the head – the beginning of flowering. More highly productive varieties adapted to growing in arid conditions consume less moisture on the stage of formation of generative organs of plants.

Conclusions

The net productivity of photosynthesis at the stage of formation of generative organs of sunflower plants does not have a direct effect on the formation of the weight of the seeds of the head. In the greater extent, the formation of the weight of the seeds of the head depends on the amount of consumed moisture *акціє* *еру* soil by plants during this period of development.

In the drought conditions of the steppe of Ukraine, the weight of the seeds of the sunflower head has strongly dependence from the consumption amount of soil moisture per unit of net productivity of photosynthesis in the phase of plant development: of the formation of the head - the beginning of flowering. The minimum consumption of soil moisture per unit of net productivity of photosynthesis objectively characterizes the ability of sunflower genotypes to form the maximum mass of seeds of the head, ultimately forming the maximum yield.

A negative correlation was established between the indicators of soil moisture consumption by plants per unit of net productivity of photosynthesis and the weight of the seeds of the head, the correlation coefficient was $r = -0.91$.





In the conditions of the Steppe of Ukraine, the decreasing of level of moisture consumption per unit of net productivity of photosynthesis at the fifth stage of plant ontogenesis ensures the formation of maximum yield of 2.68-3.49 t/ha at sunflower varieties Emelard, Igolya, Orlik.

Determining the level of soil moisture consumption during the period of head formation - the beginning of flowering allows to evaluate and select the genotypes highly productive of sunflower that consume less moisture per unit of dry matter accumulation by plants in the phase of formation of generative organs of plants in the most critical period for water consumption.

Knowledge and understanding of the physiological and biological patterns of sunflower development at fifth stage of plant ontogenesis allows us to select and create genotypes with a high level of productivity, adapted to cultivation in the Steppe of Ukraine.

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ID: 431

Evaluating the Efficacy of *Cassia fistula* L. Based Nanoparticles of CuO, ZnO and their Nanocomposites for Mitigating Drought Stress in Lentil (*Lens culinaris*)

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Abstract

Amaltas (*Cassia fistula* L.), which belongs to *Fabacea* family is widely used in medical, cosmetic and agricultural field. Its seeds and leaves are thought to be beneficial parts of plants because of the presence of variety of active compounds in them. The primary objective of this study was to assess the effect of *Cassia fistula*-derived nanoparticles on lentil as nanobiofertilizer. For this purpose, ZnO, CuO nanoparticles and their bimetallic nanocomposites were synthesized using *Cassia fistula* leaves extract and characterized using UV-Visible Spectrophotometry, Fourier transform infrared spectroscopy (FTIR), Scanning electron microscopy (SEM), Dynamic light scattering (DLS) and X-ray Diffraction analysis (XRD) to assess the chemical and physical properties of these nanoparticles. Three types of nanoparticles were then applied on lentil plants for mitigating drought stress in present investigation. Two types of stress were applied to the plants i.e., moderate and severe stress. Synthesized nanoparticles were applied in three concentrations i.e., 100 mg/l, 250 mg/l, 500 mg/l on plants. Morphological and biochemical traits were studied to evaluate the results. It was observed that stress caused increase in root fresh and dry weight, root length, and number of lateral roots but when nanoparticles were applied, plant roots recovered from this effect depending upon the concentration of applied nanoparticles. Comparing the results of three concentrations of nanoparticles, maximum of root parameters were observed in plants with 100 mg/l concentration and minimum were observed by plants with 500 mg/l concentration. Shoot parameters including shoot length and shoot fresh & dry weight gave maximum readings in control plants and minimum were observed in plants with 500mg/l concentration of nanoparticles. In stressed condition, biochemical parameters like catalase and peroxidase activity and hydrogen peroxide content in plants increased but when nanoparticles were applied on these plants, their concentration decreased showing a positive impact on plants condition. This study is a pathway in unraveling the potential of plant-derived nanoparticles as nanobiofertilizers offering significant benefits to the agricultural sector in future.

Keywords: *Cassia fistula*; *Lens culinaris*; Drought; Nanoparticles; Nanocomposites; nanobiofertilizers





ID: 432

Phenotypic Characterization Of Lactobacillus Autochton And Evaluation Of Their Technological And Probiotic Potential

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Abstract

The aim of the present study was to evaluate the biochemical and physiological characteristics, as well as the technological and probiotic properties of certain autochthonous Lactobacillus isolates. We first confirmed that these bacteria belonged to the genus Lactobacillus by observing their macroscopic appearance, the catalase test and Gram staining. We then studied their biochemical and physiological characteristics, followed by their technological properties. Finally, to assess their probiotic potential, we tested the antibacterial activity of some of these isolates against a pathogenic *S. Aureus* isolated from a urine sample of a patient suffering from a urinary tract infection. The results showed that the majority of the isolates are homofermentative, capable of growing under hostile conditions. Lactobacilli also have good acidifying, proteolytic and lipolytic properties. They produce flavours and EPS and have strong antibacterial properties.

In conclusion, the Lactobacillus isolates tested have good technological properties and could therefore be used in the food industry, especially in the dairy industry. In addition, their use in probiotic treatment, especially in the treatment of urinary tract infections, could represent an alternative to the use of antibiotics.

Key Words: Antibacterial activity, Lactic acid bacteria, Lactobacillus, probiotic effects, technological skills.





ID: 433

Households' Willingness to Pay for the Conservation of Debre-Libanos Monastery Forests of North Shewa Zone, Ethiopia

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Abstract

This research investigates households' willingness to pay for the conservation of the Debre-Libanos monastery forests in the North Shewa Zone, Oromia region, Ethiopia. Utilizing primary data collected from 215 households, the study employed the Tobit model to identify the determinants of maximum willingness to pay and a seemingly unrelated bivariate probit model to estimate the average willingness to pay for conservation efforts. The Tobit regression results reveal that factors such as household sex, education level, annual income, households' perception, and training positively influence willingness to pay, while age and initial bid price have a negative impact. The average willingness to pay, estimated at 33.52 Birr per year, underscores the importance of such assessments in providing policymakers and forest managers with crucial insights for designing effective conservation strategies, resource allocation, and promoting sustainable forest management.

Key Words: Contingent Valuation, Forest Conservation, Tobit Model, Willingness to Pay, Ethiopia



Nutrient Composition Of Soybean (*Glycine max* L.) In Response To Phosphorus Fertilizer Concentrations

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Abstract

The types and amount of nutrient applied to the soil are key factors in crop production. A field experiment was carried out at the out – station of the Institute of Agricultural Research and Training (IAR&T), Ikenne, Ogun State to examine the effect of different Phosphorus Concentrations on yield, protein, mineral and vitamin content of Soybean Seed. The experiment was laid out in the Randomized Complete Block Design (RCBD) with three replicates. Each replicate measured 11.2 x 2m² separated by 1m apart consisting of 4 plots of 2 x 2.4m² separated by 0.5m. The treatment were different rates of phosphorus fertilizer applied at 20kg/ha, 40kg/ha, 60kg/ha and at zero level. Soybean seed used was TGX 1440 – IE. Cultural practices were carried out and data taken. At maturity soybean grains were harvested, threshed and weighed in kg/ha. The grains were analyzed for proximate and mineral composition. The result showed that application of 60kg P/ha significantly (p<0.05) gave the highest grain yield of 190.76 kg/ha than other treatments. Proximate analysis result showed that soybean treated with 60kg/ha of phosphorus had the highest protein content (39.50%). While crude fat, was not affected by application of phosphorus. Phosphorus at zero levels gave high values of iron and calcium content (18.01mg/kg and 324.02Cmol/kg respectively) while 20kg/ha level of phosphorus gave highest value for magnesium content (338.74Cmol/kg). The study therefore recommends application of Phosphorus at the rate of 60kg/ha for optimum soybean grain yield with high protein content.

Key words: Soybean, Phosphorus, Grain, Yield, Proximate

Introduction

Soybeans are a widely consumed agricultural commodity around the world in many forms, such as the whole soybean, soy oil and soy meal (Fearnside, 2001). Soybean as described is known as “miracle bean” or the “golden bean” because it is a cheap, protein rich grain with a high protein content of about 40% which is superior to all other plant foods and it has a good balance of the essential Amino acids (Omotayo *et al.*, 2007).

Soybean quality and protein content is influenced by nutrient availability and phosphorus has a positive effect upon its protein content. Phosphorus application is necessary for high protein and yield of soybean grains (Shah *et al.*, 2001) and yield components like the straw (Cheizey 2001). Soybean contains approximately 37 – 41% protein, 18 – 21% oil, 30 – 40% carbohydrate and 4 -5 Ash research has shown that (Morrison *et al*, 2000). Generally, soybean is regarded as a highly versatile and multipurpose agricultural product that has about three hundred and sixty-five (365) application in the formulation of both human, animal foods and other industrial uses, soybean has the highest protein content of all field crops and is the second only to groundnut in terms of oil content among the food legumes. (Hungria and Mendes, 2015). The protein in soybean contains amino acids required for human nutrition and that of livestock (Zarei *et al*; 2012). For this reasons soybean has been recognized as one of the premier agricultural crops today, thus it is the best source of protein and oil, and now been recognized as potential supplementary source of nutritious food (Wilcox and Shibles, 2001).

Phosphorus has significant implications on growth and yield of soybean attributes (Kumaga and Ofori, 2004). Small quantity of phosphorus in the soil is a key obstacle to the growth as well as yield of soybean. Soybeans thrives well on a relatively well – drained loamy soil rich in phosphorus with a pH range of 4.5 to 8.5, but performs badly on drought stressed soils and water soaked soils and soil lack of phosphorus (Mofa, 2006).

A major constraint for Soybean production on disturbed soil is Phosphorus (Ferguson *et al.*, 2006). Phosphorus nutrition has strong impact on photosynthesis and yield quality of Soybean (Singh *et al.*, 2014).

Phosphorus is the main nutrient contributing protein in soybean, phosphorus from the soil is imperceptible, it is the most nutritive nutrients that soybean productivity comes from; phosphorus deficiency in soybean can limit the nodule formation while the Phosphorus fertilization does not only overcome the deficiency but also promote nutrient uptake and and eventual yield of the crop. (Carsky *et al*, 2001).

Phosphorus application is also necessary for high protein and oil yield from Soybean grains (Shah *et al.*, 2001). Damodar *et al.*, (2000) and Manna *et al.*, (2007) reported that manure application along with Phosphorus inorganic



fertilizer is an effective strategy to help improve soybean nutrient like iron, calcium and magnesium also phosphorus in the soil. It has been reported that, Phosphorus application through Single Super Phosphate significantly increased the grain yield and oil content in the crop (Tanwar and Shaktawat, 2003).

The quality of soybean is also influenced by nutrient availability with phosphorus having a positive impact on Soybean nutrient composition (Borges and Mallarino, 2000). Several researchers have pointed out that the use of Phosphorus significantly improves the content of Soybean nutrient composition (Brennan and Bolland, 2004). It becomes imperative therefore to determine the quantity of phosphorus level that should be applied to soybean to obtain optimum nutrient quality in soybean; hence, this study.

Materials And Method

The field experiment was carried out at the out-station of the institute of Agricultural Research and Training (IAR&T) Ikenne, Ogun State. The experimental plot measuring 11.1×35 m was prepared by ploughing and harrowing and laid out into 12 plots 11.1×2 m² Phosphorus fertilizers (P) at different rates were incorporated into the soil a week before planting. The different rate of phosphorus fertilizer are 20 kg/ha, 40 kg/ha, 60 kg/ha, and zero level which is the control rate.

The soybean (*Glycine max* L) seed used was early maturing TGX 1440 - IE which was obtained from the seed store of the Institute of Agricultural Research and Training (IAR&T) Moor Plantation, Ibadan. The experiment was laid out in the randomized complete Block Design (RCBD) with three replicates. Each replicate measures 11.1×2 m² separated by 1m apart and each replicate was divided into 4 plots of 2×2.4 m² separated by 0.5m. Soybean seeds were sown at two seeds per stand, agronomic practices were carried out and data collected on growth and yield parameters. At maturity, soybean seeds were harvested, threshed and weighed and weight recorded in kg/ha. Then the seeds were taken to the laboratory for proximate analysis and mineral composition analysis. The data collected were subjected to statistical analysis using ANOVA to test the level of significance of treatment on the measured parameters and the significant means were compared and separated using least significant difference (LSD) at 5% levels of probability.

Result And Discussion

The result of physical and chemical properties of the pre cropping soil is presented in table I. It showed that the soil was slightly acidic with a pH of 6.14. Total Nitrogen was very low (0.083%), compare to the standard value of (1 - 1.5) available phosphorus (7.63 mg/kg) compared to the standard value of (7 - 7.20) and organic carbon (0.83%) compared to the standard value of (1.0 - 1.4) were low. Exchangeable base: Potassium, Calcium, Magnesium and Sodium of the soil range from 0.29 – 1.10 and 0.40 cmol/kg, the texture of the soil was sandy loamy soil with sand, silt and clay content of 861, 79 and 60 g/kg respectively.

Effect of Phosphorus concentration on Soybean yield (kg/ha) and yield components

The effect of treatment on the yield of soybean is presented in Table 2, The yield of soybean was significantly ($p < 0.05$) higher with the application of 60 kg P/ha than other levels of P with a yield difference of 52.56% for zero application, 21.24 and 36.6 % for 40 and 20 P respectively. This study buttresses the fact that Phosphorus, an essential mineral nutrient is required in relatively large amount to maintain growth and play a vital role in improving Soybean yield and quality (Jack and Sara, 2001) and that it has strong impact on photosynthesis and yield quality of Soybean grains (Singh *et al.*, 2014)..

Effect of phosphorus concentration on Proximate analysis of soybean seeds

The result of proximate analysis of soybean is presented in Table 3. It was observed that treatment effect was not significant on moisture content of soybean; while for crude protein, treatment effect was significant. Soybean treated with 60kg of phosphorus had the highest value of protein content 39.50% which was significantly higher than other treatments. This corroborates the work of Tanwar and Shaktawat (2003) who also opined that phosphorus application significantly increased the seed protein content (SPC) of soybean. Treatment effect was not significant on crude fat. This is in contrast to the work of Brennan and Bolland (2004) who submitted that, Phosphorus significantly improves the oil content of many oil seed crops.

The study however support the findings of Rogerio *et al* (2013) who stated that different level of Phosphorus in oil seed crops (Crambe) does not significantly increased oil content of the crop. Considering the crude fiber content, the control (0P) was significantly higher than other treatments except that of 20P. Meanwhile, there is no significant difference between the crude fibre content of soybean at 20 P and 60 P application. This indicates that enough crude fibre content can still be derived with the application of 60 kg P/ha which also supports optimum yield and protein content in soybean For total ash there was no significant difference among the treatments.



Significant difference was observed among the treatments for nitrogen free extract in which Soybean treated with 40 P was significantly higher than those treated with 60 P but was comparable to those of 0 Phosphorus and 20 Phosphorus statistically. This is also an indication that application of Phosphorus for soybean support the availability of free Nitrogen extract. This is consistent with the findings of Malik *et al.* (2006).

Table 1. Physical and chemical characteristics of experimental soil

Parameters	Value
pH	6.14
Total Nitrogen	0.08
Organic carbon (g/kg)	0.83
Available phosphorus (g/kg)	7.63
Exchangeable Cations (cmol/kg)	
Ca ²⁺	0.59
Mg ²⁺	1.10
Na ⁺	0.40
K ⁺	1.01
H ⁺	1.01
ECEC	3.39
Particle size distribution (g/kg)	
Sand	861
Clay	60
Silt	79
Textural class	Sandy loam

Source: Authors

Table 2. Effect of phosphorus concentration on Yield of Soybean (kg/ha)

Treatment (kg P/ha)	Yield (kg/ha)
0(Control)	90.50
20	120.92
40	150.25
60	190.76
LSD (0.05)	80.52

The means were separated using LSD at 5% level of Significant

Table 3. Proximate analysis of soybean

Treatment (kgP/ha)	Moisture (%)	Crude Protein (%)	Crude Fat (%)	Crude Fiber (%)	Total Ash (%)	NFE (%)
0(control)	9.58	34.57	24.22	6.69	5.49	19.44
20	9.68	35.75	23.46	6.22	5.29	19.50
40	9.35	37.19	22.82	5.38	4.88	20.38
60	9.69	39.50	23.91	5.97	5.04	15.89
LSD (P= 0.05)	ns	1.50	ns	0.58	ns	3.45

Significant means were separated by LSD P<0.05; Source: Authors

Effect of phosphorus concentration on Mineral Composition of soybean

The result of treatment effect on mineral Analysis of Soybean is presented in Table 4. The result revealed that, there was significant differences in iron content among all the treatment, soybean with no treatment (control) had the highest iron content of 18.01%, which was significantly higher than other treatments. This indicates internal inactivation of Iron by the Phosphorus this is because, phosphorus deficiency has been shown to result in increased Iron concentration. (Hirsch *et al.*, 2006). Likewise, for calcium content there were significant difference across the treatments. Soybean not treated with phosphorus (control) had the highest calcium content of 324.02%, while the soybean treated with phosphorus were significantly lower in calcium content, with 40 kg P/ ha having the least followed by 20 P then 60 P. These results showed that application of Phosphorus fertilizer to the soil in soybean field has nothing to do with the iron content and calcium content in soybean. These minerals can be gotten by soybean from other sources. Meanwhile, effect of treatment on magnesium content of soybean seed showed that there were significant differences among the treatments in which soybean treated with 20kg of phosphorus had the highest magnesium content of 338.74% which is comparable statistically with those 40 and 60 level of phosphorus while the 0 level of Phosphorus had the least value of magnesium content of 281.03% different from those of 40 and 60 level of Phosphorus.



Conclusion And Recommendation

Phosphorus concentration of 60 kg/ha gave the highest soybean yield of 190.76 kg/ha and high protein content (39.50%). Mineral content like Magnesium also responds to application of Phosphorus in soybean. However, crude fat does not response to phosphorus application in soybean. Also with zero Phosphorus fertilizer application to soybean, enough minerals like iron and calcium which are beneficial to humans can be derived from the crop. Selective Phosphorus concentration can be used in precision soybean cultivation to improve target nutrients in Soybean. This will encourage the production of Soybean selectively rich in predetermined class of nutrients. Soybean production is targeted to make protein for man hence, the applications of 60kg/ha of phosphorus is recommended to achieve optimum yield and high protein content in soybean which does not however affect the availability of oil in the crop adversely.

Table 4. Mineral Composition Analysis

Treatment (kgP/ha)	Fe (Mg/kg)	Ca (Cmol/kg)	Mg (Cmol/kg)
0(control)	18.01	324.02	281.03
20	10.78	211.70	338.74
40	13.53	201.56	325.56
60	14.68	232.49	325.56
LSD (0.05)	0.03	0.79	0.53

Significant means were separated by LSD $P < 0.05$; Source: Authors

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ID: 435

Uçucu Yağ İçeren Nanoemülsiyon Film Kaplama Formülasyonlarının Şeker Pancarının (*Beta vulgaris* L.) Depo Kalitesine Etkileri

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Özet

Bu çalışma, farklı uçucu yağlar kullanılarak oluşturulan kitosan bazlı nanoemülsiyon film kaplama formülasyonlarının depolama devresinde şeker pancarı kök gövdelerinde depo kalitesine etkilerinin belirlenmesi amacıyla kontrollü koşullarda yürütülmüştür. Çalışmada Conviso Smart (KWS) şeker pancarı çeşidinin kök gövdeleri hasattan hemen sonra 250, 500 ve 1000 ppm dozlarında kekik (*Thymus vulgaris*), karanfil (*Syzygium aromaticum*), zencefil (*Zingiber officinale* Rosc.) ve çay ağacı (*Melaleuca alternifolia*) uçucu yağları ile oluşturulan nanoemülsiyon film formülasyonları ile kaplanarak plastik kasalar içerisinde kontrollü şartlarda (+ 8-10 °C, % 85-90 nispi nem) 90 gün süre ile depolanmıştır. Depo devresi başından itibaren 30 gün aralıklarla kök gövdelerde ağırlık kaybı, depolama devresi sonunda ise sertlik derecesi, kuru madde oranı, briks değeri, polar şeker, indirgen şeker, alfa amino azot ve glycine betain içerikleri ile kök gövdelerde fungal enfeksiyon gelişimleri belirlenmiştir. Film kaplama uygulamaları şeker pancarı kök gövdelerinde hasat sonrası ağırlık ve kalite kayıplarını önemli derecede etkilemiştir. Uygulamalar depo devresinde kök gövde ağırlık kayıplarını kontrole göre önemli derecede azaltmıştır. En yüksek kuru madde oranı Briks değerleri ile sertlik derecesi 1000 ppm tarçın ve kekik uçucu yağı içeren film kaplama uygulamalarından elde edilmiştir. Film kaplama uygulaması yapılan kök gövdelerde polar şeker oranı kontrole göre daha yüksek olurken, alpha amino azot, glycine betaine ve indirgen şeker içerikleri önemli derecede azalma göstermiştir. Kök gövde üzerinde gelişen beyaz küf ve yeşil küf enfeksiyonları özellikle yüksek dozlarda yapılan film kaplama uygulamaları ile önemli derecede azalma göstermiştir. Çalışmada, şeker pancarı kök gövdelerinin uçucu yağ içeren nanoemülsiyon film formülasyonlarıyla kaplanması ile depo devresinde kök gövde ağırlık ve kalite kayıpları ile fungal hastalık gelişiminin önemli derecede azaltılabileceği sonucuna varılmıştır.

Anahtar kelimeler: Ağırlık kaybı, Antifungal aktivite, Depo kalite değişimi, Polar şeker, Şeker pancarı

The Effects of Nanoemulsion Film Coatings Containing Essential Oils on the Storage Quality of Sugar Beets (*Beta vulgaris* L.)

Abstract

This study was carried out under controlled conditions in order to determine the effects of chitosan based nanoemulsion film coating formulations formed using different essential oils on storage quality of sugar beet root during the storage period. In the study, roots of Conviso Smart (KWS) sugar beet variety were coated with nanoemulsion film formulations formed with thyme (*Thymus vulgaris*), clove (*Syzygium aromaticum*), ginger (*Zingiber officinale*) and tea tree (*Melaleuca alternifolia*) essential oils at 250, 500 and 1000 ppm doses immediately after harvest and stored in plastic case under controlled conditions (+ 8-10 °C, 85-90% relative humidity) for 90 days. Weight loss in beet root was determined at 30-day intervals starting from the beginning of the storage period, and at the end of the storage period, firmness, dry matter ratio, brix value, polar sugar, reducing sugar, alpha amino nitrogen and glycine betaine contents and fungal infection developments in beet roots were determined. Film coating applications significantly affected postharvest weight and quality losses in sugar beet roots. Applications significantly reduced root weight losses in the storage period compared to the control. The highest dry matter ratio, Brix values and firmness were obtained from film coating applications containing 1000 ppm cinnamon and thyme essential oil. While polar sugar ratio was higher in root which film coated compared to the control, alpha amino nitrogen, glycine betaine and reducing sugar contents showed significant decreases. White mold and green mold infections developing on root showed significant decreases especially with film coating applications applied at high doses. In the study, it was concluded that by coating sugar beet roots with nanoemulsion film formulations containing essential oils, weight and quality losses and fungal disease development during the storage period could be significantly reduced.

Keywords: Weight loss, Antifungal activity, Storage quality change, Polar sugar, Sugar beet



Uçucu Yağların Fungal Patojenler Üzerine İn-Vitro Antifungal Aktivitelerinin Belirlenmesi

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Özet

Bu çalışma, kekik (*Thymus vulgaris*), çörtlük (*Echinophora tenuifolia* subsp. *sibthorpiana*), karanfil (*Syzygium aromaticum*), tarçın (*Cinnamomum zeylanicum*), okaliptüs (*Eucalyptus globulus*), dereotu (*Anethum graveolens*), ardıç (*Juniperus communis*), ve zencefil (*Zingiber officinale*) bitkilerinden elde edilen uçucu yağların *Rhizoctonia solani* ve *Fusarium solani* enfeksiyonlarına karşı in-vitro antifungal aktivitelerinin belirlenmesi amacıyla yürütülmüştür. Çalışmada uçucu yağlar 0, 500, 1000 ve 2000 ppm dozlarında, otoklav edilen potato dextrose agar (PDA) besiy ortamına ilave edilmiştir. Petri kaplarının merkezine 5 mm çapında hastalık etmenlerinin miselyum diskleri aktararak, 24±2 °C’de 7 gün boyunca inkübasyona bırakılmıştır. Fungusların misel gelişim çapları ölçülerek uçucu yağların biyokontrol etkinlikleri hesaplanmıştır. Çalışmadan elde edilen verilere göre uçucu yağ uygulamaları *R. solani* enfeksiyonuna karşı önemli derecede antifungal aktivite göstermiş, tarçın, kekik ve karanfil uçucu yağları 1000 ppm, dereotu uçucu yağı ise 2000 ppm dozunda misel gelişimini tamamen engellemiştir. Ardıç (%2.4-12.6), okaliptüs (%2.8-26.6) ve zencefil (%18.2-37.3) uçucu yağlarının biyokontrol etkinlikleri düşük bulunmuştur. Karanfil ve kekik uçucu yağları 2000 ppm dozunda *F. solani* misel gelişimini tamamen engellerken, zencefil (%1.6-3.7), okaliptüs (%1.2-7.4) ve dereotu (%2.9-9.8) uçucu yağlarının biyokontrol etkinlikleri düşük olarak bulunmuştur. Genel olarak değerlendirildiğinde, özellikle karanfil, kekik, tarçın ve çörtlük uçucu yağlarının her iki fitopatogene karşı da yüksek derecede in-vitro antifungal aktivite gösterdikleri ve sentetik fungusit aktif maddelerine alternatif olarak kullanılabilme potansiyaline sahip olabilecekleri sonucuna varılmıştır.

Anahtar kelime: *Fusarium solani*, *Rhizoctonia solani*, Uçucu yağ, Antifungal aktivite, Fitopatojen

Determination of In-Vitro Antifungal Activities of Essential Oils Against Fungal Pathogens

Abstract

This study was carried out to determine the in-vitro antifungal activities of essential oils obtained from thyme (*Thymus vulgaris*), Turkish pickling herb (*Echinophora tenuifolia* subsp. *sibthorpiana*), clove (*Syzygium aromaticum*), cinnamon (*Cinnamomum zeylanicum*), eucalyptus (*Eucalyptus globulus*), dill (*Anethum graveolens*), juniper (*Juniperus communis*), and ginger (*Zingiber officinale*) against *Rhizoctonia solani* and *Fusarium solani* infections. Essential oils were added to autoclaved potato dextrose agar (PDA) medium at 0, 500, 1000 and 2000 ppm doses. Mycelium disks of both fungi with a diameter of 5 mm were transferred to the center of petri dishes and incubated at 24±2 °C for 7 days. By measuring the mycelial development diameters of fungi, the biocontrol efficiencies of essential oils were calculated. Essential oil applications showed significant antifungal activity against *R. solani* infection and cinnamon, thyme and clove essential oils at 1000 ppm, and dill essential oil at 2000 ppm doses completely inhibited mycelial development. The biocontrol efficiencies of juniper (%2.4-12.6), eucalyptus (%2.8-26.6) and ginger (%18.2-37.3) essential oils against *R. solani* were found to be low. While clove and thyme essential oils completely inhibited *F. solani* mycelial development at 2000 ppm dose, the biocontrol efficiencies of ginger (%1.6-3.7), eucalyptus (%1.2-7.4) and dill (%2.9-9.8) essential oils were found to be low. It was concluded that especially clove, thyme, cinnamon and Turkish pickling herb essential oils showed high in-vitro antifungal activity against both phytopathogens and may have the potential to be used as an alternative to synthetic fungicide active substances.

Key words: Antifungal activity, Essential oil, *Fusarium solani*, *Rhizoctonia solani*, Phytopathogen



The Use of Polymerase Chain Reaction in the Detection of Reoccurring Salmonella in Frozen Food Samples from Local Stores in Abeokuta Nigeria

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Abstract

Food-borne salmonellosis has been identified as one of the major causes of gastroenteritis worldwide. The need for more rapid and accurate techniques for the detection of food-borne pathogens has led to the development of novel molecular techniques. Though the conventional culture technique still stands as the golden standard for pathogen detection, it has proved to be laborious and takes 3 to 7 days to get a positive result. Rapid molecular techniques such as polymerase chain reaction (PCR) have been developed to produce more specific, sensitive, and accurate results within a shorter period. This study was performed to detect the presence of *Salmonella* in beef, pork, egg, prawn and chicken samples purchased from retail stores in Abeokuta Nigeria. The presence of *Salmonella* was assayed using the conventional culture technique and PCR with *Salmonella* Enteritidis primers specific to the *sefB* gene. Both culture and PCR were unable to detect *Salmonella* from the food samples. Probable reasons for this were discussed.

Key worss: Food safety, Pathogens, *Salmonella* spp. Cultural methods, Polymerase chain reaction.

Introduction

Food being an essential component of human life, could serve as an important and common source of infection. Different food samples serve as vectors for the acquisition and transmission of infectious diseases caused by several food-borne pathogens. Common food-borne pathogens include; *Escherichia coli*, *Salmonella*, *Campylobacter jejuni*, *Shigella*, *Listeria monocytogenes*, *Vibrio cholera*, *Hepatitis A* *Clostridium botulinum*, *Rotavirus*, *Norovirus*, *Ascaris lumbricoides*, *Toxoplasma gondii* and so on. Most food-borne infections are as a result of microorganisms that infect the living plant or animal or contaminate food or water during handling or processing (Sine, 1995; Todar, 2005). Food-borne infections remain a great concern of public health, as food and water contaminated by sources such as bacteria, toxins, parasites, viruses, plants, animal tissues, moulds, algae and chemicals can easily be encountered when proper sanitary measures are not put in place (Nantel, 1996). When these pathogenic organisms or toxic substances are ingested in food or water, they invade the intestinal mucosa and thereby multiply and invade host cells.

Due to the increased interest and awareness of the severity of food-borne diseases, the demand for monitoring pathogens in food samples in the shortest possible time has increased significantly (Riyaz-ul-Hassan *et al.*, 2004). The traditional culture method used to detect microorganisms from food samples usually involve pre-enrichment, selective enrichment, isolation on selective media and confirmation of the presumptive positive isolates by biochemical and serological tests (Fratamico, 2003; Hong *et al.*, 2003). The importance of enrichment cultivation is to accelerate the entire analytical process. Pre-enrichment could be done using non-selective enrichment broths such as buffered peptone water (BPW), maximum recovery diluent (MRD), nutrient broth (NB) or universal pre-enrichment broth (UPB) (Tsakila *et al.*, 2012). A distinctive feature of these non-selective broths is that they contain peptones as their source of minerals, carbon, nitrogen and vitamins. Although the presence of phosphates and sodium chloride in UPW and BPW also help maintain their buffering capacity and osmotic balance respectively.

These non-selective broths permit the growth of various organisms, which can be a form of setback when trying to isolate a particular organism. This drawback is made up for by the next step which is selective enrichment. Unlike pre-enrichment, selective enrichment is carried out using an enrichment medium that selects for and favours growth of the target organism. Series of enrichment media have been developed and appraised for the selective isolation of various pathogenic microorganisms. Examples include; Bolton broth (Oxoid microbiology products, 2012) for *Campylobacter jejuni*, buffered *Listeria* selective broth (Oxoid microbiological products, 2012) for *Listeria monocytogenes* and rappaport vassiliadis soy broth for the selective isolation of *Salmonella* (Hein *et al.*, 2006; Taskila *et al.*, 2012). After the process of pre-enrichment and selective enrichment, the concluding steps (isolation on selective media and confirmation of the presumptive positive isolates by biochemical and serological tests) are very much specific and often tailored to suit the target microorganisms. With the increase in food-borne infections came an increase in the demand for faster, safer and more efficient means of isolating and identifying infectious pathogens. Over the years there have an improvement from traditional culture techniques to rapid



molecular techniques such as; polymerase chain reaction (PCR), real time PCR, enzyme-linked immunosorbent assay (ELISA), gel electrophoresis, micro-array, restriction fragment length polymorphism (RFLP), macromolecule blotting and probing (Hein *et al.*, 2006; Almeida *et al.*, 2010; Cheung *et al.*, 2012; Taskila *et al.*, 2012). Mark and Warren (2003) illustrate that the impelling force for the development of new diagnostic techniques came from the escalating

Recent studies have focused on the need for more rapid and less laborious means of detecting food pathogens, especially due to the perishable nature of food and food products which are the vectors for food-borne pathogenic microorganisms (Saroj *et al.*, 2008).

These new methods not only have to be rapid but also need to be specific and highly sensitive (Seo *et al.*, 2003; Malorny *et al.*, 2007; Saroj *et al.*, 2008; McGuinness *et al.*, 2009). As far as molecular biology technology is concerned, the study of rapid molecular diagnostic techniques is an important aspect of molecular medicine (Riyaz-Ul-Hassan *et al.*, 2004), with several researches concentrating on how to perfect existing techniques and also the discovery of novel ones (Hassanein *et al.*, 2011). However the increasing interest in the reproducibility and accuracy of molecular techniques such as PCR has heightened the need for more research to be carried out under different conditions and varying protocols. PCR has appeared more prominent and widely studied due to its combination of simplicity accompanied by accuracy, specificity, and sensitivity. Different research are being carried out, focusing on the specific and most conducive experimental conditions suitable for various food pathogens concerning the food samples and the inhibitory effect of components present in different food types (Hassanein *et al.*, 2011; Saroj *et al.*, 2008;). As PCR is one of the most prominent molecular techniques, some food-borne pathogens have a higher prevalence than other pathogens. *Salmonella* is one of the most frequent causes of food-borne gastrointestinal infection worldwide that can be transmitted either between humans or from animals to humans (Agarwal *et al.*, 2002; Wang *et al.*, 2009; Kusar *et al.*, 2010; Hassanein *et al.*, 2011). In light of this, the purpose of this investigation is to identify the presence of *Salmonella* in various food samples using both traditional culture method and PCR. It would be carried out with the aim of analysing how recent developments in the field of molecular biology have led to more reliable identification and surveillance of *Salmonella* in food.

Materials And Method

Food samples

The following food samples were used for the isolation of *Salmonella*: frozen chicken, unpasteurized milk, cheese produced from unpasteurized milk, pork, egg and beef. Food samples were purchased from various local stores in Abeokuta Nigeria.

Isolation and identification of *Salmonella* using the conventional culture technique

This procedure was carried out using the standard culture procedure of pre-enrichment, selective enrichment, selective plating on solid media and biochemical analysis of presumptive colonies (Fratamico, 2003; Hong *et al.*, 2003).

Pre-enrichment

The samples used in this present study have been listed above in section 3.2. These food samples were all purchased within their period of expiry, in appropriate holding conditions and processed on the day of purchase. The different food types were tested for the presence of *Salmonella* spp. by enrichment of 10 g or 10 ml (in the case of egg and milk) in 90 ml of Maximum Recovery Diluent (MRD; Oxoid, UK). Each 10 g or 10 ml of the samples were removed aseptically and added to different 100 ml volume flasks containing 90 ml of MRD and were incubated at 37°C for 22 hours.

Selective enrichment

The secondary enrichment which was aimed at favouring the growth of *Salmonella* over all other food pathogens that might be present was carried out by adding 0.1 ml of the previously incubated MRD enrichment to 10 ml of Rappaport Vassiliadis enrichment broth (RV; Oxoid, UK) in glass universal bottles. The bottles were incubated at 42°C for 24 hours.

Detection and isolation of *Salmonella* spp. on selective media

Serial dilution

Before plating on selective media, a 10-fold serial dilution was carried out on the incubated RV enrichment. Each sample bottle containing the incubated RV medium (the stock) was provided with 6 tubes (labeled 1 to 6), containing 9 ml of MRD each. 1 ml of the stock culture was added to tube 1, thereby producing 10 ml of the dilute solution. This process was repeated in succession for the remaining tubes with 1ml of the previous dilution added to the next tube. Each step results in a further 10-fold change in the bacterial concentration from the previous



concentration. Serial dilution was carried out to help reduce the bacterial colonies that would grow on the agar plate and thereby facilitate the counting process.

Selective plating

Dilutions of RV broth ranging between 10^{-3} to 10^{-6} were streaked onto Xylose Lysine Deoxycholate (XLD) agar plates with the use of a sterile inoculating loop. The plates were incubated at 37°C for 24 hours. A pure culture of *S. Typhimurium* was used as the positive control. Due to the presence of very few colonies, another set of experiments was carried out without performing serial dilution. The RV broth was directly inoculated on the solid agar. Observed colonies were further analysed by gram stain and the applicable biochemical tests.

Gram stain

Gram stain was carried out on the bacterial isolates from the agar plates so as to differentiate these organisms into gram negative or gram positive on the basis of their chemical and physical cell wall property. A loop full of distilled water was placed on a clean microscope slide. Part of a colony was picked up using a sterile loop and homogenised in the distilled water on the slide, to create a smear.

The smear was then heat fixed by passing the slide over the Bunsen flame for 10 to 15 minutes. After heat fixing, the slides were placed on a rack and crystal violet was poured over the slides and left there for 60 seconds. The slides were washed with water and then flooded with iodine for 30 seconds. Iodine serves as a mordant which binds crystal violet and is therefore retained by gram positive bacteria. The slide was then washed again with water and flooded with ethanol which serves as a decolouriser, thereby removing crystal violet from gram negative cells. Safranin which serves as a counter stain was then applied to the slides and left there for 30 seconds. The slides were carefully blotted dry and observed under 100 x oil immersion lenses. Gram positive bacteria retain crystal violet and appear purple while gram negative bacteria retain safranin in their cell wall and appear pink when viewed under the microscope.

Biochemical analysis

Catalase test

A small portion of the test organism was put on a clean glass slide to which 1 to 2 drops of 3% hydrogen peroxide was added. The rapid appearance of continual gas bubbles indicates a positive result, while the absence of bubbles indicates a negative result. The production of bubbles is as a result of an enzyme which converts hydrogen peroxide to oxygen and water.

Molecular identification of Salmonella by PCR

DNA extraction

DNeasy® blood and tissue kit (Qiagen)

Pre-enrichment and selective enrichment was carried out as described in section 3.3 on fresh samples to be used for PCR. 5 ml of RV was centrifuged at 5000 x g for 10 minutes at 4°C. DNA extraction was performed on the cell pellet using the DNeasy® Blood and Tissue Kit (Qiagen) following the manufacturer's instruction.

Phenol chloroform extraction

An alternative DNA extraction technique using phenol-chloroform was performed (Oliveira *et al.*, 2002). 5 ml of RV was placed in the microcentrifuge (Biofuge 13) at 3300 rpm for 5 mins. The supernatant was discarded and the pellets were re-suspended in 200 µL of lysis buffer and 20 µL of proteinase K. The mixture was incubated at 100°C for 10 minutes, after which 150 µL of 3.0 M of sodium acetate was added and kept at -20°C for 10 minutes. The resulting mixture was centrifuged at maximum speed for 10 minutes. The pellets were discarded and 680 µL of phenol-chloroform-isoamyl alcohol (25:24:1) (Sigma) was added to the supernatant. The Eppendorf tubes were mixed gently by inverting the tubes and this resulted in the development two phases; the lower organic phase and upper aqueous phase. This was centrifuged at 3300 rpm to further separate the solution into phases. The top phase containing the DNA was carefully removed into new tubes using 1000 µL pipette. 680 µL of chloroform/isoamyl alcohol (24:1) (Sigma) was added to it and mixed gently for 2 minutes. The mixture was centrifuged for 5 minutes at maximum speed (the chloroform would further separate the DNA to the top phase). The top phase containing the DNA was carefully removed using a 1000 µL pipette and transferred to a new tube. The DNA was precipitated by adding 360 µL of isopropanol and allowed to stand at room temperature for 10 minutes. The mixture was centrifuged for 10 minutes at 3300 rpm to pellet the DNA. The supernatant was discarded and the DNA pellets were washed with 70% ethanol. Mixing of the tube content was avoided and it was centrifuged at 3300 rpm for 10 minutes. The supernatant was discarded and the pellets were allowed to air dry. On drying completely, the pellets were re-suspended in 20-50 µL of ultrapure water or TE buffer. This final mixture was stored in the freezer and to be used as a template for PCR.

Spectrophotometry readings using Nano-Drop

The Nano-Drop 1000 (Thermo scientific) machine was used to measure the amount and the purity of the DNA present in the purified DNA extract. Using sterile tips, 2 µL of distilled water was dispensed on the reading platform to blank the Nano-Drop. The Nano-Drop was then wiped clean and 2 µL aliquot of the purified DNA



extract for each sample was dispensed on the reading surface and the sampling arm was closed to initiate spectral measurement with the aid of the operating software on the PC. Each concentration was recorded.

Agarose gel electrophoresis

After nucleic acid quantification, agarose gel electrophoresis was performed on the chromosomal DNA extracted from the RV broth, so as to determine the presence as well as the size of the DNA. Using sterile pipette tips, 1 µL of the loading dye (6X) was added to 6 µL of the ladder (GeneRuler™, 100bp) and each sample which was then dispensed into different wells. The order in which the samples were loaded into the wells was recorded. The gel tank was closed by placing the lid in such a way that the wells are at the negative electrode. Since DNA is negatively charged, it runs from the negative electrode to the positive. The electrodes were connected to the power supply which was set to run at constantly 70 volts.

Primers and PCR conditions

The PCR mixture for the amplification of the *sefB* gene of *Salmonella enteric* serovar Enteritidis contained the 20nt (nucleotide) of forward and backward primers (Eurofins, UK). The primers; SefBF (5'-AGATTGGGCACTACACGT-3') and SefBR (5'-TGTAATCCACCAGGTAATTG-3') where expected to produce a DNA fragment of 535 bp (Wang *et al.*, 2009). The reaction mixture consisted of 5µL of the template DNA, 1 unit (0.2µL) of Taq polymerase (Sigma-Aldrich) 5µL of 10mM dNTP mix (Invitrogen) which already contains dATP, dCTP, dGTP, and dTTP in water (pH 7.5) each at a concentration of 10mM, 10µL of 5x reaction buffer and 1ml of each primer (1µM) in a final volume of 50µL. *S. Typhimurium* served as the template DNA for the positive control, while the negative control was void of any template. Amplification reactions were performed in a thermal cycler (BIO RAD) with the following thermal cycling protocol; DNA was denatured at 94°C for 2 minutes and amplified for 35 cycles at 94°C for 2 minutes, 60°C for 50 seconds and 72°C for 50 seconds. The final extension incubation was at 72°C for 2 minutes. The PCR product was loaded on a 0.7% agarose gel and electrophoresis was carried out in 1 x TAE buffer at 70 volts. The gel was visualised in a UV box (Syngene) with the aid of the operating software on the PC.

Results

Table 1, details the observed outcome for the plating of Rappaport Vassiliadis enrichment broth on solid media as well as gram stain.

Table 1. Result for plating on solid agar, gram stain and catalase test of the observed colonies.

Sample	Media	Colony morphology	Colony number	Gram stain	Catalase test
Yoke	XLD	Large, raised, golden yellow colonies	8	Gram negative short rods	Positive
	MacConkey	Large, raised, pink colonies	3	Gram negative rods	
Beef	XLD	large, distinct, flat yellow colonies	55	Gram negative rods	Positive
	MacConkey	Large deep pink colony	1	Gram negative rod	
Prawn	XLD	Small red colony	1	Gram positive diplococci	Positive
	MacConkey	Red, minute colonies	30	Gram positive diplococci in clusters	
Pork	XLD	Small, distinct cream colonies	39	Gram negative rods	Positive
	MacConkey	Flat, distinct pink colonies	33	Gram negative short rods (coccobacilli)	
Milk	XLD	—	—	—	—
	MacConkey	—	—	—	—
Cheese	XLD	—	—	—	—
	MacConkey	—	—	—	—
Albumen	XLD	—	—	—	—
Albumen	MacConkey	—	—	—	—

DNA extraction and nucleic acid quantification

Table 2 shows the results obtained from both DNA extraction methods indicating that a higher concentration of nucleic acid was derived using the phenol-chloroform extraction.



Table 2. Comparison of the nucleic acid concentrations of DNA extracted from food samples using DNeasy® Blood and Tissue Kit (Qiagen) and phenol-chloroform extraction method

Samples	Nucleic acid concentration (ng/ul)	
	DNeasy kit	Phenol-chloroform extraction
<i>S. Typhimurium</i> (Positive Control)	31.1	5332.8
Egg	6.5	23.4
Beef	5.6	131.2
Prawn	15.6	—
Pork	8.8	476.9
Milk	4.8	—
Cheese	4.7	22.0

Specificity testing of the *sefB*-specific PCR assay

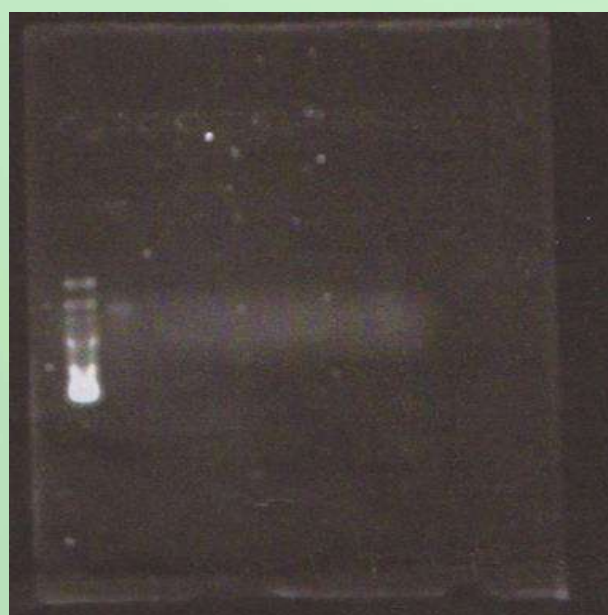


Figure 1. Gel electrophoresis of PCR product for the detection of *Salmonella* in food samples. No visible bands were seen for the positive control and all samples (beef, pork, cheese, milk, egg and prawn). The first well contains the 100bp ladder.

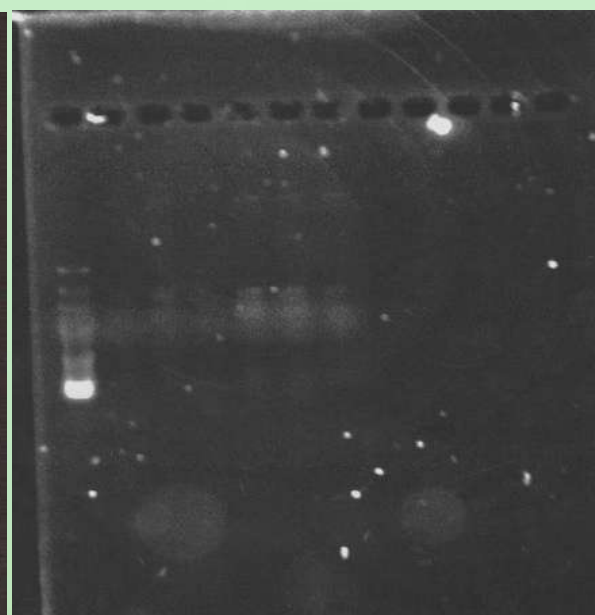


Figure 2. Gel electrophoresis of the rerun PCR assay for the detection of *Salmonella* in the same food samples. No specific bands were seen for the positive control and all the food samples. Well 1 contains the gene ladder.



Figure 3. Gel electrophoresis of the PCR assay carried out at 50°C annealing temperature. No visible bands were seen for the positive control and all samples. Well 1 contains the gene ladder.



Discussion

Conventional culture methods are identified as the basic and standard method of detecting pathogens such as *Salmonella* in food samples. Whyte *et al.* (2002), Hein *et al.* (2006), Wang *et al.* (2009) and Cheung *et al.* (2012) in their studies have shown that it would take 4 to 7 days to isolate and confirm the presence of these pathogens in food via standard culture methods. The purpose of this investigation was to carry out a comparative study which would further confirm the increased level of specificity and sensitivity associated with rapid molecular techniques such as PCR over the conventional culture methods. The enrichment protocol used involved the cultivation of *Salmonella* in MRD to facilitate the recovery of injured cells and then selective enrichment cultivation in RV broth. Studies have shown that a higher amount of *Salmonella* is recovered from food samples when RV enrichment is used (Fratamico, 2003). A loop full of the RV enrichment was inoculated on XLD agar. XLD agar relies on the production of hydrogen sulfide, xylose fermentation, and lysine decarboxylation for the differentiation of *Salmonella* from non-pathogenic bacteria. Typical colonies of *Salmonella* appear red with or without black centers, while atypical colonies are yellow with or without black centers. In this research, *Salmonella* was not detected using the conventional culture method.

The viable bacteria cell count per g or ml of yoke, beef, prawn and pork on XLD agar was calculated to be approximately 8×10^1 , 5.5×10^2 , 1×10^1 and 3.9×10^2 cfu respectively. The bacterial cells isolated from beef, yoke and prawn were all gram-negative rods and catalase-positive and are indicative of organisms such as *E. coli*, *Citrobacter*, *Klebsiella* and *Proteus* (www.oxid.com). Gram-positive cocci and weakly catalase-positive bacterial cells were isolated from prawn samples which is indicative of *Enterococcus* spp. Apart from the possibility of *Salmonella* not being present in the food samples due to adequate and effective surveillance measures that have been implemented, several obstacles might have resulted in the inability to detect *Salmonella*. The enrichment cultivation step can fail to produce the desired impact, which is to favour growth of *Salmonella*. This might be as a result of antibacterial components present in the food sample which can lead to the establishment of non-culturable but viable cells of the target organism (Taskila *et al.*, 2012).

As shown by Tatsadjieu *et al.* (2009) certain bacteriocins of lactic acid bacteria also inhibit the growth of *Salmonella*. Muniesa, *et al.* (2005) indicated in their research 'The effect of bacteriophages on the outcome of *Salmonella* and *Shigella* enrichment culture', that the presence of bacteriophages in food samples produces a significant reduction in *Salmonella*. Though MacCann *et al.* (2005) showed that the inhibitory effect of food components which are capable of producing a false negative result also depends on the enrichment broth and the food sample. It has been identified that, though the enrichment cultivation of *Salmonella* is carried in two steps; pre-enrichment and selective enrichment, there is a possibility that the background microbiota could outgrow the target microorganism during the pre-enrichment stage. For example, the growth of enteric bacteria could be inhibited by the presence of lactic acid bacteria (Vold, *et al.*, 2000). Sveunm and Harman (1997) established the use of a selective supplement in the non-selective culture medium that would favour the growth of *Salmonella*. This was achieved by the gradual release of iodine and selenite into the non-selective medium via a wax-coated gelatine capsule. Jensen *et al.* (2003) in a related study also showed that overgrowth of the background microbiota could be reduced by the addition of antibiotics such as novobiocin and malachite green to the non-selective enrichment cultivation. Though is of contrasting opinion that the addition of antibiotics at the early stage of cultivation especially in the presence of sub-lethally injured *Salmonella* cells could be a source of stress and risk the recovery of such cells (Taskila *et al.*, 2012). Chen *et al.* (2010) also showed that *Salmonella* can be detected directly, after cultivation in non-selective media with the use of certain detection techniques.

The result of the PCR performed in this research was not conclusive enough to carry out a comparative study, as there were no visible amplicons for the reaction. This would have been interpreted as culture being more effective than PCR, but several studies have been carried out that validate the increased specificity, sensitivity, and accuracy of PCR over culture. Table 5.1, shows a compilation of the results from comparative studies that validate the accuracy of PCR over culture for the detection and identification of *Salmonella* in food samples such as poultry, egg, milk, beef, pork, and their products. However, in the study carried out by Whyte *et al.* (2002), PCR was unable to identify *Salmonella* in 7(22%) samples from which the pathogen was isolated via culture. This resulted in the opinion that a combination of both methods would provide more accurate assessment of the prevalence of food-borne pathogens.

The positive control also did not have any visible bands because the primers used were not complementary to any gene sequence present in *S. Typhimurium*. The non-specificity of the primer sequence to the positive control was identified by carrying out a blast similarity search on the NCBI internet site (<http://blast.ncbi.nlm.nih.gov/Blast>). Several factors were put into consideration to identify why the PCR assay failed to work. This could have been as a result of the following: error in set up, wrong annealing temperature, inadequate template, primer dimmers, error in cycling, error in gel analysis, DNA not clean or contains inhibitors or Secondary structure in template (McPherson *et al.*, 1995). To combat the fore mentioned probable causes of error, the annealing temperature was lowered from 60°C to 50°C, all reagents were checked to identify if they were properly added, if the gel was loaded properly and if the program on the thermal cycler was correct. Conventional PCR methods have also advanced with the development of real-time PCR, multiplex PCR and so on, which are more effective in the detection of



Salmonella. Real-time PCR, also known as quantitative real-time not just allows more rapid detection but also quantification of the PCR product. Conventional PCR methods require post-amplification manipulations such as gel-electrophoresis or heterogeneous hybridisation which sometimes results in a false positive result due to contamination (Taskila *et al.*, 2012). In contrast, real-time PCR is carried out in a closed assay format where by amplification is monitored by an increase in fluorescence at every reaction cycle.

It requires no post-PCR modification and therefore reduces technical complexity, the risk of deriving a false positive result and increased robustness (Taskila *et al.*, 2012; Hein *et al.*, 2006). The two most popular fluorescence reporter systems used in real-time PCR are, the DNA binding dye technology and the 5' nuclease assay which use intercalating SYBR® Green and TaqMan® (<http://www.premierbiosoft.com>) respectively as probes for the detection and quantification of *Salmonella* (Cheung *et al.*, 2012; Taskila *et al.*, 2012; Hein *et al.*, 2006). Other systems such as the molecular beacon-based PCR assay and Scorpion probes (<http://www.sigmaaldrich.com>) are also in use (Cheung *et al.*, 2012; Taskila *et al.*, 2012).

Reference

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ID: 439

Bacterial and Fungal Contamination of Commercially Prepared Fresh-Cut Fruits in Wudil, Nigeria and Implications for Consumer Health

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Abstract

The regular consumption of fruits and vegetables is crucial for health. In Nigeria, there's a growing trend of purchasing fresh-cut, washed, and packaged fruits for consumption. This study evaluated the microbial quality of such fruits sold in Wudil, Nigeria. A total of forty-five (45) samples of different fruits (Pawpaw (*Carica papaya*), coconut (*cocos nucifera* L.), Watermelon (*Citrullus lanatus*), Pineapple (*Ananas comosus*) and sugarcane (*Saccharum Officinarum*) were collected from vendors from different parts of Wudil town. Furthermore, swabs of the vendors' hands and samples of the water used for washing the fruits were collected for bacteriological analysis. The bacterial and fungal counts of the fruit samples were obtained and *Escherichia coli* and *Staphylococcus aureus* were isolated from the fruits, hand swab and water samples using standard methods. The bacterial and fungal counts of the coconut samples (3.55×10^5 and 6.36×10^5 cfu/g) were significantly higher than those of all other fruits ($P \leq 0.05$). Alarmingly, *E. coli* and *Staphylococcus aureus* were identified from all the fruit samples. Similarly, they were also isolated from almost all the vendors' hand swabs and water samples. About 66.7 % of the vendors utilised water from boreholes, while the others used pipe borne and well water for washing their fruits. These results highlight the safety issues associated with consuming these fresh-cut fruits, and show that they could be a health hazards to consumers. It is recommended that the vendors be educated on the need for proper hygiene and handling of the fruits.

Keywords: Fruits, Bacteria, Fungi, Wudil, Nigeria



Production of Black Onion: Health Effects and Benefits

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Abstract

Onion (*Allium cepa* L.) is a key component of the Mediterranean diet and is widely used globally. Originating from Central Asia, this plant has been recognized throughout history for its medicinal properties. Particularly, members of the *Allium* genus contain biofunctional compounds that are effective in preventing various types of cancer. Recently, the food industry has developed black onion, a product obtained by processing onions from the *Allium* genus under controlled temperature and humidity conditions. This maturation process reduces the pungency and bitterness of fresh onions, resulting in a sweet and pleasant flavor. Black onion is commonly used in gourmet cuisine and has a longer shelf life compared to fresh onions. Although research on black onion is limited, some in vitro studies suggest that it may possess anticancer and anti-inflammatory properties. Additionally, studies on the bioaccessibility of polyphenols and organosulfur compounds in both black onion and fresh onion indicate that black onion may offer potential benefits in managing diabetes and related diseases. While further research is needed to fully understand the nutritional and phytochemical composition of black onion, existing evidence suggests that this product may have positive health effects.

Key Words: Onion (*Allium cepa* L.), Black onion, Health benefits, Phytochemical composition

Siyah Soğanın Üretimi: Sağlık Üzerine Etkileri ve Faydaları

Özet

Soğan (*Allium cepa* L.), dünya genelinde yaygın olarak kullanılan ve Akdeniz diyetinin temel bileşenlerinden biridir. Orta Asya kökenli bu bitki, tarih boyunca birçok tıbbi özelliğiyle dikkat çekmiştir. Özellikle *Allium* cinsinin üyeleri, çeşitli kanser türlerinin önlenmesinde etkili biyofonksiyonel bileşikler içermektedir. Son yıllarda, gıda endüstrisi tarafından geliştirilen siyah soğan, dünya genelinde yaygın olarak tüketilen *Allium* cinsine ait soğanın, kontrollü sıcaklık ve nem koşulları altında işlenmesiyle elde edilen bir gıda ürünüdür. Bu olgunlaştırma süreci, taze soğanın keskinliğini ve acılığını azaltarak tatlı ve hoş bir tat geliştirir. Siyah soğan, gurme mutfağında yaygın olarak kullanılır ve raf ömrü taze soğana kıyasla daha uzundur. Siyah soğan üzerine yapılan çalışmalar sınırlı olsa da, bazı in vitro araştırmalar, siyah soğanın antikanser ve antiinflamatuvar aktivitelere sahip olabileceğini göstermektedir. Ayrıca, siyah soğan ve taze soğandaki polifenoller ve organosülfür bileşiklerinin biyoerişilebilirliği üzerine yapılan çalışmalar, siyah soğanın diyabet ve ilişkili hastalıkların tedavisinde potansiyel faydalar sunabileceğini ortaya koymaktadır. Siyah soğanın besinsel ve fitokimyasal bileşimi hakkında daha fazla araştırma yapılması gerekmektedir, ancak mevcut veriler, bu ürünün sağlık üzerinde olumlu etkiler gösterebileceğini düşündürmektedir.

Anahtar Kelimeler: Soğan (*Allium cepa* L.), Black onion, Sağlık faydaları, Fitokimyasal bileşimi



ID: 441

Determination of *Prunus necrotic ringspot virus* (PNRSV) and *Apple mosaic virus* (ApMV) Infections on Rose Plants (*Rosa* spp.) in Konya Province

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Abstract

Roses, which are known for their different colours and fragrances, have found a wide place in both aesthetic landscaping and industrial uses and have both economic and cultural value for our country. *Prunus necrotic ringspot virus* (PNRSV) and *Apple mosaic virus* (ApMV) are important plant viruses that cause significant infections in rose (*Rosa* spp.) plants and can negatively affect plant growth, flower quality and general health. No previous study has been conducted to detect virus diseases in rose growing areas of Konya province. Within the scope of this study, leaf, branch and flower samples were collected from 94 rose plants of different varieties showing symptoms similar to the symptoms of virus diseases such as mosaic, deformations, chlorotic patterns, chlorotic ring spots on leaves, color breaks and deformations on flowers from various rose growing areas in Konya province in 2023. Rose plant samples collected from parks and gardens were tested using the DAS ELISA method, a serological diagnostic method. It was determined that PNRSV was present in 12.76%, ApMV in 11.70% and PNRSV + ApMV mixed infection in 2.12% of the tested rose plant samples. The total infection rate in the province was determined as 24.46%. It is thought that the results obtained from this study will contribute to the literature on rose virus diseases and will be an important source of information for rose producers, agricultural engineers and plant pathologists in the region. In addition, in the control of these two virus diseases in roses, the issues that producers should pay attention to such as vector insect control to control the spread of viruses and the plant material used for vegetative propagation should be free of viruses were emphasized.

Key Words: ApMV, DAS-ELISA, Konya, PNRSV, Rose

Konya İlinde Gül (*Rosa* spp.) Bitkisinde Enfeksiyon Oluşturan Erik Nekrotik Halkalı Leke Virüsü (PNRSV) ve Elma Mozaik Virüsü (ApMV)'nün Varlıklarının Belirlenmesi

Özet

Farklı renklerde ve güzel kokularıyla tanınan güller hem estetik peyzaj düzenlemelerinde hem de endüstriyel kullanımlarda geniş bir yer bulmuştur ve ülkemiz için hem ekonomik hem de kültürel bir değer taşımaktadır. Gül (*Rosa* spp.) bitkilerinde Erik Nekrotik Halkalı Leke Virüsü (*Prunus necrotic ringspot virus*, PNRSV) ve Elma Mozaik Virüsü (*Apple mosaic virus*, ApMV) önemli enfeksiyonlara neden olan ve bitkinin büyümesini, çiçek kalitesini ve genel sağlığını olumsuz etkileyebilen önemli bitki virüslerindendir. Konya ili gül yetiştirme alanlarında virüs hastalıklarını tespit etmeye yönelik daha önce bir çalışma yapılmamıştır. Bu çalışma kapsamında, 2023 yılında Konya ilindeki çeşitli gül yetiştirme alanlarından; yapraklarında, mozaik, deformasyonlar, klorotik desenler, klorotik halkalı lekeler, çiçeklerinde ise renk kırılmaları ve deformasyonlar gibi virüs hastalıkları belirtilerine benzer belirtileri gösteren farklı çeşitlerdeki 94 adet gül bitkisinden yaprak, dal ve çiçek örnekleri toplanmıştır. Park ve bahçelerden toplanan gül bitki örnekleri, serolojik bir teşhis yöntemi olan DAS ELISA yöntemi kullanılarak testlenmiştir. Testlenen gül bitkisi örneklerinde PNRSV'nin %12,76; ApMV'nin %11,70; PNRSV + ApMV karışık enfeksiyonunun ise %2,12 oranında varlık gösterdiği belirlenmiştir. İldeki toplam enfeksiyon oranı ise %24,46 olarak tespit edilmiştir. Bu sonuçlar, bölgedeki gül üreticileri ve bitki sağlığı uzmanları için önemli bir bilgi kaynağı olmaktadır ve bu konuda literatüre katkı sağlanmıştır. Ayrıca virüslerin yayılımını kontrol altına almak ve enfeksiyonları minimize etmek için çeşitli stratejilerin geliştirilmesine olanak tanımaktadır.

Anahtar Kelimeler: ApMV, DAS-ELISA, Gül, Konya, PNRSV



ID: 442

Investigation of the Bioactive Compounds of Wild Grown Prickly Pear (*Opuntia Ficus-Indica* L.) Fruits and Peels in the İskenderun Region

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Abstract

Due to global warming, there is an increasing interest in plant-based foods that have low water requirements and contain valuable compounds. The aim of this study is to determine the total phenolic and flavonoid content of prickly pear (*Opuntia Ficus-Indica* L.) fruits (M) and peels (K), which are recognized as promising sources among healthy foods, and to evaluate their antioxidant activity. For this purpose, samples were first extracted with methanol. The total phenolic content was determined using the Folin-Ciocalteu method, while flavonoids were assessed using the aluminum nitrate method. The phenolic content in the extracts was found to be 835.66 ± 21.12 mg GAE/100 g for K and 760.66 ± 17.61 mg GAE/100 g for M. The total flavonoid content was calculated as 222.00 ± 4.35 µg KE/g for K and 204.76 ± 0.87 µg KE/g for M. Antioxidant activity was evaluated using two different methods: free radical scavenging activity (DPPH) and copper (II) reduction capacity (CUPRAC). The IC₅₀ values of the fruit and peel extracts were calculated, showing that K had the closest value to the standard BHT (butylated hydroxytoluene). The reducing capacities were determined to be 28.67 ± 1.14 µg TE/mL for M and 59.26 ± 1.58 µg TE/mL for K. In conclusion, prickly pear fruits and peels possess significant amounts of phenolic and flavonoid compounds, as well as high antioxidant activity. The higher content of bioactive compounds in the peels positively influences antioxidant activity, particularly showing a greater reduction capacity in the peel extract. Further studies on prickly pear, which is among the tropical fruits used in folk medicine, are necessary. Increasing the recognition of the fruit may contribute to a rise in demand and production. Additionally, it can be considered as an alternative in health-promoting food production.

Key Words: Antioxidant, Phenol, Flavonoid, Prickly Pear, *Opuntia Ficus-Indica* L.

İskenderun Bölgesinde Kendiliğinden Yetişen Dikenli İncir (*Opuntia Ficus-İndica* L.) Meyve ve Kabuklarının Biyoaktif Bileşenlerinin Araştırılması

Özet

Küresel ısınma nedeniyle su gereksiniminin düşük ve yapısında değerli bileşenlerin bulunduğu bitkisel gıdalara olan ilgi giderek artmaktadır. Bu çalışmanın amacı kendiliğinden yetişen ve sağlıklı gıdalar arasında umut verici kaynak olarak gösterilen dikenli incir (*Opuntia Ficus-İndica* L.) meyve (M) ve kabuklarının (K) toplam fenolik ve flavonoid madde miktarlarını belirlemek ve antioksidan aktivitesini değerlendirmektir. Bu amaçla öncelikle numuneler metanol ile ekstrakte edildi. Toplam fenolik madde miktarları Folin-Ciocalteu yöntemiyle, flavonoidler ise Alüminyum nitrat yöntemi ile belirlendi. Ekstraktardaki fenolik miktarlarının sırasıyla K’da 835.66 ± 21.12 mg GAE/100 g, M ise 760.66 ± 17.61 mg GAE/100 g olduğu tespit edildi. Toplam flavonoid madde miktarlarının ise K’da 222.00 ± 4.35 µg KE/g ve M’de ise 204.76 ± 0.87 µg KE/g olduğu hesaplandı. Antioksidan aktivite, serbest radikal giderme aktivitesi (DPPH) ve Bakır (II) indirgeme kapasitesi (CUPRAC) olmak üzere iki farklı yöntem kullanılarak değerlendirildi. Meyve ve kabuk ekstraktlarının IC₅₀ değerleri hesaplandı ve standart BHT (Bütıl hidroksi toluen) ile karşılaştırıldığında en yakın değerin K’da olduğu görüldü. İndirgeme kapasitesiteleri ise M’de 28.67 ± 1.14 µg TE/mL ekstrakt ve K’da 59.26 ± 1.58 µg TE/mL ekstrakt olarak hesaplandı.

Sonuç olarak dikenli incir meyve ve kabuklarının önemli ölçüde fenolik ve flavonoid madde miktarına ve yüksek antioksidan aktivitesine sahip olduğu belirlendi. Kabuklardaki biyoaktif bileşen miktarının meyve kısmından fazla olmasının antioksidan aktiviteyi de olumlu etkilediği ve kabuk ekstraktının özellikle indirgeme kapasitesinin daha yüksek olduğu görüldü. Özellikle halk hekimliğinde kullanılan tropikal meyveler arasında yer alan dikenli incir ile ilgili yapılacak yeni çalışmalara ihtiyaç vardır. Meyvenin tanınırlığının artması buna bağlı olarak talebin ve üretimin artmasına katkı sağlayabilir. Ayrıca sağlık geliştirici gıda üretiminde alternatif olarak değerlendirilebilir.

Anahtar Kelimeler: Antioksidan, Fenol, Flavonoid, Dikenli incir, *Opuntia Ficus-İndica* L.



In vivo potent hepatoprotective effects of *F. indica* and *S. aromaticum* against hepatotoxicity induced by Mercuric chloride

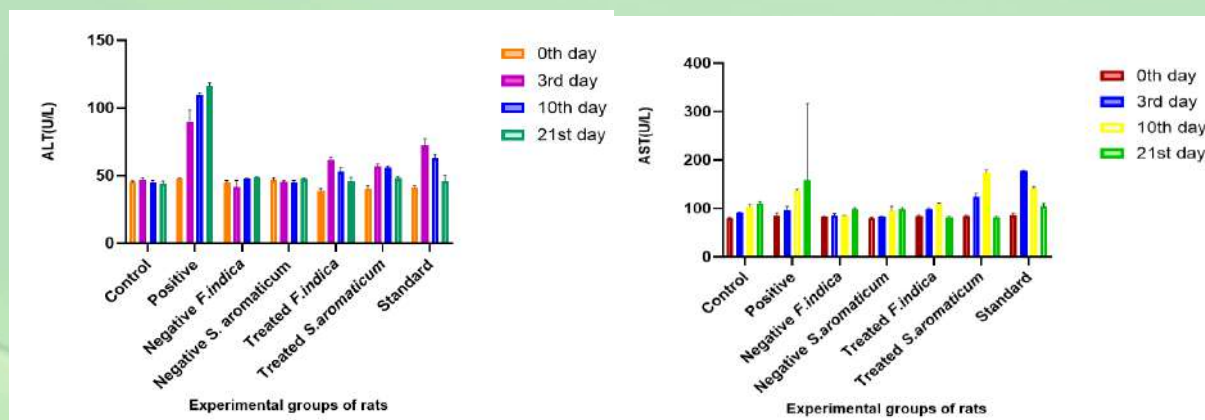
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Abstract

Human's largest body organ is liver which performs significant function including detoxification, synthesis of protein and metabolic function. Hepatotoxicity has become one of the major health issue worldwide and increases rapidly due to infectious and non-infectious agents. Mercuric Chloride is non-infectious agent that causes hepatotoxicity when taken in high dose by elevating liver enzymes and disrupting its functions. Green medicine have been used to cure various diseases from the ancient times. So, the aims of this research was to examine the hepatoprotective potential of medicinal plants *F.indica* and *S. aromaticum*. Methanolic extracts of both plants were prepared and analyzed through antioxidant activities initially and then *in vivo* hepatoprotective analysis was conducted on experimental rats. *In vitro* results indicated that both plants have antioxidant potential but among of them *F.indica* showed high TFC, TPC and % inhibition of DPPH as compared to *S.aromaticum*. Moreover, the hepatoprotective effects of these plants against mercuric chloride were measured and compared to standard drug Allopurinol. Blood serum samples were collected and analyzed for hepatoprotective potential in which LFT's were examined. Both plants showed hepatoprotective properties by recovering increased levels of liver enzymes. It was revealed from histopathological results that both plants have potency to recover vacuolization and necrosis of hepatic cells which was occurred due to mercuric chloride in comparison with allopurinol. This study lays the door for future therapeutic applications addressing oxidative stress-related diseases, representing a significant step forward in the intersection of herbal medicine and healthcare innovation.

Key Words: Hepatoprotective, Oxidative stress, Liver function test, Mercuric chloride



Osteoanabolic Effects of Carrot (*Daucus carota*) Roots on Ovariectomy-Induced Osteoporotic Rats

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Abstract

Estrogen depletion leads to bone loss (osteoporosis) mostly seen in postmenopausal women and ovariectomized rats. Osteoporosis is a silent disease with high mortality among elderly people. Several therapeutic treatments employed to correct/manage this disease were found to have specific adverse effect. The present study evaluated the effect of Carrot roots (CRT) on some bone remodeling biomarkers and anthropometrics parameters in ovariectomized (OVX) rats. Twenty-four (24) female Wistar rats weighing between 115 to 120 g, were Ovariectomized and six (6) were sham operated, the rats were divided into five groups, six rats per group: group one (sham control), group two (OVX untreated control), group three (OVX + 200 mg/kg body weight (b.w) CRT), group four (OVX + 400 mg/kg b.w CRT) and group five (OVX + 5 mg/kg b.w Alendronate) and treated daily for six weeks. The result elucidated that, oral administration of 200 and 400 mg/kg CRT for 6 weeks significantly ($P<0.05$) reduced over expression of remodeling biomarkers (Osteocalcine, Bone Alkaline Phosphate and RANKL), endometrial atrophy of the uterine histology, and elevated the serum estradiol level of the OVX rats ($P<0.05$) compared to OVX untreated rats. Moreover, oral administration of CRT for 6 weeks significantly reduced the loss of femur dry weight and femoral thickness of OVX rats. Hence this results suggested bone health benefit of carrot roots.

Keywords: Carrot root, Osteoporosis, Ovariectomized rats, Bone Biomarkers, Osteoanabolic effect.

Introduction

Bone is a dynamic and metabolically active tissue, it continually undergoes remodeling process mediated by the coordinated activities of bone resorbing cells (osteoclasts) and bone forming cells (osteoblasts). Imbalance between bone formation and resorption ultimately results in bone degeneration and a greater susceptibility to fractures (Song, *et al.*, 2017). Estrogen plays a crucial role in the preservation of bone homeostasis (Cauley, 2015). Its deficiency increases the life of osteoclasts, the cells that degrade bone tissue; it also decreases the longevity of osteoblasts, which function to build bone tissue (Lane, 2006). Post-menopausal women and estrogen-deficient ovariectomized (OVX) rats are more predisposed to developing osteoporotic fractures as a consequence of accelerated bone turnover from increased number and activity of osteoclasts (Li, *et al.*, 2019).

Estrogen replacement therapy (ERT) was the first line of action however, it comes with risks such as breast, ovarian, and endometrial cancers and therefore exceed its benefits in older women (Lee, *et al.*, 2011; Skjodt, *et al.*, 2019). The current antiresorptive therapies comprise the usage of selective estrogen receptor modulators, bisphosphonates, denosumab and strontium (Ettinger, *et al.*, 1999; Meunier, *et al.*, 2004; Murad, *et al.*, 2012; Bone, *et al.*, 2017), although these drugs show the desirable therapeutic effectiveness, semi-permanent use of them bring about many adverse events in the long run; like gastrointestinal problems, typical femoral subtrochanteric fractures, and some drug-specific infections (Qaseem, *et al.*, 2017; Lagari, *et al.*, 2018).

Epidemiological evidence has indicated a link between dietary intake of fruits and vegetables and bone health (Mackinnon, *et al.*, 2011). Higher consumption of fruits and vegetables has also been correlated with a reduction in the risk for the development of postmenopausal osteoporosis Bitto, *et al.*, 2009). Carrot (*Daucus carota*) root (CRT) is a popular vegetables grown throughout the world. Biochemically it is loaded with carotenoids, phenolics compounds, vitamins C and E fiber and many essential micronutrients and functional ingredients (Alasalvar *et al.*, 2001; Sarfaraz *et al.*, 2016; Ndife, 2016). The present study was aimed to evaluate anabolic effect of CRT on estrogen deficient ovariectomized rats.



Materials and Methods

Reagents and Assay Kits

Rats RANKL, osteocalcin (OC) and estradiol ELISA kits were purchased from Wuhan Fine Biotech Co., Ltd. China. The standard drug Alendronate (ALE) was purchased from Sigma-Aldrich chemicals Co. Inc. (Milwaukee WI, USA). Rat bone alkaline phosphatase (BALP) kit was purchased from Agappe Diagnostics (Knonauerstrasse, Switzerland). All other chemicals and reagents used in this study were of analytical grade.

Experimental Animals

A total of 30 female wistar rats, weighing between 115 to 120 g were kept in well ventilated laboratory cages in the Animals House of the Department of Pharmacology, Ahmadu Bello University Zaria at room temperature and allowed to acclimatize to the surrounding for two weeks. They were provided access to standard rat chow diet and water *ad libitum*.

Ovariectomy and Sham operation

Anaesthesia was induced in the rats (n=24) by injecting each with ketamine hydrochloride (50 mg/kg body weight) and xylazine (12 mg/kg body weight) via the intraperitoneal route (Mada *et al.*, 2017). Bilateral ovariectomy was carried out by ventral approach under aseptic condition following the method described by (Kaczmarczyk-Sedlak *et al.*, 2009). The remaining rats (n=6) underwent sham operation; this surgical procedure only differs from ovariectomy given that ovaries were identified but not removed. The sham group served as a positive control. The rats were kept in separate cages for two weeks to recover and develop bone loss.

Experimental Animal Grouping and Treatments

The OVX rats were randomly divided into four groups of six rats each while the sham operated rats made the fifth group (n=6). Group one Sham operated rats (Control), group two OVX untreated rats, group three OVXrats+200mg/kg CRT and group four OVXrats+400mg/kg CRT while group five OVX rats+5mg/kg body weight alendronate. The treatment of the groups described above commenced two weeks after ovariectomy and sham operation and continued for six weeks. Experimental rats underwent mild anesthesia 24 hours after they received their last treatment and blood samples were collected into a tube via cardiac puncture. The blood samples were centrifuged to obtain the serum assayed for BALP activity, estradiol, osteocalcin and RANKL level.

Measurement of Percentage Body Weight Change

Weekly body weight of all the animals in each group were recorded using electronic weighing balance. Percentage body weight change of each animal group were calculated from their mean weekly weight and initial weight (Hefnawy, *et al.*, 2013).

Measurement uterine weight

After sacrifice of the rats, uteri were carefully dissected, weighed using an electronic weighing balance, and subsequently fixed in 10 % neutral buffered formalin for histological examination. About 5 µm pieces from the middle segment of each uterus were dehydrated in ascending grades of ethanol, cleared in xylene, and embedded in paraffin wax using the previously described protocol (Trivedi *et al.*, 2008). Representative transverse sections (5 µm) were stained with hematoxylin and eosin. Microscopic imaging of sections obtained was taken for microstructure, epithelial glands, and endometrial lumen using an Olympus inverted microscope (Waltham, MA, USA).

Measurement of serum estradiol level

Serum estradiol level was determined using rat estradiol ELISA kit (Wuhan Fine Biotech Co., Ltd. China) following the manufacturer's instruction. The principle of this assay kit was based on competitive ELISA detection method.

Measurement of serum Alkaline Phosphatase Activity

Serum alkaline phosphatase level was determined using BALP kit (Agappe Diagnostics Co., Ltd. Ernakulam, Kerala, India) following the manufacturer's instruction.

Measurement of serum osteocalcin level

Serum osteocalcin was determined using rat osteocalcin ELISA kit (Wuhan Fine Biotech Co., Ltd. China) following the manufacturer's protocol.

Measurement of serum RANKL level



Serum RANKL was measured using rat RANKL assay kit (Wuhan Fine Biotech Co., Ltd. China.) following the manufacturer's instructions.

Measurement of anthropometry parameters (length, thickness and weight)

The right femora were cleaned of adherent tissues, dried in an incubator at 95 °C for 12 h. The dried femora length and thickness were measured using Digital Vernier Caliper (SAN, Japan) as described by (Mada *et al.*, 2017). The dried femora were weighed using electronic weighing balance.

Statistical analysis

Data obtained were analyzed using SPSS version 20.1 and expressed as mean $\pm$ SEM mean value and analyzed using One-way Analysis of Variance (ANOVA). Statistically significant level was accepted at $P < 0.05$.

Result

Effect of Carrot roots on body weight gain

The result shows no significant ($P > 0.05$) different in terms of the mean body weight of the experimental rats in each group at the beginning of the study (Table 1.) However, after six weeks of the study period, the body weight of untreated OVX rats were significantly ($P < 0.05$) increased compared to control group. Interestingly, treatment of OVX rats with 200 and 400 mg/kg CRT significantly ($P < 0.05$) suppressed the body weight gain in comparison to untreated OVX group. Moreover, as expected ALE (standard drug) significantly ($P < 0.05$) decreases the body weight gain of the OVX rats almost similar to control group.

Table 1. Effect of Carrot roots on Percentage Body Weight Gain

Group	Control	OVX	OVX + 200mg/kg CRT	OVX + 400mg/kg CRT	OVX + 5mg/kg ALE
Initial Body Weight (g)	120.33 $\pm$ 3.86	120.67 $\pm$ 2.06	121.60 $\pm$ 5.99	119.25 $\pm$ 5.12	120.63 $\pm$ 2.05
Final Body Weight (g)	132.51 $\pm$ 2.16	159.33 $\pm$ 4.03	146.81 $\pm$ 11.72	137.31 $\pm$ 5.78	131.71 $\pm$ 5.25
Body Weight Gain (%)	9.19	24.26 ^{###}	17.17 [*]	13.15 ^{**}	8.41 ^{***}

Values are expressed a means $\pm$ SEM (n=6). ^{###} Significant ($P < 0.001$) when untreated OVX group was compared to control group; ^{*} $P < 0.05$, ^{**} $P < 0.01$ Significant when CRT treated groups were compared with untreated OVX group. Control: Sham, OVX: Ovariectomized, CRT: Carrot, ALE: Alendronate

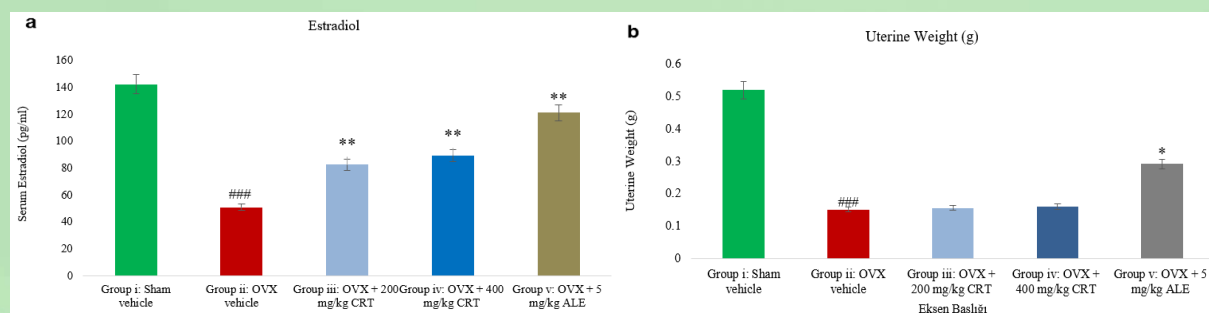


Fig. 1: Effect of Carrot roots on uterine weight and estradiol level in ovariectomized rats.

(a) Estradiol level (b) Uterine weight. Values are expressed a means $\pm$ SEM (n=6). ^{###} Significant ($P < 0.001$) when untreated OVX group was compared to control group; ^{*} $P < 0.05$, ^{**} $P < 0.01$ Significant when CRT treated groups were compared with untreated OVX group. Control: Sham, OVX: Ovariectomized, CRT: Carrot, ALE: Alendronate. 1: SHAM, 2: Untreated OVX rats, 3: OVX rats+200mg/kg CRT, 4: OVX rats+400mg/kg CRT, 5: OVX rats+5mg/kg ALE

Effect of Carrot roots on uterine weight, Histology and estradiol Level and in OVX rats

Uterine weight and estradiol level in OVX rats were significantly ($P < 0.05$) reduced compared to the control group (Fig. 1a & b). there was apparent atrophy of the endometrial lumen in OVX rats compared to sham-operated rats (Plate 1 & 2). Treatment of OVX rats with different concentration of CRT significantly ($P < 0.01$) elevates estrogen level ($P < 0.001$) and reduced atrophy of the endometrial lumen of the OVX rats (Plate 3 & 4) however, it does not reduce uterine weight loss when compared untreated OVX rats (Fig. 1a-b).

Effect of Carrot roots on Osteoanabolic (ALP and Osteocalcine) and bone-resorbing Markers (RANKL) in OVX rats

The effect of CRT on the level of osteoanabolic (ALP and Osteocalcin) and bone-resorbing markers in OVX rats were investigated. The data obtained shows that OVX-induced significant ($P < 0.001$) elevation of these biomarkers and altered bone-remodeling in OVX rats compared to control group (Fig. 2a-c). Interestingly, when OVX rats were treated with 200 and 400 mg/kg doses of CRT, significant ($P < 0.001$) reduction of these biomarkers of bone remodeling were observed in comparison to untreated OVX group (Fig. 2a-c).



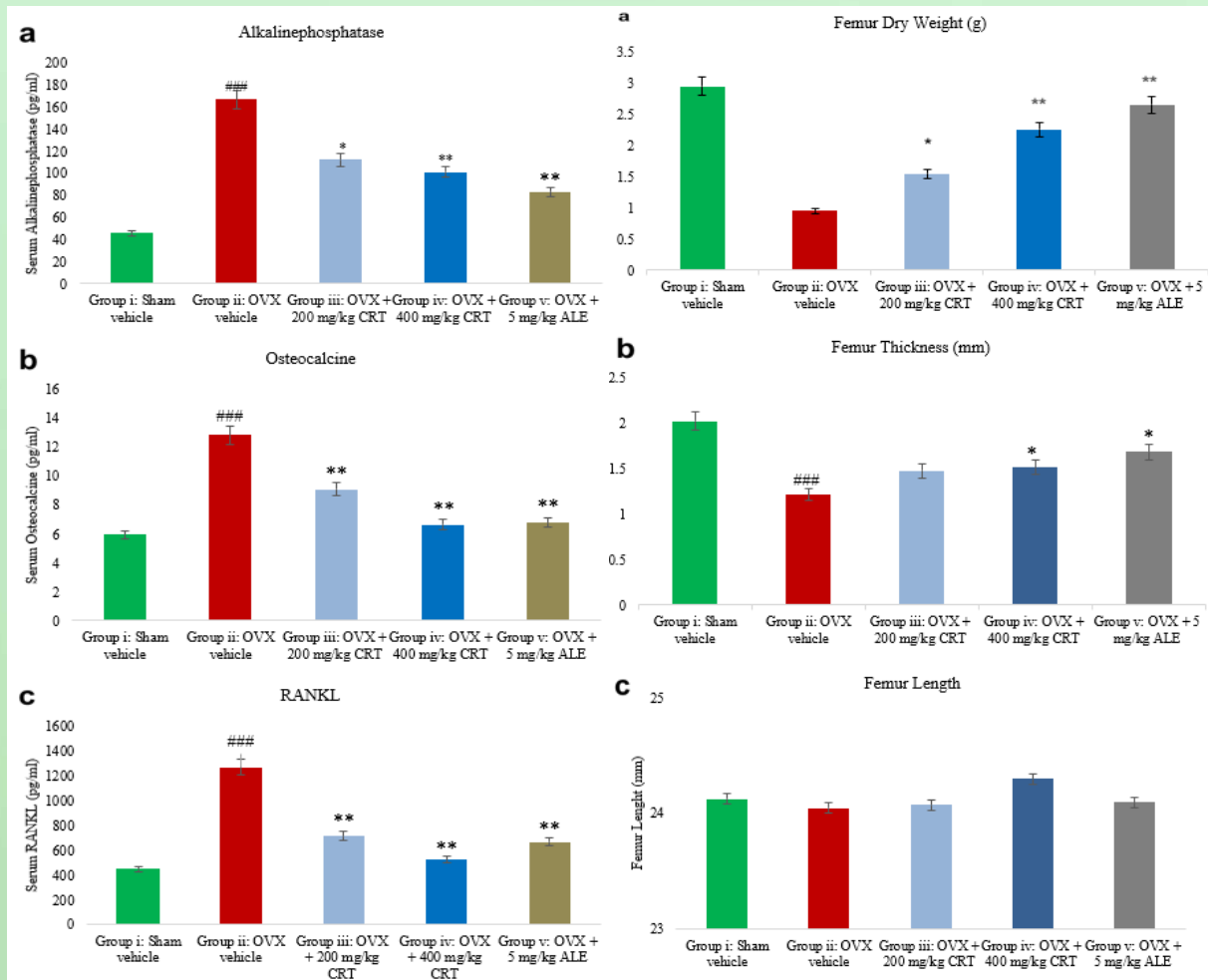


Fig. 2: Effect of carrot root on osteoanabolic and bone-resorbing markers in ovariectomized rats

(a) ALP activity (b) Osteocalcin level (c) RANKL level. Values are expressed as means $\pm$ SEM (n=6). #### Significant (P < 0.001) when untreated OVX group was compared to control group; *P < 0.05, **P < 0.01 Significant when CRT treated groups were compared with untreated OVX group. Control: Sham, OVX: Ovariectomized, CRT: Carrot root, ALE: Alendronate.

Fig. 3: Effect of carrot root on anthropometric parameters in ovariectomized rats.

(a) Femur dry weight (b) Femur thickness (c) Femur length. Values are expressed as means $\pm$ SEM (n=6). #### Significant (P < 0.001) when untreated OVX group was compared to control group; *P < 0.05, **P < 0.01 Significant when CRT treated groups were compared with untreated OVX group. Control: Sham, OVX: Ovariectomized, CRT: Carrot root, ALE: Alendronate.



Plate 1 SHAM Group i Plate 2 OVX Group ii Plate 3 OVX+ 200CRT Group ii Plate 4 OVX+ 400CRT Group iv Plate 5 OVX+ ALE Group v

Effect of CRT on Femur anthropometric parameters in OVX rats

This study investigated the effect of CRT on anthropometric parameters (femur dry weight, thickness, and length). The data indicated the femur dry weight and femur thickness were significantly (P<0.05) altered in OVX rats compared to control rats (Fig. 3a & b). Interestingly, treatment of OVX rats with 200mg and 400mg of CRT significantly (P<0.001) mitigated the reduction of these anthropometric parameters in dose-dependent manner compared to untreated OVX rats. However, there was no significant (P>0.05) difference on femur length between OVX rats and control rats (Fig. 4c). Similarly, treatment of OVX rats with different doses of CRT did not showed any effect on femur length when compared to control rats (Fig.3c).



Discussion

The objective of the present study was to investigate the potential of carrot roots (CRT) on post-menopausal osteoporosis using ovariectomized (OVX) rats. Previous reports have linked consumption of fruit and vegetable to bone health (Mackinnon, *et al.*, 2011), this may be due to its nutrients including vitamins, minerals and other phytonutrients that are present in plants generally. CRT contains high amount of β -carotene (Aurelia, *et al.*, 2009). Previous studies reported the benefits of carrots consumption on human health (Deding, *et al.*, 2020; Fujihara, *et al.*, 2021) however, the use of carrot roots on bone health is lacking. Animal model established by ovariectomy is popularly known to be used for inducing rapid bone loss in animals to mimic physiological features of postmenopausal women by alteration of bone remodeling process (Chalvon-Demersay *et al.*, 2017) which associated with estrogen (E2) deficiency, weight gain and over expression of inflammatory cytokines (Fraser *et al.*, 2017).

The result of untreated OVX rats group in our study demonstrated increase in weight gain, reduction in serum β -estradiol level and uterine weight. The reduction of β -estradiol confirmed success of the ovariectomy surgery and also induction of menopause condition in the rats, this is in line with the several previous studies which stated that OVX is associated with body fat redistribution to the abdomen, weight gain, and decrease uterine size, attributed to decreased in estrogen level (Davis, *et al.*, 2012; Curtis *et al.*, 2018). Conversely, oral administration of CRT suppressed weight gain and enhances serum estradiol level in the OVX rats in a dose dependent manner hence, our data on weight gain concur with earlier result presented by (Fujihara, *et al.*, 2021) The results of uterine weight and histology in the present study revealed that CRT administration to OVX rats does not have any impact of reducing uterine weight loss of the OVX rats however, reduced endometrial atrophy of the uterus of the OVX rats dose dependently.

Preservation of bone quality is directly related to the balance of remodeling process, which must be maintained throughout life to spare bone integrity and its mass density (Vijayan *et al.*, 2009). Bone remodeling is regulated by hormones, enzymes and anti-inflammatory cytokines to maintained normal function of osteoclast and osteoblast activities (Kuo & Chen 2017), therefore these biochemical markers can be used to monitor and evaluate bone health or its diseases. OC, enzymatic activity of BALP, TNF, IL-6 and RANKL are among the effective tools to find out bone health or otherwise (Liu *et al.*, 2016). Recent study revealed that ovariectomy operation is associated with high elevation of serum BALP activity (Yang, *et al.*, 2019). Consistently, in this study we observed higher level of serum BALP activity and OC concentration in the OVX untreated group, this may further have indicated rapid bone turn over. Dose dependently CRT impacted positively upon these bone biomarkers, with the higher dose of CRT mitigated the elevation of both serum BALP and OC almost similar to the OVX group treated with the standard drug (Alendronate), this implies potential role of CRT in lowering bone turn over biomarker. More so, at lower dose both APL and OC concentration were reduced significantly compared to the untreated OVX group. In addition, over expression of RANKL due to estrogen deficiency by osteoblast which binds its receptor RANK on surface of osteoclast to stimulate the cells to mature, differentiate and increase bone resorption activity (Callaway & Jiang 2015; Kuo & Chen 2017), the data showed positive effect of CRT regulating excessive RANKL over-expression in dose depended manner, more so positive impact of carotenoids has been reported by several studies on regulating excessive expression of RANKL (Maggio, *et al.*, 2006; Yang, *et al.*, 2008; Sahni, *et al.*, 2009).

Furthermore, anthropometry parameters (femur dry weight, thickness and length) were investigated in the present study, femurs are reported to be more prone to deterioration compared to other bones (Hodgson *et al.*, 2008) moreover, various studies reported bone loss of some anthropometry parameters attributed to rapid bone demineralization (Khajuria, *et al.*, 2015; Samarghandian, *et al.*, 2016; Dabbaghmanesh, *et al.*, 2017). Treatment of OVX rats with CRT impact positively on femur weight and thickness compared to OVX untreated rats group, this may probably confirm the effect of CRT on bone turnover makers and further concur with previous studies on effect of carotenoids on post-menopausal osteoporosis (Yang, *et al.*, 2008; Sahni, *et al.*, 2009) this evidently showed potential of CRT to minimize bone loss. However, the result of femur length obtained in our study showed that CRT does not have any effect.

Conclusion

Conclusively, the findings in this study established evidence that CRT exhibits anti-bone resorption activities potential, which effectively improve level of estrogen, suppress RANKL over expression, restored ALP and OC bone turnover markers in OVX rats. Moreover, the present findings demonstrated beneficial impact of CRT on bone femur thickness and weight in OVX rats. More so, the result of the study supports the earlier epidemiological data regarding effect of CRT on obesity through reduction of weight gain induced by ovariectomy. Altogether, these finding suggested that CRT may be beneficial therapeutic agent against bone loss in OVX rats.

Acknowledgement

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Abbreviations

ALE: Alendronate, BALP: Bone alkaline phosphatase, CRT: Carrot roots, ERT: Estrogen replacement therapy, g: Gram, IL-6: Interleukin 6, Kg: Kilo gram, mg: Milligram, OC: Osteocalcine, OVX rats: Ovariectomized rats, OVX: Ovariectomy, RANKL: Receptor activator of NF- κ ligand, Sham group: Control group, TNF- α : Tumour necrosis factor alpha

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Agricultural Management and Ecological Recycle in the World

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Abstract

Agriculture holds economic significance for both developed and developing countries. As the world population continues to grow and the demand for agricultural goods increases, agroecological approaches are increasingly recognized as potential solutions to address these pressing issues. Modern agricultural practices are well-known for their substantial environmental impact, influencing nutrient cycles, soil erosion, carbon sequestration, and various ecological patterns. Introducing more organic matter into agricultural practices can help mitigate these detrimental effects by preserving natural cycles and supporting environmental recovery. Ecological recycling has emerged as a crucial modern process, gaining popularity for several reasons, foremost among them being its environmentally friendly nature. Therefore, this study aims to explore Agricultural Management and Ecological Recycling on a global scale. Recycling techniques can effectively break down organic waste, thereby reducing waste volume, pathogens, and unpleasant odors. This process also increases nutrient content and helps minimize environmental contamination. Innovative approaches and new methods are driving trends towards sustainable farming systems, not only enhancing agricultural productivity but also significantly improving the quality of life for many farmers in an environmentally friendly manner.

Keywords:

Introduction

Agriculture techniques need to become more sustainable and efficient as the world's population grows and the demand for agricultural goods rises. An international agreement on a set of 17 Sustainable Development Goals (SDGs) and 169 goals to drive an integrated plan of action applicable to both developed and developing nations was reached five years ago, marking the culmination of a significant process of consensus building (UN, 2015). Sustainability in agriculture was recognized as a top priority for SDG2, as it is essential to tackling the enormous issue of achieving food security and nutritious diets for everyone. This agreement recognizes the need to address issues that extend far beyond a straightforward productivity indicator, embracing results that are socially and environmentally beneficial (Caron et al., 2018). Since agroecological approaches are increasingly recognized as having the potential to support the transformative change in agriculture needed to meet the SDGs, it is imperative to approach the transition to sustainable food and agricultural systems with a long-term perspective and holistic approaches (FAO, 2019). In recent years, agroecological approaches have become increasingly significant as potential remedies for issues pertaining to agricultural sustainability.

One of the biggest biological industries with the highest biomass production is agriculture, which may provide a significant bioeconomy input. The implementation of bioeconomic strategies based on agricultural waste management can effectively curb the underutilization of livestock excrement and the careless or random burning of crop residues, thereby promoting food and health security, waste valorization to produce value-added products, farmer livelihood, youth employment opportunities, and agricultural sustainability (Bracco et al., 2018). Nearly all of the above described waste managements are easily decomposable, and the byproducts of this process not only give plants vital nutrients but also increase soil porosity, which enhances soil aeration and water retentivity. Therefore, by turning agricultural wastes and byproducts into valuable resources, it will not only open up green markets and create jobs, but it will also lessen the need for fossil fuels and greenhouse gas pollution, helping to promote clean, safe, and sustainable agriculture (Scarlat et al., 2018).

The conversion of organic waste and its use for agricultural purposes to provide useful plant nutrients promotes growth and increases soil fertility. Using organic wastes in agriculture aims to preserve a sustainable cycle in which the biodegradable organic fraction of the waste is transformed into beneficial organic manure or fertilizer using techniques like anaerobic digestion, composting, and vermicomposting to create compost and slurry for use in agriculture. In order to compost, heterogeneous solid organic wastes (such as sewage sludge, crop residues, food and kitchen waste, garden waste, wood, paper, etc.) must be biologically converted into humus-like substances under controlled conditions of moisture, temperature, and aeration by microorganisms such as bacteria, fungi, and actinomycetes (Atalia et al., 2015). By means of recycling techniques, organic wastes are broken down and



stabilized in terms of a decrease in waste volume, pathogens, and malodorous compounds. This results in a product that can be used as an organic manure and soil amendment in agriculture because of its increased nutrient content and decreased risk of environmental contamination (Sharma et al., 2019). It is crucial for the ecology and the economy to reduce, reuse, and recycle agricultural waste. Therefore, this review aims to study agricultural management and ecological recycling in the world, to examine the relationship between Environmental Recycling and agricultural management, focusing on sustainable methods, international case studies, and potential paths to building a resilient agricultural system.

Agricultural Management and Ecological Recycling in World

The increasing demand for food aims not only to address food security issues but also to generate foreign exchange. However, traditional methods cannot meet the rapidly growing food requirements, leading to the development of new techniques that surpass natural processes. Unfortunately, these methods have exceeded environmental limits and caused numerous adverse effects due to unsustainable practices. The future sustainability of environmental quality is at risk because of these detrimental changes to the environment and ecosystems. While resources are finite, human demands and ambitions are boundless, and recovery or regeneration can take thousands or even millions of years. Consequently, extensive environmental degradation—including soil, water, and air pollution—along with poverty and concerns about quality of life, have become key factors driving interest in ensuring equitable access to natural resources for future generations (Gamage et al., 2023). Based on the use of chemical fertilizers, irrigation water, pesticides, high-yielding seed types, and other farming advances and techniques, modern agriculture is a dynamic field (Gamage et al., 2022). As the best agricultural land has already been utilized and has surpassed safe limits, the natural resources available for further farming expansion are nearly depleted. There is an urgent need for alternative agricultural methods that can operate within a sustainable ecosystem while maintaining and increasing productivity (Gamage et al., 2023).

The green revolution led to increases in food production, self-sufficiency, and high incomes in the majority of the countries. Moreover, it allowed certain nations to transition from a food deficit to a surplus, which opened up potential for food product exports (Kansanga et al., 2018). However, most countries had to consume less nutrient-dense food while dealing with contaminated water from the use of pesticides and fertilizers for high production (Gamage et al., 2023). High-input, resource-intensive farming systems have led to massive deforestation, water scarcity, soil depletion, and high greenhouse gas emissions, making them unsustainable for long-term food and agricultural production. What is needed are innovative systems that protect and enhance natural resources while increasing productivity. This requires a transformative shift towards holistic approaches such as agroecology, agroforestry, climate-smart agriculture, and conservation agriculture, which incorporate indigenous and traditional knowledge. Technological advancements, along with significant reductions in fossil fuel use across all sectors, including agriculture, are essential to addressing climate change and mitigating natural hazards that impact ecosystems and human life. Additionally, greater international collaboration is necessary to prevent emerging transboundary threats to agriculture and food systems, such as pests and diseases (FAO, 2017). To meet the basic needs of the growing population, crop and livestock production must be expanded annually. This expansion generates significant quantities of agricultural waste, raising concerns about its environmental impact and potential risks to human health (Koul et al., 2022). Hence, it is clear that the excessive exploitation of resources will result in adverse impacts on sustainability.

Rethinking food systems and governance is essential to address current and future challenges. Vertically coordinated and more organized food systems provide standardized food for urban areas and formal employment opportunities. However, these systems must be paired with responsible investments that consider smallholder livelihoods, the environmental impact of extended food supply chains, and effects on biodiversity. Addressing these concerns involves making food systems more efficient, inclusive, and resilient.

On the path to sustainable development, all countries are interdependent. Achieving coherent and effective national and international governance with clear development objectives and a commitment to realizing them is one of the greatest challenges. The 2030 Agenda for Sustainable Development embodies a vision that transcends the divide between 'developed' and 'developing' countries. Sustainable development is a universal challenge and a collective responsibility for all nations, necessitating fundamental changes in how all societies produce and consume (FAO, 2017). Sustainable development has become the primary goal for most countries worldwide, as it offers the best solution to the various risks and challenges faced globally.

Conclusion

The global population is expanding, leading to higher demand for agricultural products and increased strain on resources through traditional exploitation. To address these challenges sustainably, the integration of Agricultural Management with Environmental Recycling is becoming crucial. Agricultural systems worldwide face mounting pressure to meet population demands while reducing environmental harm. Ecological recycling presents a



promising approach to achieving these dual objectives. During the Green Revolution, high-input farming enhanced production but also led to resource depletion and pollution. In order to achieve the global sustainable development objectives, sustainable agricultural practices like agroecology and agroforestry are critical for increasing production while protecting biodiversity and natural resources.

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The Importance of Aquaculture Production in Africa

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Abstract

Aquaculture is a significant agricultural endeavor that has the potential to eradicate global undernourishment and provide food security. In Africa, fish farming has witnessed remarkable growth in the past period, especially in Egypt, Nigeria, and Uganda. Given the availability of water bodies, some institutional commitment, and a strong demand for fish, among other factors, these countries have very prospective aquaculture sectors. Despite the enormous potential of the aquaculture sector and the notable successes of some countries, the industry faces a number of obstacles, including low adoption of advanced technologies, a lack of fingerling supply, ineffective management practices, high infrastructure and feed costs, and a lack of knowledge about existing innovations. Therefore, this study is to highlight the importance of aquaculture in Africa and clarify the basic function that it plays in the continent's food security and economic relevance. Moreover, identify the opportunities and challenges faced by this important African business. Africa has significant potential for growth and improvement in the aquaculture sector. Considering the great potential and opportunities in this industry, several African countries have made progress in developing their aquaculture industries. Including aquaculture in regional food systems needs to be a bigger priority in Africa. Furthermore, there is an urgent need for action to address problems affecting the African aquaculture industry and secure funding for sector growth.

Key Words: Aquaculture Production, Africa

Introduction

Aquaculture has been around for thousands of years, although it has only lately seen significant global expansion. Although the exact origin of aquaculture activities is unknown, research conducted over time indicates that the practice has been going on for millennia. The first stages of this production may have begun in the Neolithic era, about 4000 B.C., and involved the capture of aquatic creatures in little pools of water so that they would always be available (Rocha et al., 2022). Due to the increased demand for seafood over the past 50 years, aquaculture has become the food industry with the highest rate of growth in the world. More than 50% of the fish food supply in the world is being produced aquaculturally, including finfish, mollusks, and crustaceans (Garlock et al., 2020; Elshelikh, 2021). The worldwide fish supply is expected to reach 204 million tons in 2030, up 25 million tons from 2018 and totally supported by aquacultural production (FAO, 2020). With a projected population of 9.6 billion by 2050, supplying the world's expanding population is already a major concern. Increasing sustainable food production, improving the nutritional value of food produced, and reducing food waste are all important to attain global food and nutritional security in an environment where land and water, two resources essential for food production, are becoming more limited (Kobayashi et al., 2015). Under these difficult conditions, aquaculture is emerging as a vital food production system (Rogers, 2023). Thus, it is evident how crucial aquaculture is to the world's food security.

Aquaculture was introduced to a number of African countries in the early 20th century, and in Kenya, tilapia was successfully raised in standing water ponds throughout the 1920s and 1930s. Later, between the 1940s and 1950s, colonial governments throughout Africa introduced aquaculture as a sustainable food production method with the goals of enhancing rural nutrition, generating additional revenue, diversifying to lower the risk of crop failure, and creating jobs in rural areas. As a result, the government constructed a large number of fish farming stations in the 1950s; by the end of 1950, there were around 300,000 operational production ponds throughout Africa (Adeleke et al., 2020).

The FAO started to lead the development of aquaculture in the area in the 1960s, working in collaboration with governments, donor nations, national and international research institutes, and non-governmental organizations. The main focus of the efforts was on basic research and development to comprehend useful methods for a variety of primarily native species. From the early 1970s to the early 1990s, additional financial and technical help accelerated the growth of aquaculture in the region (Hecht et al., 2006).

Although growth in aquaculture output has been moderate throughout the years, Africa has made some headway. The socioeconomic climate, access to capture fisheries resources, availability of water, and other factors make it



impossible to assess the aquaculture success of African nations only based on GDP contributions or absolute output levels. In addition to other macroeconomic parameters like population size and the endowment of natural resources, it is required to include other metrics that assess the significance of aquaculture as a source of food (Hinrichsen et al., 2022). Therefore, the primary goal of this study is to highlight the importance of aquaculture in Africa and clarify the basic function that it plays in the continent's food security and economic relevance. Furthermore, to provide light on the prospects and obstacles that this significant African industry faces.

The importance of Aquaculture Production in Africa

Out of all the five continents, Africa has had the fastest growth rates in the production of aquatic species since 2001. The largest increase rate, of more than 14% over the preceding decade, was noted in the years 2006–2010. The continent grew at a pace of more than 7% between 2016 and 2018, exceeding both the global average and all other continents, even if the rate decreased in the years that followed. Egypt, Nigeria, and Uganda have contributed significantly to the overall rise in aquaculture output on the continent, accounting for about 91% of the total. Furthermore, Egypt is the world's sixth-largest producer. African countries produce almost exclusively (99%) in inland freshwater systems, mostly for the cultivation of African catfish and tilapia. The remaining 1% of output comes from mariculture, a sector that has received increased attention since the early 2010s (FAO, 2020; Rocha et al., 2022). Along with the advancement of existing methods, new aquaculture production systems including tanks and cages were established. About 6.2 million people are employed in the aquaculture industry in Africa, with a significant proportion of these workers being women who work on large-scale commercial farms (Satia 2016). According to Satia (2017), women are mostly employed in the aquaculture value chain's downstream postharvest and marketing activities. Therefore, the aquaculture industry has a great chance to boost Africa's economy, lower unemployment, and increase food security. While larger-scale investments in Egypt, Nigeria, Uganda, and Ghana are generating significant amounts of fish, Africa's contribution to global aquaculture production is still negligible (about 2.7%). With a cumulative annual growth rate of 15.55%, the region's output increased twentyfold between 1995 and 2018, from 110,200 to 2,196,000 tons (Halwart, 2020).

Aquaculture production increased as a result of the establishment and expansion of small and medium-sized businesses under private sector administration. Additionally, the growth of aquaculture was aided by the establishment of the FAO Special (Adeleke et al., 2020). Several African governments have begun to recognize the significance of fostering a business-friendly atmosphere by implementing measures including accelerating, coordinating, and enacting policy reforms. A few nations have created and implemented strategic frameworks and policies based around aquaculture as a means of directing growth. A few governments have made it easier to provide soft credits and incentives, but land ownership, reasonable loan availability, and adequate input quality and quantity continue to be important obstacles to the growth and intensification of the aquaculture industry (Machena and Moehl, 2001; Jamu & Brummett, 2004; Adeleke et al., 2020). Growing private sector leadership has been observed in a few countries in the production and distribution of important aquaculture inputs, including as feeds and seeds, whereas manufacturers and suppliers of aquaculture equipment are located in other nations (Koge et al., 2018). Economies of scale, lower transaction costs, competitiveness, and support service delivery have all benefited from the establishment of fish farming clusters (Adeleke et al., 2020). Several African nations are currently addressing biotechnological, economic, and institutional obstacles that exist. These obstacles include the lack of national policies to direct the development of aquaculture, unwelcoming investment policies, a lack of connections between farmers, research/technology development and extension, and unfavorable investment climates (Babatunde et al., 2021).

Egypt, Nigeria, Uganda, Ghana, Tunisia, Kenya, Zambia, Madagascar, Malawi, and South Africa are the leading aquaculture producers in Africa. Over the last ten years, there has been a notable surge in the number of these major aquaculture producers. This growth can be attributed to various factors, including the development of capacity in crucial areas, the adoption of good governance, research and development, credit facility accessibility, and most importantly, the encouragement of private sector-led aquaculture development. Investments in competent management, new production techniques, the creation and use of aqua-feeds, and the growth of strong and vibrant producer associations and service providers are all results of private sector-led initiatives (Adeleke et al., 2020). Aquaculture in some countries has issues related to the growth of the industry, especially the scarcity of high-quality seeds and feed.

Globally, aquaculture has contributed progressively to the overall productivity of fisheries and aquaculture (except from algae), rising from 13.4% in 1990 to 49.2% in 2020, a level with capture. Within and across areas, its contribution varies substantially. Estimated at 2196 million tons, or around 2.67% of worldwide aquaculture production in 2018, freshwater finfish production accounted for the majority of Africa's production (Halwart 2020). About 90% of the region's aquaculture production is produced by the top three producers, Egypt, Nigeria, and Uganda (Table 1).



Table 1. Top 10 aquaculture producers in Africa in 2018 (FAO 2020; Adeleke et al., 2020)

Country	Production (metric tons)	Regional share (%)	Global share (%)
Egypt	1,561,457	71.10	1.90
Nigeria	291,233	13.26	0.35
Uganda	103,737	4.72	0.13
Ghana	76,630	3.49	0.09
Zambia	24,300	1.11	0.03
Tunisia	21,756	0.99	0.03
Kenya	15,124	0.69	0.02
Malawi	9014	0.41	0.01
Madagascar	7421	0.34	0.01
South Africa	6181	0.28	0.01

Due to increased private sector investment and the Egyptian government's cumulative and constant interventions throughout the years, the aquaculture business in Egypt developed quickly starting in 1998 (Soliman and Yacout, 2016). Consequently, Egypt's aquaculture output increased from 139,389 tons in 1998 to 1,561,457 tons in 2018, accounting for 71% of Africa's total aquaculture production (FAO, 2020). According to Cai et al. (2017), Nigeria has the largest demand for fish in Africa, which has led to the fast expansion of peri-urban commercial aquaculture. The production of aquaculture increased from 20,458 tons in 1998 to 291,233 tons in 2018 as a consequence of the market-driven expansion. The private sector drives the growth of the whole aquaculture value chain, with the Nigerian government tasked with creating a favorable business climate (FDF 2012). Since 2000, Uganda's aquaculture industry has grown rapidly as more people became aware of its potential to combat unemployment, food poverty, and hunger. Consequently, the government's strategic actions and the assistance of development partners boosted the growth of aquaculture (Cai et al., 2017). Between 2001 and 2018, the amount of aquaculture produced rose from 2360 tons to 103,737 tons. Given the notable increase in Egypt, Nigeria, and Uganda's aquaculture production output over the last 20 years, it is important to examine the crucial success determinants of these important regional players. Ghana, Nigeria, Egypt, and Uganda are the top 10 aquaculture producers in Africa, accounting for almost 93% of the region's overall production output (Adeleke et al., 2020).

Challenges and Future Prospects

Although it is expected that aquaculture will grow worldwide, a number of challenges might affect the industry's future. These include issues related to land and water and the conflicts they cause; the availability of feed, seeds, and genetic resources; issues with disease and environmental integrity; the development and adoption of new and improved farming technologies; issues with the market, trade, and food safety; climate change; obstacles to investment capital; and issues that may arise from unregulated and unmonitored aquaculture practices (FAO, 2016).

The aquaculture sector in Africa is generally beset by the following issues: insufficient fish fingerling supply; inappropriate management techniques; high fish pond establishment and feed costs; a low-quality ready-to-eat fish market; a lack of knowledge about available innovations; etc. These limitations may be sociocultural or institutional (Tall, 2017; Adeleke et al., 2020). Aquaculture necessitates expertise in a wide range of production-related fields, including spawning, feed production, pond design, and management. Consequently, a greater difficulty is the lack of knowledge and proficiency in these areas (Edun et al., 2018).

In Egypt, integrated aquaculture is one production technique that is becoming more and more popular, but it faces some challenges. Integrated aquaculture may not be permitted by land contracts, farmers are not allowed to use irrigation water for aquaculture, farmers are generally more comfortable with traditional farming practices than with "risky" ones, and there are a number of other restrictions. Policymakers should take these issues into consideration in order to promote the integration of aquaculture and agriculture (Cai et al., 2017). Significant obstacles to the growth of Egypt's aquafeed business have been noted, including the industry's reliance on feed ingredient imports and ongoing price increases. As aquaculture expands quickly, it is anticipated that the animal feed and aquafeed businesses will compete with one another for raw materials. This might have an impact on feed prices as well as the usage of outdated and compressed feed technologies (El-Sayed, 2014).

The main challenges to the expansion of aquaculture and sustainable cage culture in Nigeria and throughout Africa are the lack of affordable, locally made, premium extruded feeds made from local raw materials. The region's historically low wild fish prices and quality, the lack of processing and routes to developed markets in some countries, the lack of potential investors willing to take on long-term investment risk in Nigeria, and the lack of knowledge in disease identification and management are some additional constraints (Jega, Haque, & Miah, 2018). Additionally, because aquaculture is seen as risky and financially challenging by the rich, it usually fails to draw them to Nigeria. Offshore commerce and fishing are preferred by the rich (Oluwatobi et al., 2017). As a result, the sector's development is discouraged. The primary issue has been the inadequate use of suitable technology. Inadequate financial support, inadequate technology, inadequate technical know-how, unfavorable environmental



conditions, inadequate training, and lack of technical support are some of the factors contributing to aquaculture's lack of information (Abegunrin et al., 2019). Although there is a lot of promise and prospects in this business, many African nations have taken steps to enhance their aquaculture sectors. However, they are still finding it difficult to deal with the various constraints that impact the aquaculture industry. Therefore, we expect that these countries will adopt to address these obstacles and help develop this important sector of the national economy and food security in Africa

Conclusion

Aquaculture was initially introduced to Africa a long time ago, and later developed into a means of achieving food security and livelihoods. In Africa, although they are still struggling to deal with the various obstacles impacting the aquaculture business, they have taken steps to strengthen their aquaculture sectors, and there are many opportunities and possibilities in the industry. Countries like Egypt, Nigeria, and Uganda are setting the aquaculture world standard because they see a bright future. More funding and diversity are needed for aquaculture if it is to maintain its high potential. In order to achieve the goals associated with the development of the aquaculture sector to enhance food security and support the economy, efforts must be made to develop this sector.

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Tropical Tree Associations in the Anthropocene

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Abstract

In the Anthropocene, tropical tree associations are undergoing unprecedented changes driven by deforestation, climate change, and other human activities. To move from description to a deeper understanding, it is essential to focus on the functional roles of tree species and their contributions to ecosystem services. This knowledge is crucial for developing strategies that preserve tropical forest ecosystems and mitigate the impacts of the Anthropocene on biodiversity and human well-being.

Key Words: Anthropocene, Africa, Sudan, ecosystem services

Introduction

Tropical forests are among the most diverse ecosystems on the planet, characterized by complex tree associations that define their structure and ecological function. In the Anthropocene, the current epoch dominated by human activity, these tree associations are undergoing significant changes due to deforestation, climate change, invasive species, and habitat fragmentation. Moving beyond simple descriptions of these associations to a deeper understanding of how human influences are reshaping them is critical for the preservation of biodiversity and ecosystem services.

Describing Tree Associations in Tropical Forests:

Tree associations in tropical forests refer to the specific relationships between tree species, which determine forest structure and influence ecosystem processes. These associations vary across vertical layers (stratification) and horizontal gradients (heterogeneity) based on light availability, soil nutrients, moisture levels, and species interactions.

Vertical Stratification of Tree Associations

Tropical forests exhibit a multi-layered vertical structure, with different tree species occupying distinct ecological niches at varying heights:

Emergent Layer: Tall trees, such as *Ceiba pentandra* (Kapok) and *Shorea robusta*, rise above the canopy and thrive in full sunlight. These trees are typically scattered, with deep roots that provide stability in strong winds.



Ceiba pentandra L.



Shorea robusta



Canopy Layer: The dense, continuous canopy, formed by species like *Dipterocarpus* spp. and *Ficus* spp., regulates light penetration and moisture availability for the lower layers. This is the most biologically active layer, supporting a wide variety of animals and plant interactions.



Ficus sycomorus



Dipterocarpus alatus



Eugenia spp.



Inga edulis

Understory and Shrub Layers: Below the canopy, shade-tolerant species like *Eugenia* spp. and *Inga* spp. thrive in low-light conditions. These species play crucial roles in seedling regeneration and contribute to forest resilience after disturbances.

Figure 1. Vertical Stratification of Tropical Forests:

Layer	Dominant Species	Height (m)
Emergent	<i>Ceiba pentandra</i> , <i>Shorea robusta</i>	50-70
Canopy	<i>Dipterocarpus</i> , <i>Ficus</i> spp.	30-50
Understory & Shrubs	<i>Inga</i> spp., <i>Eugenia</i> spp.	5-20

Horizontal Heterogeneity and Niche Partitioning

Tree species distribution varies across tropical forests due to differences in soil quality, moisture, and topography. This horizontal heterogeneity allows species to coexist by occupying unique ecological niches.

Pioneer Species: Light-demanding pioneer species, such as *Cecropia* spp., rapidly colonize forest gaps created by natural disturbances (e.g., tree falls) or human activities (e.g., logging). These species play a key role in early forest succession.

Shade-Tolerant Species: Species that grow more slowly in shaded conditions, such as *Swietenia macrophylla* (mahogany), dominate mature forest interiors, where they contribute to long-term forest stability and biodiversity.





Cecropia spp.



Swietenia macrophylla

Keystone Species

Certain species, known as keystone species, have disproportionate effects on forest ecosystems. *Ficus* spp., for instance, provide a critical year-round food source for frugivorous animals, which in turn facilitate seed dispersal, maintaining the diversity and structure of tropical forests (Shanahan et al., 2001).

Table 1. Examples of Keystone Tree Species

Species	Ecological Role	Region
<i>Ficus</i> spp.	Year-round fruit production, supports frugivores	Global tropics
<i>Dipteryx panamensis</i>	Provides habitat and food for animals	Central America
<i>Swietenia macrophylla</i>	Canopy stabilizer, supports biodiversity	Amazon, Central America

Understanding Anthropocene Impacts on Tree Associations

In the Anthropocene, human activities are altering tree associations in tropical forests through deforestation, habitat fragmentation, climate change, and the introduction of invasive species. These changes threaten the intricate balance of species interactions and disrupt ecosystem services, such as carbon storage, water regulation, and biodiversity maintenance.

Deforestation and Habitat Fragmentation

Deforestation, driven by agricultural expansion, logging, and urban development, has led to large-scale habitat loss in tropical forests. Fragmentation isolates populations, alters microclimatic conditions, and changes the dynamics of tree associations.

Edge Effects: Forest fragmentation creates new forest edges, which are exposed to higher temperatures, light levels, and wind. These conditions favor fast-growing pioneer species like *Cecropia* spp., often at the expense of slower-growing, shade-tolerant species such as *Swietenia macrophylla* (Laurance et al., 2011).

Biodiversity Loss: Fragmentation reduces genetic diversity in tree populations by limiting seed dispersal and increasing inbreeding. Keystone species, which rely on large, continuous habitats, are especially vulnerable in fragmented landscapes.

Figure 2. Effects of Fragmentation on Tree Associations

Impact	Affected Species	Consequences
Edge Effects	<i>Swietenia macrophylla</i>	Decline in shaded habitats
Pioneer Species Expansion	<i>Cecropia</i> spp.	Dominance in fragmented forests
Reduced Genetic Diversity	<i>Dipteryx panamensis</i>	Loss of genetic variability

Climate Change and Tree Mortality

Climate change is affecting tropical tree associations by altering temperature and precipitation patterns, increasing the frequency of extreme weather events, and intensifying droughts. These changes lead to species range shifts, increased tree mortality, and altered forest dynamics.



Species Range Shifts: Some tree species, such as *Cedrela odorata* (Spanish cedar), are migrating to higher altitudes or latitudes in response to rising temperatures. This disrupts local tree associations and affects the entire ecosystem, from nutrient cycling to species interactions (Feeley et al., 2012).

Increased Mortality: Drought-sensitive species are experiencing higher mortality rates in regions like the Amazon, where extended dry seasons and increased temperatures are stressing even mature, well-established trees. These changes may result in a shift toward more drought-resistant species and reduced overall forest biomass (Phillips et al., 2009).

Invasive Species

Invasive species, introduced by human activities, are altering tree associations by outcompeting native species, disrupting forest dynamics, and reducing biodiversity.

Example: *Lantana camara*: This invasive plant has spread across tropical regions, particularly in Asia and Africa, where it forms dense thickets that prevent native tree regeneration and change the composition of tree associations (Sharma et al., 2005).



Lantana camara



Chromolaena odorata



Dipteryx panamensis

Table 2: Invasive Species Impacting Tropical Forests

Invasive Species	Region	Impact on Tree Associations
<i>Lantana camara</i>	Southeast Asia	Suppresses native tree regeneration
<i>Chromolaena odorata</i>	West Africa	Reduces biodiversity, alters forest structure

Moving Toward Understanding: Functional Traits and Ecosystem Services

To move beyond descriptive accounts of tree associations, it is crucial to focus on the functional traits of tree species—such as wood density, growth rates, and reproductive strategies—that influence their contributions to ecosystem services, including carbon storage, water regulation, and nutrient cycling.

Carbon Sequestration

Tropical forests are vital carbon sinks, sequestering around 1.5 billion metric tons of carbon dioxide annually. Tree species with dense wood, such as *Dipteryx panamensis*, store more carbon than fast-growing, light-demanding species like *Cecropia* spp. Understanding how different tree associations contribute to carbon storage is essential for mitigating climate change impacts (Pan et al., 2011).

Table 3: Carbon Sequestration Potential of Key Tropical Tree Species:

Species	Wood Density (g/cm ³)	Growth Rate	Carbon Storage Potential
<i>Dipteryx panamensis</i>	High	Slow	High
<i>Cecropia</i> spp.	Low	Fast	Low
<i>Swietenia macrophylla</i>	Medium	Moderate	High

Hydrological Services

Tropical forests play a crucial role in regulating water cycles, influencing regional rainfall patterns and maintaining water availability. Large canopy trees with high transpiration rates, such as *Ficus* spp., help mitigate the impacts of drought by promoting cloud formation and precipitation. Changes in tree associations due to deforestation or climate change can disrupt these hydrological services, leading to more severe droughts and altered rainfall patterns.



Conclusion:

In the Anthropocene, tropical tree associations are undergoing unprecedented changes driven by deforestation, climate change, and other human activities. To move from description to a deeper understanding, it is essential to focus on the functional roles of tree species and their contributions to ecosystem services. This knowledge is crucial for developing strategies that preserve tropical forest ecosystems and mitigate the impacts of the Anthropocene on biodiversity and human well-being.

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The Effect of Climate Change on Ecological Life Cycle of Pakistan

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Abstract

Ecosystem comprised by the combination of Humans, animals, plants, microorganisms and several abiotic factors. Humans completely depends on their ecosystem for food, fuel, fiber and regulatory functions like climate regulation and disease management. This ecosystem is becoming effected day by day due to increasing climate change. Climate change cause rise in temperature, elevation of caron dioxide, green house gas emissions, glaciers melting, rise in sea level. These factors cause loss of biodiversity which is important for maintenance of Agroecosystem and human environment interaction. In this article we are discussing about effects of climate change on Ecological Life Cycle of Pakistan. Pakistan is a developing country and more vulnerable to Global warming and climate changes. Pakistan blessed with rich agricultural land but this land going to become disturbed because of rising temperature, irregular pattren of rainfall, causing water shortage for crops. This leads to shortage of crop production and food deficiency in Pakistan. Disturbance of ecosystem cause migration and extinction of many plant and animal species. The most effective areas of Pakistan ecosystem includes Indus river belt and coastal areas of Karachi. There should be some starategies from institutes and policymakers to keep balance in all components of ecosystem to mitigate the effects of climate change.

Key Words: Ecological Life Cycle, Climate Change, Pakistan

Introduction

An ecosystem is a dynamic complex comprising communities of bacteria, fungi, plants, and animals that are linked to an abiotic environment. Humans are an essential component of ecosystems. Ecosystems differ in terms of their size and composition, and there is a relationship between biodiversity and the size and health of an ecosystem. Biodiversity is impacted by human activity on both terrestrial and marine habitats. Human populations rely on the ecosystem to provide them with goods like food, fuel, and fiber; regulatory functions like disease management and climate regulation; and nonmaterial advantages like spiritual or aesthetic satisfaction. The ultimate water sources for ecosystems are precipitation and glaciers, and any changes brought about by climate change will eventually have an impact on people. The degradation of habitats due to land use changes poses a danger to biodiversity alongside over-exploitation of resources, pollution, invasions by non-native species, biological effects of elevated atmospheric carbon dioxide levels, and climate change. Climate change generally has gradual, hard-to-measure effects on the ecology and ecosystem, most of which are irreversible. It is anticipated that as time goes on, the consequences of climate change will probably become more pronounced than those of other variables. Urbanization, deforestation, rapid industrialization, increased use of fossil fuels in transportation and industry, and population growth are examples of human effects. The rise in greenhouse gas (GHG) emissions, primarily of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), is the true cause of climate change, sometimes referred to as global warming (IPCC, 2007).

Biodiversity

The variety of life on Earth is referred to as biodiversity. As to the United Nations Convention on Biological variety, biological variety encompasses a wide range of species, genes, habitats, and corresponding ecological processes. The average abundance of the original species at a particular period relative to its original abundance when ecosystems were barely influenced by humans is another definition of biodiversity (UNEP, 2004). All biological variety that is relevant to food and agriculture as well as all biological diversity that makes up the agroecosystem is collectively referred to as agricultural biodiversity. It encompasses the genetic, species, and ecological diversity and variability of plants, animals, and microbes that are essential to maintaining the essential functions, structure, and processes of the agro-ecosystem.

Consequences of Climate Change on Biodiversity

Certain plant and animal species may survive, thrive, and reproduce depending largely on temperature and rainfall. It is well known that an organism's physiology is directly impacted by its temperature. One illustration is how temperature affects the sex of growing turtle and alligator embryos. There are direct and indirect consequences of climate change on ecosystems and species. Climate change has several direct effects on ecosystems and species.



It is anticipated that the worldwide forest cover will shift in response to climate change. There will be changes in the biomes or vegetation zones. There will also be changes to the species makeup and ranges of several species. The physiology, phenology, and interactions between species will all be impacted by climatic changes, which will alter species distribution patterns. Changes in plant phenology, or the timing of reproduction and duration of growing seasons, have the potential to upset significant ecological connections. The long-term alterations in the biological events or phenology of plants and animals have been extensively studied. The distribution and number of species are directly impacted by precipitation as well.

Changes in Ecosystem functioning

Variations in temperature and water availability due to climate change have an impact on animal physiology, as well as alter the functioning of ecosystems. The interactions between respiration, carbon dioxide fixation, nitrification, litter decomposition, etc., are essential to the ecosystem's ability to operate. Climate change has the potential to impact ecosystem functioning by decreasing biodiversity because of species extinction or migration. In addition, invasive and opportunistic species will outnumber endemic or native species and have wider ranges. Rising sea levels will cause changes in the habitat of estuaries and the shoreline.

Mangroves, coastal wetlands, corals, and seagrass populations will all be impacted differently, depending on how well they are able to withstand erosion, depositional processes, and subsequent changes in the shoreline. According to scientific data, these alterations are already taking place in tandem with the century-long warming trends (Qureshi & Ali, 2011). Although the exact type and rate of change for species and ecosystems is unknown, these changes are anticipated to pick up speed and become more noticeable over the course of the next several decades. Pakistan is blessed by nature with a diverse range of landscapes, populations, climates, seasons, ecosystems, and other features. The regions' topography varies from snow-capped peaks in the Himalayan Range in the north to the Arabian Sea coastline in the south; from lush, green plains with canal irrigation to scorching, arid deserts in Sindh and Baluchistan; from well below freezing points in the HKH mountainous region to as hot as 520 °C in the inland areas; and from more than 1000 mm of precipitation per year in the humid, northern areas to less than 150 mm in the hyper-arid regions of Baluchistan. Numerous living things, such as flora, fauna, animals, birds, insects, etc., have arisen because of this diversity, and they offer economic advantages and services to human civilization in addition to ecological, recreational, cultural, and aesthetic aspects.

The effects of climate change vary throughout the world, but in developing nations, they are more severe (Rahman & Lateh, 2017). This is due to a variety of factors, including low institutional capacity, a lack of awareness and knowledge about effective measures, a lack of resources and their improper use, and unfavorable economic conditions (Ullah et al., 2019). In the upcoming years, the Intergovernmental Panel on Climate Change (IPCC) has projected that it will have a detrimental influence on natural resource depletion, human actions, and natural disasters. Globally, the hydrologic reserves and biological systems were affected by El Nino and La Nina. Between 1895 and 1995, the temperature increased by 0.4 °C. Severe weather conditions such as heat waves and relatively hotter days and nights have been brought on by the rising temperatures (Meehl and Tebaldi, 2004; Rauf et al., 2017). Due to its rapidly melting glaciers, declining hydrological reserves, floods, and droughts, Pakistan will likewise bear the burden of climate change (Chaudhry et al., 2009).

From 2020 to 2050, Pakistan's temperature is expected to increase from 0.9 to 1.5 °C. The worst droughts to ever hit Pakistan occurred in 1998 and 2004 (Hussain & Mumtaz, 2014). The country's largest province, Baluchistan, was particularly hard hit, with 84% of its people directly affected and 76% of its livestock killed. Because in individual provinces, the entire nation suffered greatly from massive floods that forced many people to flee their homes in both the northern and central regions (Chang 2014; Ullah et al., 2018). Hussain et al. (2018) state that extreme heat, severe droughts, pest illnesses, health issues, and lifestyle changes are expected to persist in the upcoming years. Due to its geographical position, increased reliance on agriculture, increased dependency on water resources, and inadequate ability to handle climate emergencies, Pakistan is poised to become a victim of the consequences of climate change (Balkhair et al., 2018; Malik et al., 2012). Furthermore, it is unlikely that climate change will have a uniform impact on all regions (Malik et al., 2012). There is worrying evidence that poor farmers in rural areas will be disproportionately affected by climate change (Ali & Erenstein, 2017) and the 2010–2011 floods highlight the vulnerabilities that these farmers face (Gorst et al., 2015).

Many people who live in mountainous regions of developing nations rely on natural resources for their livelihood. Therefore, according to Mukwada & Manatsa (2018), climate change poses a serious threat to the country's economy and rural life. According to Baloch & Suad (2018), Pakistan is among the top nations anticipated to face climate issues, despite its small and inconsequential share of global greenhouse gas emissions. The issue is particularly bad in Pakistan because of the nation's lengthy history of uncontrolled growth, which has had a detrimental effect on the socioeconomic structure of the nation, particularly in metropolitan areas (Hussain et al., 2018). In Pakistan, certain crops such as rice, wheat, cereals, vegetables, spices, and grains are sensitive to the climate. Reduced agricultural production, increasing temperatures, and irregular rainfall patterns are all contributing factors to the challenge of food security (Li & Yap, 2011).



Examples from Pakistan Distribution of Marine Turtles in Pakistan

A vital group of reptiles that frequent the nearby sandy beaches from Sindh's coast to Baluchistan's coast are marine turtles. During their mating season, they often go from the deeper water to the coastal regions to deposit their eggs. The Olive Ridley (*Lepidochelys olivacea*) and Green (*Chelonia mydas*) sea turtle species are often sighted in Pakistan's coastal regions, but the Loggerhead and Hawksbill turtle species are less frequently seen (Firdous, 2001). The wildlife agency conducted long-term research on the distribution and ecological characteristics of the subject, starting with Karachi's coastal areas (Firdous, 2001).

The IUCN Red List of Threatened Species includes the green turtle. As a signatory to the Conservation on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the Sindh Wildlife Protection Ordinance 1972 offers protection for turtles under its regulatory provisions. Additionally, the Federal Ministry of Food, Agriculture, and Livestock, Government of Pakistan, has prohibited the export and domestic consumption of any aquatic turtles through clause 5 of the Pakistan Fish Inspection and Quality Act 1997. Long-term research (1981–1997) of the distribution of these turtles' nesting occurrences reveals a tendency toward fewer egg-laying females being observed in Sandspit for both *C. mydas* and *L. olivacea*; this can be linked to human effects such as pollution and degradation of habitat.

Avian biodiversity

Ali (2005) conducted research on the impact of climate change on bird diversity and the available management choices in a Pakistani wetland complex classified as a Ramsar site. Pakistan's physical and strategic location makes it possible for it to act as a bird migratory route from the Palearctic to Asia. Pakistan's rivers all contribute to this important bird migratory route, which is ranked as the fourth most significant in terms of importance. Seasonal birds in flight; winter and summer visitors descend in large numbers from northern mountain regions.

The Uchalli Wetland Complex, which was designated as a Ramsar site in 1996, is made up of the three separate wetlands of Uchalli, Khabbaki, and Jahlar. These wetlands are visited by many globally endangered bird species (Ali, 2005). The study demonstrated that a variety of factors, such as variations in water level year-round in response to precipitation, sustain wetland features. The weather varies from season to season. However, drought conditions returned after 1997, with a recorded 50% decrease in rainfall. The morphology of the Uchalli Wetlands Complex revealed a decline, with just 27% (336 ha) of the water area there as opposed to 1,243 ha.

This had a significant effect on the number of migrating birds (Ali, 2005). In this wetlands complex, there was a strong positive link between the number of birds and the precipitation. Wetlands alternate between a wet and dry condition due to both short- and long-term climate trends: Salinity and other aspects of wetland water chemistry are influenced by the interactions between surface and ground water, rocks, and soils. Climate change's physical effects on lakes include increased evapo-transpiration brought on by high temperatures, prolonged growth seasons, and longer ice-free periods. Lake levels rise as precipitation increases while evapotranspiration increases reduce water levels.

The Indus River

Variations in the weather and climate have a significant impact on aquatic systems. Global climate change is a result of greenhouse gas accumulation in the atmosphere, which also affects freshwater availability and quality through precipitation patterns, evaporation, snowpack, floods, and droughts (IPCC, 2001a). Because of its heavy reliance on glacial water, the Indus River is vulnerable to climate change, much like other rivers throughout the world. More than any other river in Asia, the Indus flows seasonally, with most of its water coming from the melting of the Himalayan glaciers (70–80%) (Kiani, 2005).

The Indus Basin is in an arid region with little rainfall; yet, the monsoon season, which produces 51% of the yearly flow, is characterized by substantial flow. Due to excessive extraction for agriculture, the Indus basin already suffers from acute water shortage, which is producing saline water intrusion in the delta (WRI, 2003). Furthermore, according to Revenga et al. (1998) and WRI (2003), the Indus basin has already lost more than 90% of its natural forest cover.

Evaluating the minimal freshwater release and sediment load or alternative delta progradation engineering solutions is urgently needed. The Indus River should be managed holistically, considering all habitats, not only the coastal zone from the delta's source in the catchment region. The Indus Delta will see a greater manifestation of the negative effects of sea level rise. According to Tabrez et al. (2008), the sea level rise rate along the Karachi coast (1.1 mm per year) is predicted to double in the next century, resulting in a 20–50 cm rise in sea level.

If current trends continue, the Indus Delta will become a transgressive beach like to San Francisco because of the influence of high intensity waves on erosion and a lack of sediment intake (Haq, 1999). To assess the corresponding effects on the water inflows into our rivers, as well as the productivity and health of various ecosystems, it is necessary to develop an adaptation strategy that takes climate change into account. This strategy will be based on short- and long-term monitoring studies as well as modeling projections of expected climate changes in Pakistan over the coming decades. Strategies and procedures for climate change mitigation and adaptation should be developed through a collaborative and coordinated effort involving governmental institutions, lawmakers, officials, environmental groups, and community people.



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The Negative Effects of Pesticide Use in Agricultural Production on Aquaculture

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Abstract

Pesticides are used to increase Agricultural food crop productions to fulfill the food requirement of growing population. However these pesticides can cause contamination in aquatic ecosystem through different ways like leaching, runoff and drift spray. These contaminants produce toxicity in aquaculture which becomes threatening to aquatic organisms. For example changing behaviour of fish feeding and movement and even leads to fish mortality. Toxic compounds which were reported includes Atrazine, endosulfan, profenofos, diazinon (organophosphorus) and carbofuran (carbamate). These compounds have severe toxicological effects on fish with different concentrations and even sometime in combination. These toxic compounds also cause eradication of inhabitants in aquatic ecosystem so aquatic organisms also become more vulnerable for predators. Reproductive system of fish also disturbed. For instance, pyrethroid pesticides impact fish reproduction-related systems, The capacity of adult male salmon parr (*Salmo salar*) to recognize and react to the female priming pheromone prostaglandin F2 α (PGF2 α) was shown to be decreased when exposed to low amounts of cypermethrin. Most Agricultural pesticides undergo physical, chemical, and biological transformations that gives one or more transformation products. When the concentration is high enough to provide such an impact, aquatic creatures may be exposed to both the original compound toxicity and the transformation products. However these transformed products could be more harmful than the original molecule.

Key Words: *Agricultural Production, Pesticide Use, Aquaculture*

Introduction

Pesticides encouraged food enhancement output in response to the uncontrollably rising population (Rasul & Thapa, 2003). According to Van den Brink (2013), there are several ways in which the use of pesticides can cause pollution of the aquatic environment, including spray drift, runoff, and leaching. Pesticide contamination of water can cause fish mortality or decreased fish productivity in natural waterways, either directly or indirectly. Fish can be directly impacted by pesticides by having their typical activity changed (Satyavardhan, 2013; Ullah et al., 2014; Rani & Kumaraguru, 2014), physiological function as well as modifications to the liver, kidney, gut, and other tissues' histoarchitecture (Saeedi et al., 2012; Salam et al., 2015; Sharmin et al., 2015). By upsetting the aquatic food chain and causing a loss or change in the number of native species, pesticides have an indirect impact on the aquatic ecosystem (Parveen & Faisal, 2002).

Additionally, it may alter the fish's behavior and reduce the appropriateness of their habitat, making them more vulnerable to predators. This is a direct consequence because of an indirect effect (Prashanth et al., 2011; Gill & Raine, 2014). According to the results, these indirect effects can occasionally have a greater impact than the direct ones (Murthy et al., 2013). In addition to creating jobs, lowering poverty, and producing foreign cash, aquaculture is crucial in reducing protein deficiencies. Aquaculture ponds' inherent productivity accounts for most of the fish output. Consequently, the use of pesticides is likely to cause pond ecosystem deterioration, which would lower fish output in aquaculture ponds.

Approximately 60% of the natural food supply for bottom-feeding fish in aquaculture ponds comes from benthic invertebrates, which are an essential part of the aquatic food chain (Ali et al., 1987). Through their burrowing and eating habits, they also contribute significantly to the interactions between sediment and water. They aid in the flow of nutrients, dissolved gases, and other elements between the sediments and the water above them as well as in re-suspending the bottom of the pond. In agriculture, pesticides such as sumithion and O-O dimethyl O-(3-methyl-4-nitrophenyl) are employed to protect crops (Habib et al., 1984). In the paddy fields, it works well to manage a variety of significant insects as well as certain other arthropod pests. It is also employed in fishponds for the development of larvae to manage tiger bugs. Knowing the level of harm that these pesticides give to fish and other aquatic life is crucial since sumithion is frequently used to protect crops and eradicate aquatic insects from aquaponds.



Effects on water and sediment quality parameters

The characteristics of water quality have a major influence in the toxicity of various pesticides, which in turn has a negative impact on the variety, abundance, and dynamics of aquatic life. Even at low concentrations, fish and aquatic plants find the tastes, smells, and colors of pesticides in water distasteful and repulsive (De, 2003). Furthermore, a number of published studies showed that mass mortalities of grass carp in carp aquaculture ponds were attributed to a multifactorial disease primarily caused by bacterial agents and may be triggered by inappropriate environmental factors, such as low oxygen levels, poor feed bases, poor water quality, and acute or chronic exposure to pesticides dissolved in the water or included in the feed (Anyusheva et al., 2012).

While pH affects the physicochemical characteristics of pesticides such as hydrolysis, volatilization, and ion balancing, it usually has little effect on the toxicity of organophosphate chemicals. The application of sumithion did not alter any of the water quality measures under evaluation, including temperature, dissolved oxygen, pH, alkalinity, and nutrients. A dilution factor with a relatively tiny amount of sumithion relative to a huge volume of water may be the cause of the restricted fluctuation in the water quality variables. Numerous studies in aquaculture ponds have also noted these water quality indicators (Uddin et al., 2012; Rahman et al., 2012; Siddika et al., 2012; Nupur et al., 2013).

Lower levels of bottom resuspensions in ponds treated with sumithion may be connected to lower abundances of benthic invertebrates, which in turn may result in higher transparency and lower concentrations of phosphate and nitrate in comparison to control ponds. These ponds reduced nutrient contents may have led to a decrease in phytoplankton biomass, which is inversely correlated with transparency. In addition to serving as crucial sinks for a variety of pollutants, sediments are crucial in the remobilization of pollutants in aquatic systems when certain circumstances are met. Pesticide residues are incorporated into the aquatic food chain and eventually bioaccumulate into fish tissues through the interaction of water and contaminated sediments (Amaraneni, 2006). Furthermore, Shi et al. (2011) discovered harmful effects on aquatic animals in the water and sediments of Tai Lake in Eastern China due to the detection of trace organic contaminants, including organophosphorus pesticides.

Effects on benthic invertebrates

This research reported three kinds of benthic fauna: Mollusca, Chironomidae, and Oligochaeta. The most prevalent category of benthic fauna among the three groups was Oligochaeta, and during the course of the research, both the high and medium doses of sumithion drastically reduced the number of individual Oligochaeta. Organophosphorus insecticides have been shown to have a negative impact on benthic arthropods (e.g., McCutchan, 1999). Additionally, it has been shown that Oligochaeta colonized more quickly following the administration of herbicide (Kikuchi and Kurihara, 1982). Nonetheless, during the course of the research, the number of Oligochaeta individuals reduced, which may have been brought on by the ongoing impacts of the weekly administration of sumithion.

The second dominating family of benthic invertebrates was found to be less common in ponds containing sumithion. In an experiment to look at how pesticides affect Chironomidae, Marchiori et al. (2012) found that pesticides initially had a detrimental influence on the Chironomidae community. This suggests that the number of benthic invertebrates in aquaculture ponds was significantly decreased by a lower dosage of sumithion. Thus, the usage of pesticides in aquaculture ponds and agricultural areas is concerning for bottom feeder fish's natural food source. Pesticides do, in fact, alter the ecosystem of water bodies and disrupt the fish food supply (Maskaoui et al., 2005; Helfrich, 2009).

Pesticide toxicity to fish

Pesticide toxicity to fish has been investigated in several studies (Hamelink & Spacie, 1977; Kumaraguru & Beamish, 1981; Mulla & Mian, 1981; Barry et al., 1995; Steinberg et al., 1995; Moore & Waring, 1996; Waring & Moore, 1997; Moore et al., 1998; Csillik et al., 2000; Moore & Waring, 2001). Remarkably, not much research has indicated that fish living in natural freshwater habitats might be impacted by accidental pesticide spills (Bálint et al., 1997; Csillik et al., 2000). Many people believe that herbicides are generally safe for fish. There are few direct impacts of herbicides such as atrazine. However, research has shown that atrazine concentrations as low as 5 µg/L have an impact on zebrafish (Steinberg et al., 1995) swimming behavior. For four weeks, the fish was exposed to low doses of atrazine, and during that time, researchers examined whether it preferred bright or dark environments.

Even at the lowest measured dose (5 µg/L), which is about three orders of magnitude lower than acute toxicity data, the zebrafish changed its swimming pattern and showed a preference for darker environments. As a result, changes in schooling and eating habits may occur, potentially making prey more vulnerable to predators.



Reproductive disorders

Fish that are actively reproducing often experience physiological stress, which makes them more vulnerable to natural dangers like illness and predators. Fish that are spawning may also meet a variety of man-made substances, such as insecticides. In comparison to non-spawning fish, this may raise the hazards connected with reproduction and make spawning fish more vulnerable to toxins. For instance, it has been demonstrated that pyrethroid pesticides impact fish reproduction-related systems (Barry et al., 1995; Tanner & Knuth, 1996; Moore & Waring, 2001).

The capacity of adult male salmon parr (*Salmo salar*) to recognize and react to the female priming pheromone prostaglandin F_{2α} (PGF_{2α}) was shown to be decreased when exposed to low amounts of cypermethrin, according to Moore & Waring (2001). Due to decreased olfactory recognition of the priming pheromone, the pyrethroid decreased the rise in expressive milt and the levels of plasma sex hormones. According to the scientists, the pyrethroid exposure directly affected the sodium channels, which in turn prevented the olfactory system's nerve signals from being sent. According to Moore & Waring (2001), cypermethrin exposure decreased the amount of fertilization in salmon eggs and milt, indicating a further harmful effect of the pesticide on salmon reproduction. Esfenvalerate, another pyrethroid, has also been demonstrated to reduce fry growth, delay spawning, and reduce hatching in bluegills (*Lepomis macrochirus*; Tanner & Knuth, 1996) as well as to decrease fecundity and egg failure in Australian crimson spotted rainbowfish (*Melanotaenia fluviatilis*; Barry et al., 1995).

Additionally, additional pesticides that come from a wide range of pesticide groups prevent male salmon from detecting and responding to female priming pheromones, which may have an impact on the effectiveness of salmon reproduction (Moore & Waring, 1996; Waring & Moore, 1997; Moore & Waring, 1998). At doses as low as 1.0 µg/L, the two insecticides—diazinon (organophosphorus) and carbofuran (carbamate)—exhibited comparable effects to cypermethrin (Waring & Moore, 1997). Additionally, the herbicide atrazine affects systems involved in salmon reproduction. It has been determined that atrazine has a 96-hour LC₅₀-value of >18 and 6.3 mg/L for rainbow trout and brook trout, respectively, suggesting that it is a reasonably mild toxicant for fish. At 0.04 µg atrazine/L, the male salmon's reaction to female pheromones was already impacted, leading to a decrease in the priming effect on milt and a reduction in plasma sex steroid levels (Moore & Waring, 1998).

Joint Toxicity of Pesticides

There is less evidence in the literature to suggest that accidental pesticide spills cause ecological disruption in natural aquatic habitats. On the other hand, the lack of knowledge on pesticides can be the biggest threat to aquatic ecosystems. Although we are aware that several pesticide groups have comparable modes of action (Ecobichon, 1991; Belden & Lydy, 2000), nothing is known about their combined toxicity. Since agricultural pesticides are frequently used in combination to protect crops, there is a clear possibility that they will have additive or even synergistic effects.

In Australia, the endosulfan pesticide had detrimental impacts on the macroinvertebrate fauna after cotton field runoff events in the Namoi River watershed (Leonard et al., 1999). In this field investigation, high endosulfan concentrations impacted five out of the six dominating species. While endosulfan has a stronger link with the densities of the examined species, profenofos' presence cannot be completely ruled out. Organophosphorus pesticide profenofos is very hazardous to fish and other macroinvertebrates. It is known that endosulfan and a related organophosphorus pesticide have toxicologically synergistic effects (Arnold et al., 1995).

Moreover, terrible fish fatalities linked to accidental pesticide spills have been documented. Large numbers of eels (*Anguilla anguilla*) perished in Lake Balaton in Hungary, the biggest freshwater lake in Europe, in 1991 & 1995 (Bálint et al., 1997). Numerous scientific organizations were participating in the effort to identify potential causes of the widespread fish mortality. Among the elements examined were pesticides, bacterial infections, eutrophication, and water temperature. *Anguillicola crassus* is a parasite. Pyrethroid poisoning appears to be the primary cause of the eel deaths in Lake Balaton, despite the existence of conflicting theories.

In order to repel mosquitoes, the area was treated with both permethrin and deltamethrin. The pesticides were detected in fish tissues, with the gills containing the greatest concentrations. Furthermore, a typical sign of pesticide exposure was a substantial inhibition of AChE in eels and other fish species.

The micro-layer theory, which postulates that pesticides created a very thin layer on the water's surface, provided an explanation for why eels were the primary species impacted. Eels frequently stick their heads above the surface, exposing them to pesticides. Comprehensive study is required to be able to rule out other reasons than pesticides, even when the consequences are evident and catastrophic as in this instance.

There are even more complex situations where the results are difficult to define and quantify. One such pyrethroid, cypermethrin, is primarily used in sheep dips in the United Kingdom to prevent and cure lice, scabs, and ticks on sheep. It is also used to treat infestations of parasitic sea louse (*Lepeophtheirus salmonis*) in intensive salmonid farming. According to Moore & Waring (2001), sheep are often treated in October, and cypermethrin has been detected in many salmon breeding rivers and tributaries in November and December.



In fish, insects, and mammals, pyrethroids are more poisonous at low temperatures than they are at high ones (Kumaraguru & Beamish, 1981; Song & Narahashi, 1996). Thus, during the cold season—when salmon spawning, for example—there is an increased danger of deleterious effects by pyrethroids on the aquatic ecology. Apart from the potential adverse impacts on salmon reproduction, pyrethroids have the potential to influence olfactory imprinting to the birth river, which might significantly reduce the capacity of adult salmon to return to their home river for spawning (Moore & Waring, 2001). The fact that pyrethroid impacts on salmon spawning regions have not yet been studied may be attributed to their difficulty in quantifying harmful levels in natural water are harder to detect because pyrethroid pesticides can be harmful in extremely low quantities, sometimes even below the detection limit (Hedlund, 2002).

Apart from the parent chemicals, we also need to consider the fact that most pesticides used in agriculture undergo physical, chemical, and biological transformations that result in one or more transformation products. When the concentration is high enough to provide such an impact, aquatic creatures may be exposed to both the parent poisons and the transformation products. Indeed, according to Belden & Lydy (2000), the transformation product can occasionally be more harmful than the original molecule.

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Production, Foreign Trade, Use, and Support Policies of Chemical Fertilizers in Türkiye

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Abstract

In this study, the production, trade, usage, and support policies of chemical fertilizers in Türkiye are examined. Chemical fertilizers are inorganic materials that provide essential nutrients to improve plant productivity and quality. In 2022, a total of 207 million 175 thousand 748 tons of chemical fertilizers were produced globally, with Türkiye accounting for 0.83% of this production. Nitrogenous and phosphorous fertilizers are prominent in fertilizer use, and due to domestic production not meeting demand, Türkiye holds a significant position as an importer. According to foreign trade data, Türkiye lags considerably in terms of exports, yet ranks as the 6th largest importer of nitrogenous fertilizers and 14th in the import of phosphorous fertilizers. The major challenges associated with chemical fertilizer use include environmental impacts, ecosystem degradation due to improper use, and soil and water pollution. To prevent these issues, the adoption of soil analysis and good management practices is necessary. Moreover, government policies and support mechanisms play a critical role in promoting the sustainable use of chemical fertilizers. The study also examines the relationship between fertilizer costs and government subsidies in Türkiye and discusses the effects of these subsidies on agricultural enterprises. The findings highlight the importance of chemical fertilizers for agricultural production and productivity, while indicating that farmers do not find these fertilizer subsidies sufficient and that a balance must be established between environmental sustainability and economic efficiency.

Key Words: Chemical Fertilizer, Import, Support Policies, Sustainability

Türkiye’de Kimyevi Gübrelerin Üretimi, Dış Ticareti, Kullanımı ve Destekleme Politikaları

Özet

Bu çalışmada, Türkiye’deki kimyasal gübrelerin üretimi, ticareti, kullanımı ve destekleme politikaları incelenmiştir. Kimyasal gübreler, bitki verimliliğini ve kalitesini artırmak için temel besin maddeleri sağlayan inorganik materyallerdir. 2022 yılında dünya genelinde toplam 207 milyon 175 bin 748 ton kimyasal gübre üretilmiş olup, Türkiye bu üretimin %0,83’ünü oluşturmaktadır. Gübre kullanımında azotlu ve fosforlu gübreler öne çıkmakta olup, yurtiçi üretimin talebi karşılayamaması nedeniyle Türkiye önemli bir ithalatçı konumundadır. Dış ticaret verilerine göre, Türkiye ihracatta oldukça geride kalırken, azotlu gübre ithalatında 6., fosforlu gübre ithalatında ise 14. sırada yer almaktadır. Kimyasal gübre kullanımında karşılaşılan en büyük zorluklar arasında çevresel etkiler, yanlış kullanım nedeniyle ekosistem bozulmaları ve toprak ile su kirliliği yer almaktadır. Bu sorunların önlenmesi için toprak analizi ve iyi yönetim uygulamalarının benimsenmesi gerekmektedir. Ayrıca, hükümet politikaları ve destek mekanizmaları, kimyasal gübrelerin sürdürülebilir kullanımını teşvik etmede kritik bir rol oynamaktadır. Çalışmada, Türkiye’deki gübre maliyetleri ile devlet destekleri arasındaki ilişki de incelenmiş ve bu desteklerin tarım işletmeleri üzerindeki etkileri tartışılmıştır. Elde edilen bulgular, kimyasal gübrelerin tarımsal üretim ve verimlilik açısından önemini vurgularken, çiftçilerin bu gübre desteklerini yeterli düzeyde bulmadığını ve çevresel sürdürülebilirlik ile ekonomik verimlilik arasında bir dengenin kurulması gerektiğini ortaya koymaktadır.

Anahtar Kelimeler: Kimyevi Gübre, İthalat, Destekleme Politikaları, Sürdürülebilirlik

Giriş

Artan nüfusun gıda ihtiyacını karşılamak için, tarımsal arazinin birim alanında verimlilik ve kaliteyi sağlamak gerekmektedir. Bitkilerin beslenmesinin, tarımsal verimlilik ve kaliteyi kontrol eden en önemli faktörlerden biri olduğu bilinmektedir. Bu bağlamda, yapılan tarımsal faaliyetlerde gübreleme işlemi ön plana çıkmaktadır (Savci, 2012). Gübre, bitkilerin büyümesi ve verimliliğini artırmak için toprak veya bitki yüzeyine uygulanan, gerekli besinleri sağlayan maddelerdir (Mengel & Kirkby, 2001). Tarımda en çok kullanılan gübre sınıfı ise kimyevi gübrelerdir. Kimyevi gübreler, bitkilere azot (N), fosfor (P) ve potasyum (K) gibi temel besin maddelerini sağlayan inorganik maddelerdir. Bu besin maddeleri, bitki büyümesi, gelişimi ve verimi için oldukça önemlidir (Stewart et al., 2005; Pahalvi et al., 2021).



Sürekli olarak tarımsal faaliyetlerde bulunulması, toprak besin maddelerini tüketebilir ve zamanla toprak verimliliğini düşürebilir. Kimyevi gübrelerin uygulanması bu besin maddelerini yenileyerek toprak sağlığını ve üretkenliğini korur (Sanchez, 2010). Ayrıca uzun dönemli çalışmalar, N, P ve K dengeli gübrelemesinin toprak verimliliğini sürdürebileceğini ve toprak organik madde içeriğini artırabileceğini göstermiştir (Chen et al., 2008). Özellikle azot, klorofilin temel bileşeni olup, fotosentez için kritiktir. Fosfor, enerji transferi ve kök gelişimi için gereklidir, potasyum ise su alımını ve enzim aktivitesini düzenler (Mengel & Kirkby, 2001). Çeşitli bitkilerde yapılan çalışmalar, uygun kimyevi gübre kullanımının verimi önemli ölçüde artırabileceğini göstermiştir (Cassman et al., 2002). Bunlarla birlikte, kimyevi gübre kullanımının ormansızlaşma ve arazi dönüşüm ihtiyacını azalttığı bildirilmektedir (Tilman et al., 2002).

Kimyevi gübre kullanımının faydalarına rağmen, bazı zorlukları ve çevresel endişeleri de vardır. Aşırı uygulama veya yanlış kullanım, besin maddelerinin yüzey akışına, su kirliliğine ve ekosistemlerinin bozulmasına yol açabilir (Carpenter et al., 1998). Ayrıca, aşırı azot gübrelemesi, sera gazları olan azot oksitlerinin (N_2O) salınımına neden olarak iklim değişikliğine katkıda bulunabilir (Snyder et al., 2009). Bu nedenle, kimyevi gübrelerin faydalarını maksimize ederken çevresel etkilerini en aza indirmek için toprak analizinin yapılması, iyi yönetim uygulamaları ve hassas tarım gibi tekniklerinin benimsenmesi önemlidir (Mulla, 2013; Zhang et al., 2015; Penuelas et al., 2023). Hükümet politikaları ve destek mekanizmaları, kimyevi gübrelerin sürdürülebilir kullanımını teşvik etmede kritik roller oynar. Bu bağlamda, üretim alanı, verimlilik, rekabet ve gelirin artırılması ile kırsal kalkınmanın sağlanması gibi amaçlarla kimyevi gübrelere farklı şekillerde sübvansiyonlar uygulanmaktadır (Morris et al., 2007). Tarımsal yayım ve danışmanlık hizmetleri ise çiftçilerin kimyevi gübreleri uygulama ve benimsemelerinde yardımcı araçlar olabilir (Pingali & Shah, 2001). Tüm bunlara karşılık, politika yapıcılarının gübre kullanımını teşvik etme ve çevresel sürdürülebilirliği sağlama arasında bir denge kurması gerekmektedir (Wang et al., 2023).

Tüm bu hususlar değerlendirildiğinde, kimyevi gübrelerin gıda ve tarım sektörü açısından önemli bir yere sahip olduğu görülmektedir. Konunun daha iyi bir şekilde ele alınabilmesi ve özellikle Türkiye'deki durumun ortaya konması amacıyla, bu çalışmada Türkiye'de başlıca kimyevi gübrelerin üretimi, ticareti, kullanımı (tüketimi) ve destekleme politikaları incelenmiştir. Ayrıca tarım işletmelerinde gübre maliyeti ve gübre desteği arasındaki ilişki incelenmiş ve gübre desteğinin işletmeler üzerindeki etkileri literatürden referans alınarak tartışılmıştır.

Materyal ve Yöntem

Bu çalışmanın ana materyalini ikincil veri kaynakları oluşturmaktadır. Çalışmada, Birleşmiş Milletler Gıda ve Tarım Örgütü (United Nations Food and Agriculture Organization - FAO), Uluslararası Ticaret Merkezi (International Trade Center – ITC) ve Tarım ve Orman Bakanlığı (TOB) gibi kurum ve kuruluşlardan elde edilen istatistikî verilerin yanı sıra, konuyla ilgili ulusal ve uluslararası düzeyde yayınlanan makale, bildiri ve rapor gibi çeşitli kaynaklardan faydalanılmıştır. Söz konusu veri ve kaynaklardan elde edilen bulgular, çizelge ve şekil haline getirilerek yorumlanmış ve tartışılmıştır. Bu hususlara ek olarak çalışmada, cari fiyatların reel fiyatlara dönüştürülmesi için Tarımsal ÜFE (2020=100) deflatörü kullanılmıştır.

Bulgular ve Tartışma

Türkiye'de Kimyevi Gübre Üretimi

Dünya genelinde 2022 yılında toplam 207 milyon 175 bin 748 ton kimyevi gübre (N+P+K) üretilmiştir. Bu üretimin 118 milyon 150 bin 583 tonunu (%57,03) azot (N) grubu gübreler, 46 milyon 110 bin 940 tonunu (%22,26) fosfor (P) grubu gübreler ve 42 milyon 914 bin 224 tonunu (%20,71) potasyum (K) grubu gübreler oluşturmaktadır. Azotlu gübre üretiminde en yüksek paya %21,70 ile Çin sahipken, %13,32 ile Hindistan ikinci, %11,69 ile ABD üçüncü, %10,09 ile Rusya dördüncü ve %4,03 ile Suudi Arabistan beşinci sırada yer almaktadır. Fosforlu gübre üretiminde en yüksek paya %27,97 ile Çin sahipken, %11,81 ile Fas ikinci, %10,98 ile ABD üçüncü, %10,86 ile Hindistan dördüncü ve %9,42 ile Rusya beşinci sırada yer almaktadır. Potasyumlu gübre üretiminde ise en yüksek paya %31,58 ile Kanada sahipken, %17,62 ile Belarus ikinci, %17,00 ile Rusya üçüncü, %9,63 ile Çin dördüncü ve %6,11 ile İsrail beşinci sırada yer almaktadır (FAO, 2024).

Türkiye, 2022 yılında toplam 1 milyon 728 bin 789 ton kimyevi gübre (N+P+K) üretmiştir. Türkiye'nin dünya genelindeki toplam üretim içindeki payı %0,83'tür. Aynı yıl Türkiye, azotlu gübreler üretiminde %0,86'lık pay ile 19. sırada, fosforlu gübreler grubunda %1,26'lık pay ile 10. sırada ve potasyumlu gübreler grubunda %0,31'lik pay ile 17. sırada yer almaktadır (FAO, 2024).

Çizelge 1'de, 2018-2022 yılları arasında Türkiye'nin kimyevi gübre üretimindeki mevcut durumu ve değişimleri detaylı olarak ele alınmıştır. Azotlu (N) gübreler, 2018'de 979.901 ton üretimle başlayıp 2022'de 1.014.085 tona ulaşarak %58,66'lık oranla en yüksek paya sahiptir. Fosforlu (P) gübrelerinin üretimi, aynı dönemde 468.740 tondan 582.016 tona yükselmiş ve %33,67 oranında bir pay elde etmiştir. Potasyumlu (K) gübrelerin ise 2018'de üretim verisi bulunmazken, 2022'de 132.688 ton üretilmiş ve %7,68 ile en düşük payı almıştır. Toplam kimyevi gübre üretimi (N+P+K), 2018'de 1.448.641 tondan 2022'de 1.728.789 tona çıkmıştır. 2018 yılı baz alındığında, üretim endeksi 2022'de 119,34 seviyesine ulaşmıştır. Bu veriler, Türkiye'de kimyevi gübre üretiminde genel bir artış eğilimi olduğunu, ancak yıllara göre bazı dalgalanmalar yaşandığını göstermektedir.



Çizelge 1. Türkiye’de kimyevi gübre üretimi (ton)

	2018	2019	2020	2021	2022	Oran (%)
Azot (N)	979.901	1.143.689	1.469.117	1.325.527	1.014.085	58,66
Fosfor (P)	468.740	497.642	761.628	739.836	582.016	33,67
Potasyum (K)	-	99.844	112.870	154.814	132.688	7,68
Toplam (N+P+K)	1.448.641	1.741.175	2.343.615	2.220.177	1.728.789	100,00
İndeks (2018=100)	100,00	120,19	161,78	153,26	119,34	-
Zincirleme İndeks	100,00	120,19	134,60	94,73	77,87	-

Kaynak: FAO, 2024

Türkiye’de Kimyevi Gübre Dış Ticareti

Dünya genelinde 2022 yılında toplam 96 milyon 707 bin 228 ton kimyevi gübre (N+P+K) ihracatı gerçekleşmiştir. Bu ihracatın 43 milyon 841 bin 64 tonunu (%45,33) azot (N) grubu gübreler, 18 milyon 627 bin 313 tonunu (%19,26) fosfor (P) grubu gübreler ve 34 milyon 238 bin 911 tonunu (%35,40) potasyum (K) grubu gübreler oluşturmaktadır. Azotlu gübre ihracatında en yüksek paya %16,44 ile Rusya sahipken, %11,94 ile Çin ikinci, %6,14 ile Katar üçüncü, %5,90 ile Suudi Arabistan dördüncü ve %5,60 ile ABD beşinci sırada yer almaktadır. Fosforlu gübre ihracatında en yüksek paya %20,65 ile Fas sahipken, %18,26 ile Çin ikinci, %16,58 ile Rusya üçüncü, %11,14 ile Suudi Arabistan dördüncü ve %9,69 ile ABD beşinci sırada yer almaktadır. Potasyumlu gübre ihracatında ise en yüksek paya %37,26 ile Kanada sahipken, %23,33 ile Rusya ikinci, %7,57 ile Belarus üçüncü, %7,56 ile İsrail dördüncü ve %6,63 ile Almanya beşinci sırada yer almaktadır (FAO, 2024).

Türkiye, 2022 yılında toplam 514 bin 567 ton kimyevi gübre (N+P+K) ihraç etmiştir. Türkiye'nin dünya genelinde toplam ihracat içindeki payı %0,53'dür. Aynı yıl Türkiye, azotlu gübreler ihracatında %0,76'lık pay ile 24. sırada, fosforlu gübreler grubunda %0,75'lik pay ile 15. sırada ve potasyumlu gübreler grubunda %0,12'lik pay ile 24. sırada yer almaktadır (FAO, 2024).

Dünya genelinde 2022 yılında toplam 96 milyon 985 bin 693 ton kimyevi gübre (N+P+K) ithalatı gerçekleşmiştir. Bu ithalatın 44 milyon 335 bin 148 tonunu (%45,71) azot (N) grubu gübreler, 19 milyon 170 bin 320 tonunu (%19,77) fosfor (P) grubu gübreler ve 33 milyon 480 bin 225 tonunu (%34,52) potasyum (K) grubu gübreler oluşturmaktadır. Azotlu gübre ithalatında en yüksek paya %14,68 ile Hindistan sahipken, %13,82 ile Brezilya ikinci, %8,18 ile ABD üçüncü, %4,45 ile Fransa dördüncü ve %3,77 ile Avustralya beşinci sırada yer almaktadır. Fosforlu gübre ithalatında en yüksek paya %20,37 ile Brezilya sahipken, %19,52 ile Hindistan ikinci, %4,99 ile Bangladeş üçüncü, %4,84 ile Kanada dördüncü ve %4,83 ile ABD beşinci sırada yer almaktadır. Potasyumlu gübre ithalatında ise en yüksek paya %22,45 ile Brezilya sahipken, %19,89 ile ABD ikinci, %14,80 ile Çin üçüncü, %5,90 ile Endonezya dördüncü ve %5,58 ile Hindistan beşinci sırada yer almaktadır (FAO, 2024).

Türkiye, 2022 yılında toplam 1 milyon 792 bin 468 ton kimyevi gübre (N+P+K) ithal etmiştir. Türkiye'nin dünya genelinde toplam ithalat içindeki payı %1,85'dir. Aynı yıl Türkiye, azotlu gübreler ithalatında %3,15'lik pay ile 6. sırada, fosforlu gübreler grubunda %1,25'lik pay ile 14. sırada ve potasyumlu gübreler grubunda %0,47'lik pay ile 25. sırada yer almaktadır (FAO, 2024).

Çizelge 2, 2018-2022 yılları arasında Türkiye'nin kimyevi gübre dış ticaretini göstermektedir. İhracat verilerine bakıldığında, Azotlu (N) gübrelerinin ihracatı 2018'de 241.068 tondan 2022'de 335.502 tona çıkarak %65,20'lik oranla en yüksek paya sahip olmuştur. Fosforlu (P) gübrelerinin ihracatı aynı dönemde 105.683 tondan 139.075 tona yükselmiş ve %27,03 oranında pay almıştır. Potasyum (K) gübrelerinin ihracatı ise 14.177 tondan 39.990 tona çıkmış ve %7,77'lik en düşük paya sahip olmuştur. Toplam kimyevi gübre ihracatı, 2018'de 360.928 tondan 2022'de 514.567 tona yükselmiştir. İhracat endeksi, 2018 yılı baz alındığında 2022'de 142,57 seviyesine ulaşmıştır.

Çizelge 2. Türkiye’nin kimyevi gübre dış ticareti (ton)

		2018	2019	2020	2021	2022	Oran (%)
İhracat Miktarı (ton)	Azot (N)	241.068	331.227	335.163	275.289	335.502	65,20
	Fosfor (P)	105.683	126.027	190.851	136.879	139.075	27,03
	Potasyum (K)	14.177	34.227	29.467	32.427	39.990	7,77
	Toplam (N+P+K)	360.928	491.481	555.481	444.595	514.567	100,00
	İndeks (2018=100)	100,00	136,17	153,90	123,18	142,57	-
	Zincirleme İndeks	100,00	136,17	113,02	80,04	115,74	-
İthalat Miktarı (ton)	Azot (N)	1.391.751	1.693.311	1.441.799	1.489.995	1.396.288	77,90
	Fosfor (P)	289.699	452.051	358.369	282.179	239.864	13,38
	Potasyum (K)	168.550	177.826	226.141	231.207	156.316	8,72
	Toplam (N+P+K)	1.850.000	2.323.188	2.026.309	2.003.381	1.792.468	100,00
	İndeks (2018=100)	100,00	125,58	109,53	108,29	96,89	-
	Zincirleme İndeks	100,00	125,58	87,22	98,87	89,47	-

Kaynak: FAO, 2024



İthalat verilerine göre, Azotlu (N) gübrelerinin ithalatı 2018'de 1.391.751 tondan 2022'de 1.396.288 tona çıkarak %77,90'lık oranla en yüksek paya sahip olmuştur. Fosfor (P) gübrelerinin ithalatı aynı dönemde 289.699 tondan 239.864 tona düşerek %13,38 oranında pay almıştır. Potasyum (K) gübrelerinin ithalatı ise 168.550 tondan 156.316 tona düşerek %8,72 ile paya sahip olmuştur. Toplam kimyevi gübre ithalatı, 2018'de 1.850.000 tondan 2022'de 1.792.468 tona düşmüştür. İthalat endeksi, 2018 yılı baz alındığında 2022'de 96,89 seviyesine gerilemiştir (Çizelge 2).

Türkiye, 2022 yılında 3 milyar 31 milyon 474 bin ABD\$ değerinde kimyevi gübre ithalatı gerçekleştirmiştir. İthalat yaptığı ülkeler arasında %31,81 ile Umman ilk sırada yer alırken, %12,67 ile Çin ikinci ve %11,72 ile Rusya üçüncü sırada bulunmaktadır. Aynı yıl, Türkiye 982 milyon 569 bin ABD\$ değerinde kimyevi gübre ihraç etmiştir. İhracat yaptığı başlıca ülkeler arasında %21,52 ile Romanya ilk sırada yer alırken, %11,58 ile Irak ikinci ve %5,15 ile İtalya üçüncü sırada yer almaktadır (Şekil 1).



Şekil 1. Türkiye'nin gübre sektöründe ticaretle bulduğu başlıca ülkeler (2022 yılı)*

Kaynak: ITC, 2024

*Söz konusu veriler Çizelge 2'den farklı olarak tüm gübre ticaretini kapsamaktadır

Bu veriler genel olarak değerlendirildiğinde, Türkiye'nin kimyevi gübre ihracatında genel bir artış eğilimi olduğunu, ithalatında ise dalgalanmalar yaşandığını ve özellikle fosfor (P) ve potasyum (K) gübrelerinin ithalatında düşüşler gözlemlendiğini göstermektedir. Bununla birlikte, Türkiye'nin ihracattan ziyade kimyevi gübrede ithalatçı bir konumda olduğu söylenebilir.

Türkiye'de Kimyevi Gübre Kullanımı

Dünya genelinde 2022 yılında toplam 185 milyon 14 bin 235 ton kimyevi gübre (N+P+K) kullanılmıştır. Bu kullanımın 107 milyon 718 bin 634 tonunu (%58,22) azot (N) grubu gübreler, 41 milyon 869 bin 444 tonunu (%22,63) fosfor (P) grubu gübreler ve 35 milyon 426 bin 157 tonunu (%19,15) potasyum (K) grubu gübreler oluşturmaktadır. Azotlu gübre kullanımında en yüksek paya %22,80 ile Çin sahipken, %18,76 ile Hindistan ikinci, %10,61 ile ABD üçüncü, %6,29 ile Brezilya dördüncü ve %3,40 ile Pakistan beşinci sırada yer almaktadır. Fosforlu gübre kullanımında en yüksek paya %23,12 ile Çin sahipken, %18,92 ile Hindistan ikinci, %13,70 ile Brezilya üçüncü, %8,77 ile ABD dördüncü ve %2,79 ile Avustralya beşinci sırada yer almaktadır. Potasyumlu gübre kullanımında ise en yüksek paya %25,35 ile Çin sahipken, %21,70 ile Brezilya ikinci, %12,06 ile ABD üçüncü, %5,55 ile Endonezya dördüncü ve %4,84 ile Hindistan beşinci sırada yer almaktadır (FAO, 2024).

Türkiye, 2022 yılında toplam 2 milyon 313 bin 688 ton kimyevi gübre (N+P+K) kullanmıştır. Türkiye'nin dünya genelindeki toplam kullanım içindeki payı %1,25'dir. Aynı yıl Türkiye, azotlu gübreler kullanımında %1,47'lik pay ile 13. sırada, fosforlu gübreler grubunda %1,44'lük pay ile 12. sırada ve potasyumlu gübreler grubunda %0,37'lik pay ile 27. sırada yer almaktadır (FAO, 2024).

FAO 2022 yılı verilerine göre, birim alana en fazla azotlu gübre kullanan ülke 328,22 kg/ha ile Mısır olurken, bunu sırasıyla 309,40 kg/ha ile Türkmenistan, 191,35 kg/ha ile Çin, 187,24 kg/ha Özbekistan ve 176,59 kg/ha ile İrlanda takip etmektedir. Birim alana en fazla fosforlu gübre kullanan ülke 130,64 kg/ha ile Tayvan olurken, bunu sırasıyla 120,56 kg/ha ile Bangladeş, 105,77 kg/ha ile Kuveyt, 90,46 kg/ha Brezilya ve 76,59 kg/ha ile Hong Kong takip etmektedir. Birim alana en fazla potasyumlu gübre kullanan ülke 180,00 kg/ha ile Kuveyt olurken, bunu sırasıyla 127,43 kg/ha ile Tayvan, 126,89 kg/ha ile Kosta Rika, 120,04 kg/ha Umman ve 115,20 kg/ha ile Brezilya takip etmektedir.

Türkiye, azotlu gübrelerde 66,18 kg/ha ile birim alana en fazla gübre kullanan 46. ülke olurken, fosforlu gübre kullanımında 25,29 kg/ha ile 32. ülke ve potasyumlu gübre kullanımında 5,48 kg/ha ile 110. sıradaki ülke olmuştur (FAO, 2024).



Çizelge 3. Türkiye tarımında gübre kullanım miktarları

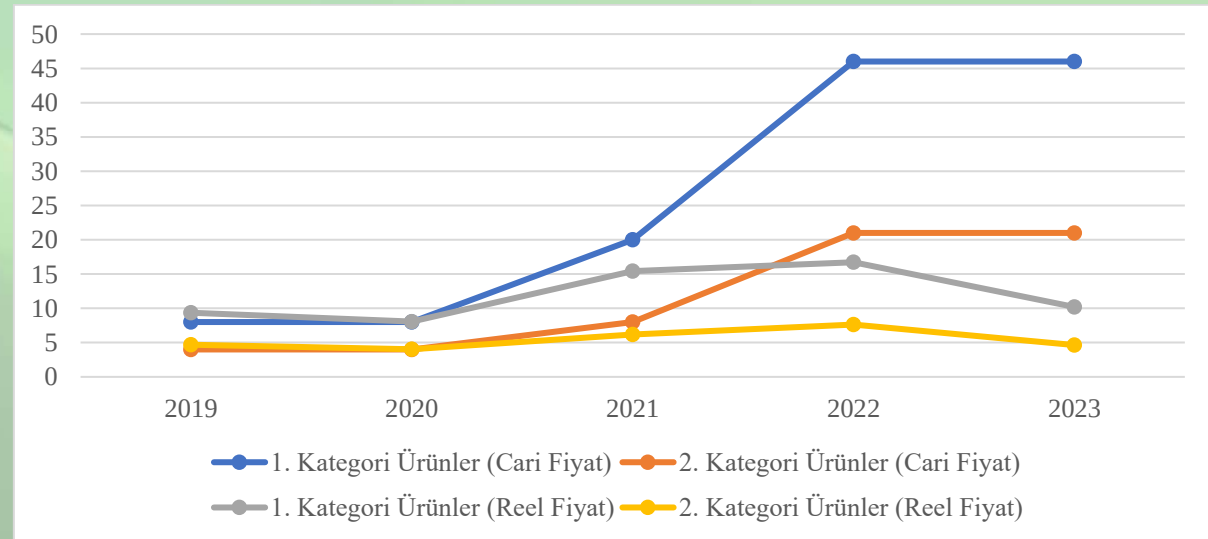
		2018	2019	2020	2021	2022	Oran (%)
Toplam Kullanım Miktarı (ton)	Azot (N)	1.527.588	1.682.549	2.052.685	1.787.348	1.579.383	68,26
	Fosfor (P)	521.058	667.367	763.639	633.575	603.558	26,09
	Potasyum (K)	115.512	116.500	114.565	154.223	130.747	5,65
	Toplam (N+P+K)	2.164.158	2.466.416	2.930.889	2.575.146	2.313.688	100,00
	İndeks (2018=100)	100,00	113,97	135,43	118,99	106,91	-
	Zincirleme İndeks	100,00	113,97	118,83	87,86	89,85	-
Birim Alana Kullanım Miktarı (kg/ha)	Azot (N)	65,90	72,84	88,69	76,14	66,18	68,26
	Fosfor (P)	22,48	28,89	32,99	26,99	25,29	26,09
	Potasyum (K)	4,98	5,04	4,95	6,57	5,48	5,65
	Toplam (N+P+K)	93,36	106,77	126,63	109,70	96,95	100,00
	İndeks (2018=100)	100,00	114,36	135,64	117,50	103,85	-
	Zincirleme İndeks	100,00	114,36	118,60	86,63	88,38	-

Kaynak: FAO, 2024

Çizelge 3’de, Türkiye tarımında gübre kullanım miktarları yıllara göre verilmektedir. 2018-2022 döneminde, toplam gübre kullanım miktarı (azot, fosfor ve potasyum) 2.164.158 tondan 2.313.688 tona yükselmiştir. Azot (N) gübreleri, toplam kullanımın %68,26’sını oluştururken, fosfor (P) %26,09 ve potasyum (K) %5,65 oranında kullanılmıştır. Birim alana kullanım miktarına (kg/ha) bakıldığında, 2018 yılında 93,96 kg/ha olarak gerçekleşen toplam gübre kullanımı 2022 yılında 96,95 kg/ha çıkmıştır. İndeks verileri, toplam gübre kullanımında genel bir artış olduğunu göstermekte, ancak bu artışın her yıl düzenli olmadığı, bazı yıllarda düşüşler yaşandığı görülmektedir. Zincirleme indeks değerleri de yıllık değişim oranlarını yansıtarak, gübre kullanımında dalgalanmalar olduğunu belirtmektedir. Bu veriler, Türkiye’de tarım sektöründe gübre kullanımının önemli ölçüde arttığını ancak dalgalanmalara maruz kaldığını göstermektedir.

Türkiye’de Kimyevi Gübre Destekleme Politikaları ve Tarım İşletmeleri Üzerine Etkilerinin Değerlendirilmesi

Şekil 2, Türkiye’de kimyevi gübreye sağlanan tarımsal desteklerin yıllara göre değişimini göstermektedir. Cari fiyatlar açısından, 1. kategoride yer alan ürünlere verilen destek 2019 yılında 8 TL/da iken, 2023 yılında 46 TL/da yükselmiştir. Bu destekler, 2019-2020 ve 2022-2023 yılları arasında sabit kalmıştır. 2. kategori ürünler için de benzer bir eğilim gözlemlenmiş ve destekler 2019’da 4 TL/da iken, 2023’te 21 TL/da olmuştur. Reel fiyatlar açısından değerlendirildiğinde ise, 1. kategorideki destek ürünleri 2019’da 9,37 TL/da iken, 2023’te 10,18 TL/da gerilemiştir. 2. kategori ürünlerde ise destek 2019’da 4,68 TL/da, 2023’te 4,65 TL/da olarak gerçekleşmiştir. Bu durum, cari fiyatlarda görülen artışlara rağmen reel olarak önemli bir değişim olmadığını göstermektedir.



Şekil 2. Türkiye’de ürün grupları bazında kimyevi gübre destekleme uygulamaları (TL/da)*

Kaynak: Resmi Gazete, 2019, 2020, 2021, 2022, 2023

1. Kategori ürünler; buğday, arpa, çavdar ve tritcale; Kategori ürünler; çeltik, kütü pamuk, nohut, kuru fasulye, mercimek, patates, yağlık ayçiçeği, soya, dane mısır, kuru soğan, kanola, aspir, yaş çay, fındık, yem bitkileri, zeytin ve diğer ürünler; * Ürünlerin kategorilendirilmesi yazarlar tarafından belirtilen kaynaklardan derlenerek oluşturulmuştur.



Şekil 2’de yer alan hususlara ek olarak, 29 Ağustos 2024 tarihinde Resmî Gazete’de yayımlanan Cumhurbaşkanlığı Kararı doğrultusunda, 2025-2027 yılları arasında yapılacak bitkisel üretime yönelik desteklemelerde bazı yapısal değişikliklere gidilmiştir. Bu kapsamda, önceki yıllardan farklı olarak 2025 yılı için mazot ve gübre gibi alan bazlı destekler kaldırılarak yerine hepsini içine kapsayan “temel destek katsayısı” getirilmiştir. Ürün bazında verilecek destek tutarları ise, bu temel destek katsayısının, her ürün için belirlenen ayrı bir katsayı ile çarpılmasıyla hesaplanacaktır. Örneğin, buğday için destek katsayısı 1,30 olarak belirlenmiştir ve bu katsayı 244 TL ile çarpıldığında, buğday üreticilerine 317,20 TL/da destek verilecektir. Destek katsayıları ve ürünlere ilişkin detaylı bilgi Çizelge 4’de sunulmuştur (Resmi Gazete, 2024).

Çizelge 4. Temel destek kategorileri, ürünleri ve destek katsayıları

Kategoriler	Ürünler	Destek Katsayısı
1. Kategori Ürünler	Aspir, Mercimek, Mısır (dane), Nohut, Patates, Soğan (kuru), I. grup yem bitkileri*, Diğer ürünleri	1,00
2. Kategori Ürünler	Arpa, Buğday, Çavdar, Triticale, Yulaf, II. grup yem bitkileri**	1,30
3. Kategori Ürünler	Ayçiçeği (yağlık), Fındık, Kanola (kolza), Fasulye (kuru), Soya, Çay	1,50
4. Kategori Ürünler	Çeltik, Pamuk (kütü)	2,25

Kaynak: Resmi Gazete, 2024; * Nadas alanlarına 0,30 destek katsayısı ile destek katsayısı değerinin çarpımı sonucu hesaplanan tutar üzerinden temel destek ödenir; ** I. grup yem bitkileri fığ, burçak, mürdümük, hayvan pancarı, yem bezelyesi, yem baklası, üçgül, italyan çimi, yulaf (yeşil ot), çavdar (yeşil ot) ve tritikale (yeşil ot) ile bu ürünlerden yapılan slajlar. II. grup yem bitkileri ise yonca, korunga, yapay çayır mera, slajlık mısır, slajlık soya, sorgum out, sudan out, sorgum-sudan otu melezi ürünlerini kapsar.

Gübre kullanımı tarım işletmeleri için ön plana çıkan oldukça önemli bir girdi kalemidir. Topçu et al. (2012) yaptığı çalışmada, şekerpancarı üretiminde gübre masrafının değişken masrafların %19,15’ini, toplam üretim masraflarının ise %15,10’unu oluşturduğunu tespit etmiştir. Candemir et al. (2017), Kahramanmaraş ilinde mısır ve pamuk üretimi üzerine yaptıkları çalışmada, mısır üretiminde gübre masrafının değişken masrafların %22,04’ünü, toplam üretim masrafının ise %15,19’unu oluşturduğunu belirtmiştir. Pamuk üretiminde ise gübre masrafı, değişken masrafların %14,84’ünü, toplam üretim masraflarının ise %10,41’ini oluşturmaktadır. Güldal & Özçelik (2017), Konya ili Cihanbeyli ilçesinde yaptığı çalışmada, toprak analizi yapan ve yapmayan üreticiler ile farklı tabakalardan elde ettiği bulgulara göre, buğday üretiminde gübreleme faaliyetinin değişken masraflar içinde %25 ile %30 arasında bir pay alarak en yüksek masraf kalemini oluşturduğunu bulmuştur. Aydın et al. (2022) ise, Edirne ilinde toprak analizine göre gübre kullanımının buğday üretimi üzerindeki etkilerini incelediği benzer bir çalışmada, toprak analizi yapan işletmeler için gübre kullanımının değişken masraflar içindeki payı %8,59, toplam üretim maliyetleri içindeki payı ise %6,82 olarak elde edilmiştir. Toprak analizi yapmayan işletmeler için ise gübre kullanımının değişken masraflar içindeki payı %10,87 iken, toplam üretim maliyetleri içindeki payı ise %7,59 olarak hesaplanmıştır. Semerci ve Ken (2024), kekik üretiminde girdi kullanımı ve maliyet analizinin araştırıldığı çalışmasında, gübre ve zirai ilaç masraflarının toplam değişken masrafların %30,74’ünü oluşturduğunu tespit etmiştir.

Türkiye’de gübre girdisine yönelik yürütülen destekleme politikası genellikle (2024 yılına kadar) alan bazlı destekler kapsamında ele alınmakta ve mazot ile birlikte verilmektedir. Konu ile sorumlu olan T.C. Tarım ve Orman Bakanlığı (TOB), ürün bazında verilecek destek miktarını Şekil 2’de gösterildiği gibi sağlamaktadır. Bu desteklerin tarım işletmeleri üzerindeki etkilerini analiz eden farklı çalışmalar bulunmaktadır. Semerci ve Everest (2019) çalışmasında, çeltik üreticilerine 2019 yılında 4 TL/da gübre desteği sağlandığını ve üreticilerin %90,54’ünün bu destekten faydalandığını tespit etmiştir. Ayrıca, üreticilerin %55,41’i bu desteği yetersiz bulurken, %27,03’ü ise birim fiyatının düşük düzeyde seyrettiğini belirtmiştir. Aynı çalışmada, işletme sahiplerinin faydalandıkları destekler içerisinde mazot-gübre desteğinden elde ettikleri gelir, diğer destekler arasında yaklaşık %34 oranında pay almaktadır. Araştırmanın bulgularına göre, koşulsuz esneklikler dikkate alındığında, girdi desteğinin %10 artması durumunda çeltik üretiminin %4,10 artmasının beklendiğini, koşullu esneklikler dikkate alındığında ise girdi desteğinin %10 artması durumunda çeltik üretiminin %1,30 artmasının beklendiğini göstermektedir. Ayrıca, çeltik üreticisinin desteklerden yararlanması halinde; alan bazlı (mazot - gübre), sertifikalı tohum kullanım desteği ve fark ödeme desteğinin çeltik ürününe ait GSÜD’ni %5,69, brüt kar değerini %11,33 oranında artırabileceği sonucuna varılmıştır. Semerci (2019) tarafından yapılan benzer nitelikteki başka bir çalışmada, kanola üreticilerine 2019 yılında 4 TL/da gübre desteği sağlandığı ve üreticilerin %67,47’sinin bu destekten faydalandığı tespit edilmiştir. Ayrıca, üreticilerin %44,58’i bu desteği yetersiz bulurken, %32,53’ü birim fiyatının düşük düzeyde seyrettiğini belirtmiştir. Araştırma sonucunda, kanola üretiminde uygulanan alan bazlı (mazot ve gübre desteği) ve fark ödeme desteklerinin ürünün GSÜD’ni %27 ve brüt kar değerini %115 oranında artırdığını göstermektedir. Ancak desteklerin gelirlere olan etkisinde gübreye sağlanan desteğin payının oldukça olduğu görülmektedir. Ken ve Semerci (2023) kekik üreten tarım işletmeleri üzerinde yaptıkları çalışmada,



üreticilerin %90,24'ü sadece alan bazlı desteklemeler kapsamında yer alan mazot-gübre desteklerinden faydalanmış olup, genel anlamda tarımsal desteklerden memnun olmadıkları tespit edilmiştir. Çalışmada, üreticilerin faydalandığı mazot-gübre desteğinin etkisiyle, 1 kg kekik karşılığı alınabilecek girdiler arasında gübre miktarında çeşitlerine göre %1,60-1,85, mazotta %1,75 ve kekik fiyatında %1,65 oranında artış sağlayabileceği belirlenmiştir. Ayrıca, söz konusu destek kalemi kekik üretim değerini %1,67, brüt kar değerini %2,83 ve net kar değerini %6,37 oranında arttırırken, ürün maliyetini %2,27 oranında düşürmektedir.

Genel olarak değerlendirildiğinde, Türkiye'de gübre kullanımı bitkisel üretim maliyetleri üzerinde değişken masraflar bakımından %20-30 arasında, toplam üretim masrafları içerisinde ise %10-20 arasında pay almaktadır. Bu değerler, tarım işletmeleri için gübre girdisinin önemli bir masraf kalemi olduğunu göstermektedir. Bu nedenle, gübre girdisinin kullanımı hükümetler tarafından desteklenmektedir. Gübreye sağlanan desteklerin, ürünlerin maliyetlerinin azaltılmasında ve gelirin artırılmasında belirli oranlarda katkıda bulunduğu görülmekte, ancak üreticilerin bu destekleri yeterli düzeyde bulmadığı anlaşılmaktadır. Bir başka ifadeyle, gübre masraflarının işletmeler üzerindeki payına karşılık sağlanan desteklerin aynı oranda işletmeye yansımadığı söylenebilir.

Sonuç ve Öneriler

Dünyada gıda ihtiyacını karşılamak üzere tarım ürünlerinin verim ve kalitesini arttırmaya yönelik birçok çalışma yapılmaktadır. Bu artışın sağlanmasında başlıca yürütülen faaliyetlerden biri de kimyevi gübrelerin kullanımıdır. Bu çalışmada, Türkiye'de kimyevi gübrelerin üretimi, ticareti, kullanımı ve destekleme politikaları incelenmiştir. FAO verilerine göre, 2022 yılında dünya genelinde yaklaşık 210 milyon ton kimyevi gübre üretilmiştir. Üretim ve tüketimin büyük bir kısmını, hem nüfus hem de tarım açısından ön plana çıkan Çin, Hindistan, ABD, Rusya ve Brezilya gibi ülkeler oluşturmaktadır.

Türkiye'de 2022 yılında toplam 1.728.789 ton kimyevi gübre üretilmiş olup, bu üretimin %58,66'sını azotlu gübreler oluşturmaktadır. Fosforlu ve potasyumlu gübrelerin üretim payı ise sırasıyla %33,67 ve %7,68'dir. Türkiye'nin kimyevi gübre ihracatı 2022 yılında 514.567 ton olarak gerçekleşmiş, ithalatı ise 1.792.468 ton olmuştur. Türkiye, azotlu gübre ihracatında dünya sıralamasında 24. sırada yer alırken, fosforlu gübre ihracatında 15. sırada yer almaktadır. İthalat tarafında ise, azotlu gübrelerde 6. sırada, fosforlu gübrelerde 14. sırada yer almaktadır. Türkiye, potasyumlu gübre üretimi, ticareti ve kullanımında oldukça düşük paylara sahiptir. Genel olarak bakıldığında, Türkiye'nin kimyevi gübre üretimi tüketimini karşılayamamaktadır. Bu nedenle Türkiye, özellikle azotlu ve fosforlu gübreler grubunda önemli ithalatçı ülkelerden biri konumundadır.

Kimyevi gübrelerin tarımsal üretimi artırıcı etkisi net bir şekilde ortaya konmuş olsa da, aşırı kullanımının çevresel sorunlara yol açabileceği ve sürdürülebilir tarım uygulamalarının önem arz ettiği birçok akademik çalışmada belirtilmiştir. Özellikle su kirliliği, toprak kalitesinin bozulması ve sera gazı emisyonları gibi olumsuz etkileri bulunmaktadır. Ayrıca hükümet tarafından uygulanan gübre destekleme politikaları, tarımsal verimliliği ve çiftçilerin gelir düzeyini arttırmaya yönelik amaçlar taşımakta, ancak bu desteklerin çiftçiler tarafından yeterli düzeyde bulunmadığı ve çevresel sürdürülebilirlik ile dengelenmesi gerektiği görülmektedir.

Birçok ülke, sürdürülebilir tarım uygulamalarını teşvik ederek kimyevi gübre kullanımını optimize etmeye çalışmaktadır. Kimyevi gübrelerin çevresel etkilerini minimize etmek için toprak analizlerinin yapılması ve hassas tarım tekniklerinin uygulanması önerilmektedir. Bu kapsamda, gübreleme programları toprak ve bitki ihtiyaçlarına göre düzenlenmelidir. Çiftçilerin gübre kullanımı konusunda bilinçlendirilmesi ve doğru uygulamalar konusunda eğitilmesi gerekmektedir. Tarımsal yayım ve danışmanlık hizmetlerinin yaygınlaştırılması bu konuda önemli bir rol oynayacaktır. Gübre destekleme politikalarının hem tarımsal verimlilik ve kalitede artırıcı hem de çevresel sürdürülebilirliği sağlayıcı bir dengede olması için gözden geçirilmesi gerekmektedir. Bu bağlamda, çevre dostu gübrelerin ve uygulamaların teşvik edilmesi önemlidir. Kimyevi gübrelerin verimliliğini arttırmak ve çevresel etkilerini azaltmak için araştırma ve geliştirme çalışmalarına daha fazla kaynak ayrılması önerilmektedir. Tarım politikalarının iklim değişikliği, su kaynakları yönetimi ve biyolojik çeşitlilik gibi diğer çevresel politikalarla uyumlu hale getirilmesi gerekmektedir. Dünya genelindeki trendler de dikkate alınarak, Türkiye'nin gübre politikalarını sürdürülebilirlik ekseninde geliştirmelidir.

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Seed Production, Foreign Trade, and Support Policies in Türkiye

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Abstract

This study examines the significance of seed production, trade, and support policies in Türkiye, focusing particularly on the role of certified seeds in agricultural production. Seeds are one of the most fundamental inputs in agriculture and have a critical impact on enhancing product quality, productivity, and sustainability. In 2023, Türkiye's total seed production reached 1.3 million tons. While strategic products such as wheat, potatoes, and corn constitute a significant portion of seed production, there has been a steady upward trend in recent years. From an international trade perspective, the value of seed imports was 249,563 thousand TL, and the value of exports was 326,756 thousand TL, indicating that Türkiye possesses significant capacity in seed production. The use of certified seeds, supported by government incentives, is one of the most important factors in increasing agricultural productivity and quality. However, many producers find these supports insufficient, and satisfaction levels remain low. The research highlights that the use of certified seeds increases productivity and farm income, while emphasizing the need for more producer-focused support policies. To increase producers' awareness of the benefits of certified seeds, educational and extension activities should be organized, thereby enhancing agricultural sustainability and productivity.

Key Words: *Certified Seeds, Agricultural Policies, Türkiye*

Türkiye’de Tohumluk Üretimi, Dış Ticareti ve Destekleme Politikaları

Özet

Bu çalışma, Türkiye'deki tohum üretimi, ticareti ve destekleme politikalarının önemini, özellikle sertifikalı tohumların tarımsal üretimdeki rolüne odaklanarak incelemektedir. Tohumlar, tarımsal üretimde en temel girdilerden biridir ve ürün kalitesini, verimliliği ve sürdürülebilirliği artırmada kritik bir etkiye sahiptir. 2023 yılında Türkiye'nin toplam tohum üretimi 1,3 milyon tona ulaşmıştır. Stratejik ürünler olan buğday, patates ve mısır, tohum üretiminin önemli bir kısmını oluşturmakta olup, son yıllarda istikrarlı bir artış eğilimi gözlemlenmektedir. Dış ticaret açısından bakıldığında, tohum ithalatının değeri 249.563 bin TL, ihracat değeri ise 326.756 bin TL olarak gerçekleşmiştir, bu da Türkiye'nin tohum üretiminde önemli bir kapasiteye sahip olduğunu göstermektedir. Sertifikalı tohum kullanımı, tarımsal verimliliği ve kaliteyi artıran en önemli unsurlardan biri olarak hükümet teşvikleriyle desteklenmektedir. Ancak, birçok üretici bu destekleri yetersiz bulmakta ve memnuniyet oranı düşük kalmaktadır. Araştırma, sertifikalı tohum kullanımının verimliliği ve çiftlik gelirini artırdığını vurgularken, daha üretici odaklı destekleme politikalarına ihtiyaç duyulduğunu belirtmektedir. Sertifikalı tohumların faydaları konusunda üreticilerin farkındalığını artırmak için eğitim ve yayım çalışmaları düzenlenmeli, böylece tarımsal sürdürülebilirlik ve verimlilik daha etkin hale getirilebilir.

Anahtar Kelimeler: *Sertifikalı Tohumluk, Tarım Politikaları, Türkiye*

Giriş

Tarım, toplumların temel gıda ihtiyaçlarını karşılayan en önemli sektördür. Dünyadaki gıda güvenliği, tarımsal üretimin istikrarına ve verimliliğine bağlıdır. Yeterli ve sürdürülebilir tarımsal üretim, artan dünya nüfusunu beslemek ve açlığı azaltmak için kritik öneme sahiptir (FAO, 2021). Daha detaylı bir tanımla ele alınacak olursa tarımsal üretim, bitkisel ve hayvansal ürünlerin yetiştirilmesi ve üretilmesi sürecidir. Bu süreç, tarım faaliyetlerinin ana unsurlarını oluşturur ve gıda, yem, yakıt ve diğer biyolojik hammaddelerin elde edilmesi için yapılan tüm üretim faaliyetlerini kapsar. Tarımsal üretim, çiftçilikten hayvancılığa, ormancılıktan balıkçılığa kadar geniş bir yelpazede faaliyetleri içerir ve hem insan yaşamı hem de ekonomi için hayati öneme sahiptir (Harris & Fuller, 2014).



Tarımsal üretim sürecinde bitkisel ürünlerin üretilmesi için temel materyallerden biriside tohumdur. Tohum, bitkilerin üreme organıdır ve bir bitkinin yeni bir birey oluşturması için gereken genetik materyali içerir. Tohumlar, bitkinin döllenmiş yumurtalıklarından gelişir ve embriyo, endosperm (besin dokusu) ve koruyucu bir tohum kabuğundan oluşur. Tohum, uygun koşullar sağlandığında çimlenerek yeni bir bitkiyi meydana getirir. Tarım açısından, tohumlar, tarımsal üretimin temel girdilerinden biridir ve gıda üretiminden endüstriyel ürünlere kadar geniş bir yelpazede kullanılır (Bewley et al., 2006).

Sertifikalı tohumlukların kullanımı, modern tarımda sürdürülebilir üretim ve yüksek verim elde etme açısından hayati bir rol oynamaktadır. Sertifikalı tohumlar, genetik saflığı, yüksek çimlenme oranlarını ve hastalıklara karşı direnci garanti eden sıkı testlerden geçer. Bu özellikler, çiftçilerin daha yüksek ve tutarlı verim elde etmelerine, ürün kalitesini artırmalarına ve tarımsal faaliyetlerini daha sürdürülebilir hale getirmelerine olanak tanır (Wimelasekera, 2015; Kumar et al., 2023). Böylelikle sertifikalı tohum kullanımı, beraberinde ticareti, destekleme politikalarını, farklı araştırma ve çalışma konularını beraberinde getirmiştir. Bu nedenle birçok akademik çalışma sertifikalı tohumluk kullanımının işletmeler üzerindeki etkileri incelenmiştir. Awotide (2011), Sofijanova (2012), Okello (2017) ve Baglan (2020) tarafından farklı ürünler üzerinde yapılan çalışmalarda, sertifikalı tohum kullanımının hükümetler tarafından desteklendiği ve tarım işletmeleri açısından incelendiğinde genel olarak refah üzerinde olumlu bir etkiye sahip olduğu belirtilmiştir.

Bu çalışma, Türkiye'de tohumluk üretimi, ticareti, kullanımı ve destek politikalarının mevcut durumunu, özellikle sertifikalı tohumların önemine vurgu yaparak incelemektedir. Uluslararası perspektiflerden yararlanarak, sertifikalı tohumların Türkiye'deki tarımsal verimliliği artırmadaki rolü hakkında kapsamlı bir anlayış sunmayı amaçlamaktadır. Ayrıca tarım işletmelerinin tohumluk maliyeti ve sertifikalı tohum desteği ile olan ilişkileri incelenmiş ve tarım işletmeleri üzerindeki etkileri literatürden referans alınarak tartışılmıştır.

Materyal ve Yöntem

Bu çalışmanın ana materyalini ikincil veri kaynakları oluşturmaktadır. Çalışmada, Birleşmiş Milletler Gıda ve Tarım Örgütü (United Nations Food and Agriculture Organization - FAO), Tarım ve Orman Bakanlığı (TOB) ve Türkiye İstatistik Kurumu (TÜİK) gibi kurum ve kuruluşlardan elde edilen verilerin yanı sıra, konuyla ilgili ulusal ve uluslararası düzeyde yayınlanan makale, bildiri ve sektör raporu gibi çeşitli kaynaklardan faydalanılmıştır. Söz konusu veri ve kaynaklardan elde edilen bulgular, çizelge ve şekil haline getirilerek yorumlanmış ve tartışılmıştır.

Bulgular ve Tartışma

Türkiye'de Tohumluk Üretimi ve Sertifikalı Tohumluğun Durumu

Son yıllarda dünyada toplam tohumluk üretim değeri yaklaşık 50 milyar ABD\$ olarak tahmin edilmektedir. Bu değer içerisinde ABD (12 milyar ABD\$) ilk sırada yer alırken, bunu sırasıyla Çin (10 milyar ABD\$), Fransa (2,8 milyar ABD\$), Brezilya (2,1 milyar ABD\$) ve Kanada (2 milyar ABD\$) takip etmektedir. Türkiye ise 0,75 milyar ABD\$ ile bu sıralamada 11. sırada yer almaktadır (TTB, 2023).

Çizelge 1'de, Türkiye'nin 2019-2023 yılları arasındaki tohumluk üretim miktarları ürün bazında sunulmaktadır. Veriler incelendiğinde, Türkiye'nin tohumluk üretiminde genel olarak sürekli bir artış eğilimi olduğu dikkat çekmektedir. 2019 yılında 1.143.466 ton olan toplam tohumluk üretimi, 2023 yılına gelindiğinde %13,69 oranında artarak 1.300.022 tona ulaşmıştır. Buğday, %37,96'lık payla Türkiye'nin toplam tohumluk üretiminde en büyük paya sahip ürün olarak öne çıkmaktadır. Buğdayı, %26,94 oranıyla patates izlemektedir. Patates tohumluk üretimi, özellikle 2020-2022 yılları arasında belirgin bir artış göstermiştir; 2019 yılında 255.966 ton olan üretim, 2022 yılında 481.929 tona yükselmiştir. Ancak, 2023 yılında bu miktar 350.178 tona gerileyerek önceki yıla göre bir düşüş göstermiştir. Arpa tohumluk üretimi 2023 yılında 195.733 ton olarak gerçekleşmiş ve toplam üretimin %15,06'sını oluşturmuştur. Arpa üretimi, 2020 yılında 222.265 ton ile en yüksek seviyesine ulaşmış, ancak sonraki yıllarda azalma eğilimi göstermiştir. Mısır tohumluk üretimi ise 2019'dan 2023'e kadar sürekli bir artış trendi sergilemiş ve 53.566 tondan 92.551 tona yükselmiştir. Mercimek ve ayçiçeği üretimleri de artış eğilimi göstermiş olup, mercimek %3,74, ayçiçeği ise %2,64 oranında paya sahiptir. Pamuk, nohut ve çeltik gibi ürünlerde ise tohumluk üretim miktarları daha düşük oranlarda kalmış ve dönemsel dalgalanmalar yaşanmıştır.

Çizelge 2'de, Türkiye'de 2019-2023 yılları arasında kamu ve özel sektör tarafından gerçekleştirilen tohumluk üretim miktarları verilmiştir. Buğday üretimi, son beş yıl içinde önemli ölçüde hem kamu hem de özel sektör tarafından gerçekleştirilmiş olup, 2023 yılında toplam 493.498 ton olarak kaydedilmiştir. Bu üretimin %79,55'i özel sektör tarafından sağlanmış olup, bu oran 2019 yılından itibaren artış göstermiştir. Arpa üretiminde de benzer bir trend gözlemlenmektedir. 2023 yılında toplam arpa üretimi 195.733 ton olup, bunun %88,62'si özel sektör tarafından üretilmiştir. Arpa üretiminde özel sektörün payı genellikle yüksek olup, her yıl %86'nın üzerinde seyretmiştir. Soya, mısır ve ayçiçeği gibi ürünlerde ise özel sektörün üretim payı çok daha yüksektir. 2023 yılı itibarıyla soya üretiminin %99,50'si, mısır üretiminin %99,54'ü ve ayçiçeği üretiminin %99,98'i özel sektör tarafından gerçekleştirilmiştir. Bu oranlar, bu ürünlerde özel sektörün neredeyse tek üretici olduğunu göstermektedir. Patates ve pamuk üretimi de büyük oranda özel sektör tarafından yapılmaktadır. 2023 yılında patates üretiminin %99,94'ü, pamuk üretiminin ise %99,87'si özel sektör tarafından gerçekleştirilmiştir. Benzer şekilde, sebze ve yem bitkileri üretiminde de özel sektörün payı oldukça yüksek seviyelerdedir.



Çizelge 1. Türkiye'nin tohumluk üretim miktarı (ton)

Ürünler	2019	2020	2021	2022	2023	2023 Oran (%)
Buğday	483.957	500.574	501.656	454.451	493.498	37,96
Patates	255.966	293.530	447.793	481.929	350.178	26,94
Arpa	177.306	222.265	139.695	169.444	195.733	15,06
Mısır	53.566	68.430	70.041	79.876	92.551	7,12
Mercimek	35.670	36.043	44.845	46.434	48.672	3,74
Ayçiçeği	28.602	33.573	36.011	33.833	34.320	2,64
Pamuk	26.471	18.533	16.396	25.120	27.031	2,08
Nohut	35.643	19.537	16.024	19.567	13.896	1,07
Çeltik	9.886	9.975	11.607	8.890	9.404	0,72
Yonca	3.501	3.456	3.529	3.691	4.299	0,33
Fiğ	1.526	2.487	2.993	4.168	3.202	0,25
Soya	3.960	3.937	4.497	3.064	3.195	0,25
Sebze	2.117	2.240	2.776	3.200	2.991	0,23
Yem bezelyesi	3.656	5.420	2.852	3.609	2.244	0,17
Şeker pancarı	1.425	1.563	2.122	1.575	2.045	0,16
Kuru fasulye	3.925	2.156	4.008	3.521	1.439	0,11
Korunga	773	556	382	399	1.333	0,10
Çim ve çayırotu	366	1.255	831	684	775	0,06
Aspir	289	177	304	541	226	0,02
Yer fıstığı	213	232	347	149	189	0,01
Sorgum*sudan otu	318	159	161	87	56	0,00
Kanola (kolza)	41	38	24	27	53	0,00
Yem salgamı	19	27	2	33	24	0,00
Susam	-	13	2	6	1	0,00
Yemlik pancar	1	-	-	-	-	-
Diğer	14.269	16.152	15.324	17.038	12.667	0,97
Toplam	1.143.466	1.242.328	1.324.222	1.361.336	1.300.022	100,00
İndeks (2019=100)	100,00	108,65	115,81	119,05	113,69	-
Zincirleme İndeks	100,00	108,65	106,59	102,80	95,50	-

Kaynak: TOB, 2024

Çizelge 2. Türkiye'nin kamu ve özel sektör tohumluk üretimi (ton)

Yıl	Üretici	Buğday	Arpa	Soya	Mısır	Ayçiçeği	Patates	Pamuk	Sebze	Yem Bitkileri
2019	Kamu	179.717	20.516	37	395	1	125	2	1	1.198
	Özel	304.240	156.790	3.923	53.171	28.061	255.841	26.469	2.115	10595
	Toplam	483.957	177.306	3.960	53.566	28.602	255.966	26.471	2.117	11.793
	Özel Sektör Payı (%)	62,87	88,43	99,07	99,26	98,11	99,95	99,99	99,91	89,84
2020	Kamu	149.934	22.652	58	45	2	379	9	3	6.753
	Özel	350.640	199.613	3.879	68.385	33.571	293.151	18.524	2.203	18.432
	Toplam	500.574	222.265	3.937	68.430	33.573	293.530	18.533	2.206	25.185
	Özel Sektör Payı (%)	70,05	89,81	98,53	99,93	99,99	99,87	99,95	99,86	73,19
2021	Kamu	124.837	12.024	6	238	3	142	8	2	3.426
	Özel	376.719	127.671	4.491	69.803	36.008	447.651	16.388	2.774	13.935
	Toplam	501.556	139.695	4.497	70.041	36.011	447.793	16.396	2.776	17.361
	Özel Sektör Payı (%)	75,11	91,39	99,87	99,66	99,99	99,97	99,95	99,93	80,27
2022	Kamu	129.557	22.996	22	129	15	152	19	3	3.591
	Özel	324.895	146.448	3.042	79.747	32.818	481.777	25.101	3.197	20.393
	Toplam	454.452	169.444	3.064	79.876	33.833	481.929	25.120	3.200	23.984
	Özel Sektör Payı (%)	71,49	86,43	99,28	99,84	97,00	99,97	99,92	99,91	85,03
2023	Kamu	100.945	22.265	16	429	8	195	34	5	1.248
	Özel	392.553	173.468	3.179	92.122	34.312	349.983	26.996	2.986	9.911
	Toplam	493.498	195.733	3.195	92.551	34.320	350.178	27.031	2.991	11.159
	Özel Sektör Payı (%)	79,55	88,62	99,50	99,54	99,98	99,94	99,87	99,83	88,82

Kaynak: TOB, 2024

Çizelge 3'de, 2019-2023 yılları arasında Türkiye'de yurt içine arz edilen sertifikalı tohum miktarları ürün bazında detaylandırılmıştır. Verilere göre, 2019 yılında 1.105.967 ton olan toplam sertifikalı tohum arzı, 2023 yılında %14,11 oranında artarak 1.262.025 tona ulaşmıştır. Ancak, bu artış her yıl düzenli bir şekilde gerçekleşmemiş, 2022 yılında zirveye ulaştıktan sonra 2023 yılında bir miktar gerileme yaşanmıştır. Buğday, %38,03 ile en büyük paya sahip olup, toplam sertifikalı tohum arzının önemli bir kısmını oluşturmaktadır. Patates, %29,85'lik payıyla ikinci sırada yer alırken, arpa %15,41'lik oranla üçüncü sırada gelmektedir. Bu veriler, Türkiye'deki sertifikalı tohum arzının buğday, patates ve arpa gibi temel tarım ürünlerine yoğunlaştığını göstermektedir. Genel olarak bakıldığında, söz konusu değişimlerin Çizelge 1 ile paralellik göstermektedir.



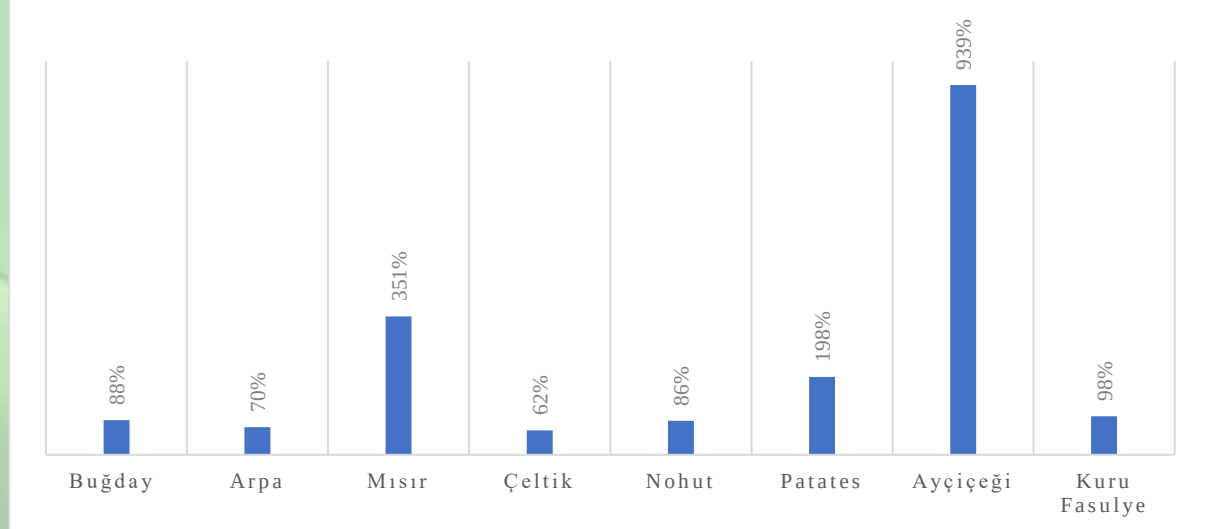
Çizelge 3. Yurt içine arz edilen sertifikalı tohum miktarı (ton)

Ürünler	2019	2020	2021	2022	2023	2023 Oran (%)
Buğday	448.882	485.366	490.027	443.978	479.895	38,03
Patates	271.684	312.271	458.986	495.708	376.773	29,85
Arpa	174.709	221.526	139.292	169.228	194.480	15,41
Mısır	46.434	48.786	50.529	61.847	70.149	5,56
Mercimek	35.670	36.043	44.743	46.421	48.472	3,84
Pamuk	23.588	15.308	13.831	25.188	22.141	1,75
Nohut	35.618	19.504	16.017	19.463	13.867	1,10
Ayçiçeği	11.469	14.854	6.072	8.146	11.419	0,90
Çeltik	9.952	10.025	11.606	8.899	9.353	0,74
Çim ve çayırotu	7.246	5.775	4.836	4.811	5.974	0,47
Sebze	2.968	3.561	6.244	3.886	4.131	0,33
Yonca	5.456	4.208	4.164	3.065	3.258	0,26
Fiğ	1.231	2.489	70	4.168	3.202	0,25
Soya	3.779	3.795	4.297	2.522	3.017	0,24
Şeker pancarı	1.880	1.833	2.647	2.099	2.199	0,17
Kuru fasulye	4.432	2.488	4.408	3.590	1.814	0,14
Korunga	773	560	382	399	1.249	0,10
Kanola (kolza)	197	114	100	2.657	735	0,06
Diğer	19.999	27.333	35.558	6.578	9.897	0,78
Toplam	1.105.967	1.215.839	1.293.809	1.312.653	1.262.025	100,00
İndeks (2019=100)	100,00	109,93	116,98	118,69	114,11	-
Zincirleme indeks	100,00	109,93	106,41	101,46	96,14	-

Kaynak: TOB, 2024

Türkiye Tohumcular Birliği'nin (TTB) 2023 yılı raporuna göre, başlıca ürünlerde sertifikalı tohumluk üretiminin ihtiyacı karşılama oranları Şekil 1'de verilmiştir. Verilere göre, buğday, arpa, kuru fasulye ve nohut tohumluğu üretiminde ihtiyacın karşılanma oranı %100'e yaklaştığı görülmektedir. Ayçiçeği, mısır ve patates gibi ürünlerde ise ihtiyacın çok üzerinde üretim yapılmaktadır. Buna karşılık, çeltik tohumluğu üretiminde ihtiyacın karşılanma oranı yaklaşık %60 seviyesinde kalmaktadır (Şekil 1). TTB (2023) raporunda, sertifikalı tohum üretiminin, sertifikalı tohum kullanım oranına bağlı olarak artma potansiyeline sahip olduğu belirtilmiştir. Buna bağlı olarak, sertifikalı tohum kullanım oranı artarsa, sektör de gerekli sertifikalı tohum üretimini artırabilecektir.

Şekil 1. 2022 yılı yenileme süresine göre başlıca ürünlerde sertifikalı tohumluk ihtiyacının karşılanma oranı (%)



Kaynak: TTB, 2023

Türkiye'de Tohumluk Dış Ticareti

Dünya tohumluk ticaretinde ağırlıklı olarak tahıllar (mısır dâhil), yağlı tohumlar (soya dâhil), sebzeler, patates, şeker pancarı, çiçekler, yem ve çim bitkileri yer almaktadır (Aras, 2019). 2020 yılı verilerine göre, dünya genelinde 15 milyar 850 milyon ABD\$ değerinde tohum ihracatı gerçekleşmiş olup, toplam ihracatın %20,15'ini Hollanda, %14,47'sini Fransa, %11,65'ini ABD, %6,96'sını Almanya ve % 5,23'ünü Danimarka gerçekleştirmiştir. İthalat açısından incelendiğinde, 2020 yılında dünya genelinde toplam 14 milyar 928 milyon ABD\$ değerinde tohum ithalatı gerçekleşmiş olup, toplam ithalatın %8,92'si Hollanda, %7,74'ü Fransa, %6,91'i Almanya, 6,24'ü ABD ve %5,26'sı İtalya'ya tarafından gerçekleştirilmiştir (ISF, 2022).



Çizelge 4’de, Türkiye’nin 2019-2023 yılları arasındaki çeşitli tarım ürünlerine ilişkin tohumluk ithalat miktarları ve değerleri yıl bazında verilmiştir. 2023 yılında toplam ithalat miktarı 51.384 ton olarak gerçekleşmiş, bu ithalatın toplam değeri 249.563 bin TL’dir. 2019 yılı ile karşılaştırıldığında, tohumluk ithalatında genel bir artış trendi gözlemlenmekle birlikte, bazı yıllarda düşüşler de yaşanmıştır. Özellikle 2022 yılında, ithalat miktarı ve değerinde önemli bir düşüş kaydedilmiş, ancak 2023 yılında bu rakamlar tekrar yükselmiştir.

Çizelge 4. Türkiye’nin tohumluk ithalat verileri

	İthalat Miktarı (ton)						İthalat Değeri (bin TL)					
	2019	2020	2021	2022	2023	Oran (%)	2019	2020	2021	2022	2023	Oran (%)
Buğday	449	1.146	707	445	503	0,98	397	893	563	413	515	0,21
Arpa	175	288	305	393	260	0,51	198	316	304	470	428	0,17
Mısır	4.861	6.705	8.594	5.796	7.612	14,81	23.003	28.730	34.224	24.401	40.262	16,13
Çeltik	90	82	41	30	0.017	0,00	86	74	44	30	0.087	0,00
Pamuk	34	60	1.036	68	45	0,09	185	208	228	68	158	0,06
Ayçiçeği	536	755	624	518	809	1,57	10.046	11.758	12.506	10.659	22.108	8,86
Kanola	156	76	86	2.636	848	1,65	905	392	517	2.702	1.713	0,69
Soya	-	-	2	-	0.043	0,00	1	-	6	-	0.702	0,00
Yerfıstığı	-	-	0	-	0.001	0,00	-	-	1	-	0.020	0,00
Patates	16.564	21.366	16.550	17.233	29.788	57,97	12.250	15.357	12.119	11.687	23.666	9,48
Şeker Pancarı	506	413	527	524	335	0,65	9.406	11.312	14.528	11.806	24.973	10,01
Yem Bitkileri	2.265	6.057	17.340	1.893	2.200	4,28	6.971	6.895	12.370	5.068	6.952	2,79
Çim ve Çayırotu	7.089	4.779	4.403	4.437	5.400	10,51	9.000	9.511	9.665	11.258	14.137	5,66
Sebze Bitkileri	1.598	1.715	4.091	1.159	1.611	3,14	93.845	109.353	126.144	86.622	110.856	44,42
Diğerleri	2.881	2.377	2.049	2.597	1.973	3,84	11.040	4.663	4.637	4.430	3.794	1,52
Toplam	37.204	45.819	56.355	37.729	51.384	100,00	177.333	199.462	227.856	169.614	249.563	100,00
İndeks (2019=100)	100,0	123,16	122,99	66,95	136,19	-	100,00	112,48	114,24	74,44	147,14	-
Zincirleme İndeks	100,0	123,16	151,48	101,41	138,11	-	100,00	112,48	128,49	95,65	140,73	-

Kaynak: TOB, 2024

Ürün bazında incelendiğinde, 2023 yılında mısır ve patates ithalat miktarı ve değeri açısından öne çıkan ürünlerdir. Mısır ithalatı 2023 yılında 7.612 ton olarak gerçekleşmiş ve bu rakam toplam ithalatın %14,81’ini oluşturmuştur. Mısır ithalatının değeri ise 40.262 bin TL’ye ulaşmış olup, bu da toplam ithalat değerinin %16,13’üne karşılık gelmektedir. Patates, 29.788 ton ile en yüksek ithalat miktarına sahip ürün olarak dikkat çekmekte ve bu ürünün ithalat değeri 23.666 bin TL’dir. Patatesin toplam ithalat içindeki payı, miktar bazında %57,97, değer bazında ise %9,48 olarak kaydedilmiştir. Bu iki ürün, 2023 yılında Türkiye’nin tohumluk ithalatında önemli bir yer tutmaktadır. Buna karşın, buğday, arpa ve ayçiçeği gibi temel tarım ürünlerinin ithalat miktarları, mısır ve patates ile kıyaslandığında daha düşük seviyelerde kalmıştır. Pamuk, kanola, soya ve yerfıstığı gibi ürünlerde ise ithalat miktarları oldukça düşük kalmış ya da hiç gerçekleşmemiştir. Sebze bitkileri ithalatı ise miktar açısından düşük olmasına rağmen, ithalat değerinin %44,42’sini oluşturarak önemli bir pay almaktadır (Çizelge 4).

Çizelge 5’de, Türkiye’nin 2019-2023 yılları arasındaki tohumluk ihracat miktarları ve değerlerine ilişkin veriler verilmiştir. 2023 yılında toplam tohumluk ihracatı 89.378 ton olarak gerçekleşmiş, bu ihracatın değeri ise 326.756 bin TL’ye ulaşmıştır. 2019 yılına kıyasla, ihracat miktarında %3,43, ihracat değerinde ise %40,44 oranında bir artış kaydedilmiştir.

Ürün bazında değerlendirildiğinde, 2023 yılında mısır ve ayçiçeği, tohumluk ihracatında öne çıkan ürünler arasında yer almaktadır. Mısır, 30.014 ton ile toplam ihracat miktarının %33,58’ini oluşturarak en yüksek paya sahip üründür. Mısır ihracatının değeri 101.016 bin TL olup, toplam ihracat değerinin %30,91’ini temsil etmektedir. Ayçiçeği de benzer şekilde 23.710 ton ile önemli bir ihracat kalemi olmuş, bu ihracatın değeri 153.342 bin TL’ye ulaşmış ve toplam ihracat değerinin %46,93’ünü oluşturmaktadır. Buğday ve pamuk gibi diğer önemli tarım ürünleri de kayda değer ihracat rakamlarına sahiptir. 2023 yılında buğday ihracatı 14.106 ton olarak gerçekleşmiş ve bu, toplam ihracatın %15,78’ini oluşturmuştur. Buğdayın ihracat değeri ise 7.527 bin TL olup, toplam değer %2,30’una karşılık gelmektedir. Pamuk ihracatı ise 4.934 ton ve 13.087 bin TL olarak kaydedilmiştir. Diğer ürünlerde ise ihracat miktarları ve değerleri daha düşük seviyelerde kalmıştır (Çizelge 5). Dış ticaret dengesi açısından bakıldığında, önceki yıllara göre 2022 yılından itibaren ihracat değerleri ithalat değerlerinin üzerinde performans sergilemektedir. Bir başka ifadeyle, dış ticaret dengesi pozitif yönlü seyretilmektedir (Çizelge 4; Çizelge 5).

Türkiye’de Sertifikalı Tohum Destekleme Politikaları ve Tarım İşletmeleri Üzerine Etkilerinin Değerlendirilmesi

Çizelge 6, Türkiye’de 2019-2024 yılları arasında çeşitli ürünler için sertifikalı tohum kullanım desteği miktarlarını (TL/da) göstermektedir. 2019 yılından 2024 yılına kadar hemen hemen tüm ürünlerde sertifikalı tohum kullanım desteğinde önemli artışlar görülmüştür. Bu artışlar özellikle 2023 ve 2024 yıllarında belirgin hale gelmiştir. Ürün bazında incelendiğinde, patates, 2019 yılındaki 80 TL/da seviyesinden 2023 ve 2024 yıllarında 260 TL/da ulaşarak en yüksek destek miktarına sahip ürün olarak öne çıkmaktadır. Buna karşılık, aspir, kanola ve susam gibi ürünlerde destek miktarları diğer ürünlere göre daha düşük kalmıştır. Ayrıca, 2023 yılından itibaren yağlık ayçiçeğinde sertifikalı tohum kullanımı destekleme kapsamına girmiştir.



Çizelge 5. Türkiye'nin tohumluk ihracat verileri

	İhracat Miktarı (ton)						İhracat Değeri (bin TL)					
	2019	2020	2021	2022	2023	2023 Oran (%)	2019	2020	2021	2022	2023	2023 Oran (%)
Buğday	35.524	16.354	12.336	10.918	14.106	15,78	16.543	7.139	5.844	6.725	7.527	2,30
Arpa	2.772	1.027	708	609	1.513	1,69	919	351	338	364	673	0,21
Mısır	11.993	26.349	28.106	23.825	30.014	33,58	28.632	36.827	44.901	59.699	101.016	30,91
Çeltik	24	32	42	21	50	0,06	18	33	44	14	76	0,02
Pamuk	2.917	3.285	3.601	4.836	4.934	5,52	7.382	8.309	9.038	11.257	13.087	4,01
Ayçiçeği	17.669	19.474	30.563	26.205	23.710	26,53	70.234	74.760	112.843	109.133	153.342	46,93
Kanola	-	-	10	6	165	0,18	-	-	19	25	189	0,06
Soya	181	142	202	542	178	0,20	344	233	374	910	338	0,10
Yerfıstığı	51	-	40	-	0.198	0,00	170	-	167	-	0.387	0,00
Patates	846	2.625	5.357	3.454	3.193	3,57	331	733	1.035	1.154	1.811	0,55
Şeker Pancarı	51	143	100	36	180	0,20	2.466	1.584	786	278	1.113	0,34
Yem Bitkileri	519	1.387	4.092	13.919	9.642	10,79	721	1.400	4.164	11.529	10.850	3,32
Çim ve Çayırotu	209	259	398	310	179	0,20	431	428	1.108	1.231	784	0,24
Sebze Bitkileri	747	394	623	473	471	0,53	23.737	29.139	32.982	27.864	33.431	10,23
Diğerleri	1.200	837	590	1.258	1.043	1,17	3.499	1.097	1.240	2.480	2.519	0,77
Toplam	74.703	72.308	86.768	86.412	89.378	100,00	155.427	162.033	214.883	232.663	326.756	100,00
İndeks (2019=100)	100,00	96,79	120,00	99,59	103,43	-	100,00	104,25	132,62	108,27	140,44	-
Zincirleme İndeks	100,00	96,79	116,15	115,67	119,64	-	100,00	104,25	138,25	149,69	210,23	-

Kaynak: TOB, 2024

Çizelge 6. Sertifikalı tohum kullanım desteği (TL/da)

	2019	2020	2021	2022	2023	2024
Buğday	8,50	16,00	16,00	24,00	65,00	65,00
Arpa	8,50	16,00	16,00	24,00	65,00	65,00
Triticale	6,00	16,00	16,00	24,00	65,00	65,00
Yulaf	6,00	16,00	16,00	24,00	65,00	65,00
Çavdar	6,00	16,00	16,00	24,00	65,00	65,00
Çeltik	8,00	16,00	16,00	24,00	65,00	65,00
Nohut	20,00	20,00	20,00	20,00	65,00	65,00
Kuru Fasulye	20,00	30,00	30,00	30,00	78,00	78,00
Mercimek	20,00	30,00	30,00	30,00	78,00	78,00
Patates	80,00	100,00	100,00	100,00	260,00	260,00
Susam	4,00	4,00	4,00	4,00	10,00	10,00
Kanola (Kolza)	4,00	5,00	20,00	20,00	40,00	40,00
Aspir	4,00	5,00	5,00	5,00	15,00	15,00
Yer Fıstığı	15,00	17,00	17,00	17,00	45,00	45,00
Yonca	30,00	30,00	30,00	30,00	78,00	78,00
Korunga	20,00	22,00	22,00	22,00	58,00	58,00
Fiğ	20,00	22,00	22,00	22,00	58,00	58,00
Soya	20,00	22,00	22,00	22,00	58,00	58,00
Yem Bezelyesi	20,00	22,00	22,00	22,00	58,00	58,00
Yağlık Ayçiçeği	-	-	-	-	135,00	135,00

Kaynak: Resmi Gazete, 2019, 2020, 2021, 2022, 2023a, 2023b

Yukarıda değinilen hususlara ek olarak, 29 Ağustos 2024 tarihinde Resmî Gazete'de yayımlanan Cumhurbaşkanlığı Kararı doğrultusunda, 2025-2027 yılları arasında bitkisel üretime yönelik desteklemelerde bazı yapısal değişikliklere gidilmiştir. Bu kapsamda, 2025 yılı için mazot ve gübre gibi alan bazlı tarımsal destekler kaldırılarak yerine temel destek katsayısı getirilmiş ve belirlenen temel destek katsayısı 244 TL/da olarak açıklanmıştır. Sertifikalı tohum kullanımına yönelik destek miktarları, bu katsayıya göre hesaplanmış olup, Çizelge 7'de ayrıntılı olarak sunulmuştur. İncelemeler, temel destek katsayısının (244 TL/da) ürün bazında verilen destek katsayısı ile çarpılmasıyla, ürün başına verilecek destek miktarlarının belirlendiğini göstermektedir. Örneğin, buğday ürünü için belirlenen destek katsayısı 0,50 olup, bu değer temel destek katsayısı ile çarpıldığında çiftçi 122,00 TL/da (244 TL/da*0,5) sertifikalı tohum kullanım desteği alacaktır. Ayrıca, önceki yıllarda destekleme kapsamında yer almayan kütü pamuk ve dane mısır ürünleri de destekleme kapsamına alınmıştır. Geçmiş yıllara göre kıyaslandığında destek miktarlarında önemli artışlar görülmektedir. Ürün bazında değerlendirildiğinde, en yüksek destek katsayısına sahip ürün patates olurken, aspir, kanola ve susam en düşük destek katsayısına sahip ürünler olarak öne çıkmaktadır (Resmî Gazete, 2024b). Ayrıca, bu karar doğrultusunda ilgili bakanlık ilk kez ilerleyen yıllarda yapılacak destek ödemelerini önceden açıklamıştır.



Çizelge 7. 2025-2027 yılları arası sertifikalı tohum kullanım destek ürünleri ve katsayıları

Ürünler	Destek Katsayısı	2025 Yılında Ödenmesi Planlanan Destek Miktarı (TL/da)
Buğday, Arpa, Çavdar, Çeltik, Tritikale, Yulaf, Fasulye (kuru)	0,50	122,00
Aspir, Kanola (Kolza), Susam	0,20	48,00
Korunga, Soya, Yer fıstığı, Yonca	0,60	146,40
Fiğ, Mercimek, Nohut, Yem Bezelyesi	0,40	97,60
Patates	2,20	536,80
Patates**	1,00	244,00
Ayçiçeği (yağlık), Pamuk (kütülü), Mısır (dane)*	0,60	146,40

Kaynak: Resmi Gazete, 2024b; * Kamu araştırma enstitüleri ve üniversiteler tarafından yurt içinde ıslah edilerek tescil edilen çeşitlerin yurt içinde üretilip sertifikalandırılan tohumunu kullanarak ekim/dikim yapan çiftçilere belirtilen destek katsayısına göre hesaplanan tutar üzerinden destek ödenir; ** Bir üst satırda (yine patates için) belirtilen destek katsayısına ilave olarak ödenir.

Çizelge 8. Yurtiçi sertifikalı tohum üretim desteği (TL/kg)

	2021		2022		2023		2024	
	Sertifikalı Kademe	Orijinal/Temel ve Üstü Kademe	Sertifikalı Kademe	Orijinal/Temel ve Üstü Kademe	Sertifikalı Kademe	Orijinal/Temel ve Üstü Kademe	Sertifikalı Kademe	Orijinal/Temel ve Üstü Kademe
Buğday	0,10	0,12	0,10	0,12	0,10	0,12	0,10	0,12
Arpa	0,08	0,10	0,08	0,10	0,08	0,10	0,08	0,10
Tritikale	0,08	0,10	0,08	0,10	0,08	0,10	0,08	0,10
Yulaf	0,08	0,16	0,08	0,16	0,08	0,16	0,08	0,16
Çavdar	0,08	0,16	0,08	0,16	0,08	0,16	0,08	0,16
Çeltik	0,25	0,35	0,25	0,35	0,25	0,35	0,25	0,35
Nohut	0,50	0,60	0,50	0,60	0,50	0,60	0,50	0,60
Kuru Fasulye	0,50	0,60	0,50	0,60	0,50	0,60	0,50	0,60
Mercimek	0,50	0,60	0,50	0,60	0,50	0,60	0,50	0,60
Patates	0,10	0,20	0,10	0,20	0,10	0,20	0,10	0,20
Susam	0,60	0,80	0,60	0,80	0,60	0,80	0,60	0,80
Kanola (Kolza)	1,20	1,80	1,20	1,80	1,20	1,80	1,20	1,80
Aspir	0,50	0,80	0,50	0,80	0,50	0,80	0,50	0,80
Yer Fıstığı	0,80	1,00	0,80	1,00	0,80	1,00	0,80	1,00
Yonca	4,00	5,00	4,00	5,00	4,00	5,00	4,00	5,00
Korunga	1,50	1,60	1,50	1,60	1,50	1,60	1,50	1,60
Fiğ	1,50	1,60	1,50	1,60	1,50	1,60	1,50	1,60
Soya	0,35	0,70	0,35	0,70	0,35	0,70	0,35	0,70
Yem Bezelyesi	1,50	1,60	1,50	1,60	1,50	1,60	1,50	1,60

Kaynak: Resmi Gazete, 2021, 2022, 2023a, 2024a

Çizelge 8’de, Türkiye’de çeşitli tarım ürünleri için 2021-2024 yılları arasında sağlanan sertifikalı tohum üretim desteği miktarları (TL/kg) verilmiştir. Bu destek grubu, ürünlerin sertifikalı kademelerine ve orijinal/temel ve üstü kademelerine göre iki sınıfa ayrılmıştır. 2021’den 2024’e kadar geçen dört yıl boyunca her bir ürün için sertifikalı kademe ve orijinal/temel ve üstü kademe destek miktarları sabit kalmıştır. Bir başka ifadeyle, destek oranlarında herhangi bir yıllık değişim olmadığı görülmektedir. Buğday, arpa, tritikale, yulaf, çavdar, patates gibi ürünler için sertifikalı kademe desteği 0,08-0,10 TL/kg arası, orijinal/temel ve üstü kademe destek miktarları ise 0,10-0,20 TL/kg arası seviyelerdedir. Çeltik, yer fıstığı, susam, ve soya gibi ürünlerde sertifikalı kademe desteği 0,25 TL/kg’den 0,80 TL/kg’ya kadar değişmektedir. Orijinal/temel ve üstü kademe destekleri de bu ürünler için 0,35 TL/kg ile 1,00 TL/kg arasında değişmektedir. Nohut, kuru fasulye, mercimek ve aspir gibi baklagiller ve yağlı tohumlar için sertifikalı kademe desteği genellikle 0,50 TL/kg civarındadır. Orijinal/temel ve üstü kademe destekleri ise 0,60 TL/kg ve 0,80 TL/kg arasında değişmektedir. Yonca ve kanola (kolza) gibi ürünler, en yüksek sertifikalı kademe desteğine (4,00 TL/kg ve 1,20 TL/kg sırasıyla) sahiptir. Bu ürünlerde orijinal/temel ve üstü kademe destek miktarları da diğer ürünlere nazaran yüksek (5,00 TL/kg ve 1,80 TL/kg sırasıyla) olarak belirlenmiştir.

Tohum, tarımsal üretim için elzem bir materyaldir. Erdem & Yücel (2015) çalışmasında, tohum kullanımı, ekim alanlarındaki değişim ve çiftçinin eline geçen ürün fiyatları ile tarımsal üretim arasındaki ilişki 1980-2010 dönemi için VAR modelleri ile incelenmiştir. Bulgular, tarımsal üretim üzerinde en etkili değişkenin tohum kullanımı olduğunu göstermiştir. Bu öneminin yanı sıra tohumluk kullanımı tarım işletmeleri için önemli bir masraf kalemini de oluşturmaktadır. Aktaş & Yurdakul (2005) Adana ilinde mısır üretimi üzerine yaptığı çalışmasında, tohumluk masrafının değişken masraflar içerisinde I. üründe %18,19, II. üründe ise %20,29 oranında pay alırken, toplam üretim masrafları içerisinde 1. üründe %10,51, 2. üründe ise %13,08 oranında pay aldığını tespit etmiştir. Taşcı & Oğuz (2014) Ankara ili Haymana ilçesinde buğday üreten tarım işletmeleri üzerine yaptığı çalışmasında, değişken masraflar içerisinde taban gübresinden sonra (%19,82) en büyük payı %17,94 ile buğday tohumluğuna ait olduğunu saptamışlardır. Candemir et al. (2017), Kahramanmaraş ilinde mısır ve pamuk üretimi üzerine yaptıkları çalışmada, mısır üretiminde tohumluk masrafının değişken masrafların %12,52’sini, toplam üretim masrafının ise



%8,62'sini oluşturduğunu belirtmiştir. Pamuk üretiminde ise tohumluk masrafı, değişken masrafların %3,84'ünü, toplam üretim masraflarının ise %2,69'unu oluşturmaktadır. Kadakoğlu & Karlı (2022) tarafından Afyonkarahisar ilinde patates üretimi üzerine yapılan çalışmada, patates üretiminde tohumluk kullanımı değişken masraflar içerisinde %30,41 oranında pay alırken, toplam üretim masrafları içerisinde %25,01 oranında pay aldığını bildirmişlerdir. Semerci (2022) çalışmasında, Trakya kesiminde kuru şartlar altında üretilen yağlık ayçiçeği üretiminde farklı işletme büyüklüklerine göre tohumluk masraflarının değişken masraflar içerisinde %11-13 arasında toplam masraflar içerisinde ise %7-9 arasında paylar aldığını tespit etmiştir.

Tohumluk kullanımında en dikkat çeken konulardan biri, sertifikalı tohum kullanımıdır. Sertifikalı tohumluk kullanımı, özellikle üretimde verimlilik ve kaliteyi arttırmasıyla ön plana çıkmaktadır. Ayrıca, bu tohumlukların kullanımı, tarımsal işletmeler için destekleme programlarına erişim ve dolaylı olarak refah düzeyinde artış sağladığı çalışmalarda bildirilmektedir. Awotide et al. (2011) Nijerya'da yaptığı çalışmada, 2010 yılından sonra hükümet tarafından sağlanan sübvansiyonlu olarak sertifikalı geliştirilmiş pirinç tohumlarına erişimin hanehalkı refahı üzerindeki etkileri analiz etmiştir. Araştırmanın bulguları, pirinç üretiminden elde edilen ortalama gelirin %18,5, kişi başına düşen hane gelirinin ise %2,3 arttığını ortaya koymuştur. Sojijanova et al. (2012) çalışmasında, sertifikalı tohum kullanılarak yapılan buğday tarımındaki ortalama verimlilik, sertifikasız tohumla yapılan üretime göre %22,5 daha yüksek bulunmuştur. Sertifikalı tohum kullanılarak yapılan buğday üretiminde toplam üretim maliyetleri, sertifikasız tohumla yapılan üretime göre %11,3 daha yüksektir. Sertifikalı tohum kullanılarak yapılan buğday üretiminde brüt kâr marjı, sertifikasız tohumla yapılan üretime göre %36 daha yüksektir. Sertifikalı tohum kullanılarak yapılan buğday tarımında hektar başına net kâr, sertifikasız tohumla yapılan üretime göre %26,5 daha yüksek bulunmuştur. Bağlan et al (2020) Kazakistan'da yürütülen çalışmada, sertifikalı tohum kullanarak üretim yapılan tarım işletmelerinin sertifikasız üretim yapan tarım işletmelerine göre %10,30 daha etkin çalıştıkları tespit edilmiştir. Cevher & Coşkun Cevher (2021) çalışmasında, sertifikalı tohum kullanımı sonrasında kuru alanlarda buğday üretim verimi %41,4, sulanan alanlarda ise %23,8 arttığını bildirmiştir. Bu artışla birlikte, kuru alanlarda hektar başına 130,24 ABD\$, sulanan alanlarda ise hektar başına 79,64 ABD\$ daha fazla kazanç elde edilmiştir. Ayrıca, buğday üretim maliyetlerinin kuru alanlarda hektar başına 10,64 ABD\$, sulanan alanlarda ise 11,78 ABD\$ azaldığı belirlenmiştir.

Bu bulguların yanı sıra, Semerci ve Everest (2019) Çanakkale ilindeki çeltik üreticileri üzerine yaptığı çalışmada, fark desteğinden yararlanan işletmelerin oranı yaklaşık %92, mazot ve gübre desteğinden yararlananların oranı ise yaklaşık %91 iken, sertifikalı tohumluk kullanım desteğinden yararlanan üreticilerin oranının %69'a düştüğünü tespit etmiştir. Ayrıca sertifikalı tohum kullanım desteğini yetersiz bulan üreticilerin oranı yaklaşık %58, düşük düzeyde bulanların oranı ise %27 olarak saptanmıştır. Destekten memnuniyet duyup orta düzey ve üzerinde bulanların toplam içindeki payı ise sadece %15 civarındadır. Aynı çalışmanın bulguları, fark desteği, mazot ve gübre desteği ile karşılaştırıldığında, sertifikalı tohumluk kullanım desteğinden elde edilen gelirin toplam gelir içinde sadece %5,11'lik bir paya sahip olduğunu göstermektedir. Kızılaslan ve Somak (2019) Tokat ilinde yürüttüğü çalışmada elde edilen bulgular, bu durumu destekler niteliktedir. Çalışmada, sertifikalı tohum, fide ve fidan desteğinde üreticilerin memnuniyet düzeyi yalnızca %25,8 olarak tespit edilmiş olup, çiftçilerin büyük çoğunluğu destek miktarlarını yetersiz bulduğunu ifade etmiştir. Köksal ve Cevher (2015) çalışmasında, kamu ve özel sektör tarafından üretilen tohumluk çeşitlerini kullanan çiftçilerin en büyük sorunları arasında, istenilen tohumun pahalı olması, kaliteli tohum bulma zorlukları ve üreticilerin nakit yetersizliği olduğu belirlenmiştir.

Genel olarak değerlendirildiğinde, tohum kullanımı bitkisel üretim maliyetleri üzerinde değişken masraflar bakımından %10-30 arasında, toplam üretim masrafları içerisinde ise %5-25 arasında paylar almaktadır. Bu değerler, tarım işletmeleri için tohum girdisinin önemli bir masraf kalemi olduğunu göstermektedir. Sertifikalı tohum kullanımı, hükümetler tarafından desteklenmekte ve ürünlerin verimliliği ile kalitesinde önemli bir rol oynamaktadır. Bu durum, dolaylı olarak refah seviyesini de artırıcı bir etki yaratmaktadır. Ancak, çiftçiler açısından değerlendirildiğinde, diğer destek kalemlerine kıyasla daha arka planda kaldığı ve destek miktarını yetersiz buldukları için memnuniyet düzeylerinin düşük olduğu söylenebilir.

Sonuç ve Öneriler

Bu çalışmada, Türkiye'de tohumluk üretimi, ticareti, kullanımı ve destekleme politikaları incelenmiştir. Elde edilen bulgular, tohum maliyetlerinin tarım işletmeleri için toplam üretim masrafları içinde %5 ile %25 arasında değişen önemli bir gider kalemi olduğunu göstermektedir. Türkiye'nin son yıllarda tohumluk üretiminde istikrarlı bir artış eğilimi sergilediği, bu artışın özellikle buğday, patates ve mısır gibi stratejik ürünlerde belirgin olduğu ve üretimde özel sektörün önemli bir pay aldığı tespit edilmiştir. Tohumluk dış ticaretine bakıldığında, dış ticaret dengesi açısından son yıllarda giderek olumlu bir tablo olduğu gözlemlenmektedir.

Sertifikalı tohumluk kullanımı, tarımsal üretimde verimliliği ve kaliteyi artıran kritik bir unsur olarak öne çıkmakta, hükümetler tarafından desteklenmekte ve bu sayede tarımsal işletmelerin refah düzeyine olumlu katkılar sağlamaktadır. Ancak, sertifikalı tohum kullanım desteğinden yararlanan üretici oranlarının diğer destek türlerine göre daha düşük olduğu ve bu desteğe yönelik memnuniyetin de düşük seviyelerde kaldığı görülmektedir. Ayrıca,



sertifikalı tohum kullanımına yönelik desteklerde yıllar içinde belirli artışlar kaydedilmesine rağmen, sertifikalı tohum üretim desteği tutarlarının sabit kaldığı tespit edilmiştir.

Bu bulgular, Türkiye’de sertifikalı tohumluk kullanımının teşvik edilmesine yönelik politika yapıcılarının destek miktarlarını ve programlarını yeniden gözden geçirmesi gerektiğini işaret etmektedir. Üreticilerin memnuniyetini ve desteğin etkisini artırmak için üretici odaklı bir destekleme politikası benimsenmelidir. Sertifikalı tohumluk kullanımının faydaları hakkında üreticilere yönelik yayım ve danışmanlık hizmetleri düzenlenmeli ve bu konudaki farkındalık artırılmalıdır. Bu tür hizmetler, üreticilerin sertifikalı tohumların avantajlarını daha iyi anlamalarını ve bu tohumları kullanmaya teşvik edilmesini sağlayacağı düşünülmektedir. Tohumluk üretimi ve sertifikalı tohum kullanımının artırılmasına yönelik Ar-Ge yatırımları teşvik edilmelidir. Özellikle yerli tohum çeşitlerinin geliştirilmesi ve bu çeşitlerin sertifikalı tohumluk statüsüne getirilmesi için üniversiteler, araştırma enstitüleri ve özel sektör arasında iş birliği artırılmalıdır. Tohumluk ithalatını azaltmak ve ihracat potansiyelini artırmak için ulusal üretim kapasitesi güçlendirilmelidir. Yerli üreticilerin uluslararası piyasalarda rekabet edebilmesi için kalite standartları ve sertifikasyon süreçleri iyileştirilmelidir. Tohumluk üretim ve kullanım politikaları, sürdürülebilir tarım uygulamaları ile entegre edilmeli ve çevresel sürdürülebilirlik göz önünde bulundurularak düzenlenmelidir. Bu yaklaşımın, hem tarımsal üretimde verimliliği artıracak hem de çevresel etkileri minimize edeceği düşünülmektedir.

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Effects of Climate Change on Growth Characteristics of Lambs and Kids

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Abstract

Climate change is currently an indisputable fact and the recent increase in ambient temperature is one of the indicators of the changing climate scenario. Various effects of climate change directly and indirectly affect ruminant livestock farming negatively, resulting in negative economic consequences for producers. Heat stress, which has effects on physiological, hormonal and behavioural responses in livestock, is one of the most important factors affecting the health, performance, welfare and physiological responses of livestock, especially with the emergence of climate change that causes temperature increase in different parts of the world. Animals experience heat stress when ambient temperature, humidity or other environmental variables exceed the upper limit of the thermo-neutral zone and animals are unable to dissipate sufficient heat to maintain homeothermy. The negative impact of heat stress not only affects the performance of animals, but also causes an increase in oxidative stress and alters immune functions. An animal's growth is influenced by environmental and genetic factors. In general, animals under temperature stress reduce their growth, production and reproductive performance to adapt to high ambient temperature conditions. In association with heat stress, reduced feed intake and decreased anabolic activity due to increased tissue catabolism are the main causes of growth retardation in livestock. It is known that the most important factor affecting productivity in sheep and goat breeding is offspring yield. In ovine breeding, lamb and kid incomes depend on the level of fertility, the proportion of lambs and kids raised and the live weight of lambs and kids. The high number of lambs and kids at birth is only meaningful with the low lamb and kid mortality until weaning or marketing period. For this reason, reproductive efficiency measures are economically valid according to the growth results. In this study, it was aimed to investigate the effects of climate change on growth characteristics of lambs and kids.

Key Words: Climate Change, Lamb, Kid, Growth, Live Weight

İklim Değişikliğinin Kuzu ve Oğlaklarda Büyüme Özellikleri Üzerine Etkileri

Özet

İklim değişikliği şu anda tartışılmaz bir gerçektir ve son zamanlarda artan çevre sıcaklığı, değişen iklim senaryosunun göstergelerinden biridir. İklim değişikliğinin çeşitli etkileri doğrudan ve dolaylı olarak, ruminant hayvan yetiştiriciliğini olumsuz yönde etkileyerek üreticiler için olumsuz ekonomik sonuçlara neden olmaktadır. Hayvancılıkta fizyolojik, hormonal ve davranışsal tepkiler üzerinde etkileri olan sıcaklık stresi, özellikle dünyanın farklı bölgelerinde sıcaklık artışına neden olan iklim değişikliğinin ortaya çıkmasıyla birlikte, çiftlik hayvanlarının sağlığını, performansını, refahını ve fizyolojik tepkilerini etkileyen en önemli faktörlerden biri durumdur. Ortam sıcaklığı, nem veya diğer çevresel değişkenler termo-nötr bölgenin üst sınırını aştığında ve hayvanlar homeotermiyi korumak için yeterli miktarda ısıyı dağıtamadığında hayvanlar ısı stresi yaşarlar. Sıcaklık stresinin olumsuz etkisi sadece hayvanların performansını etkilemekle kalmaz, aynı zamanda oksidatif strese bir artışa neden olur ve bağışıklık fonksiyonlarını değiştirir. Bir hayvanın büyümesi çevresel ve genetik faktörlerden etkilenir. Genel olarak, sıcaklık stresi altındaki hayvanlar, yüksek ortam sıcaklığı koşullarına uyum sağlamak için büyüme, üretim ve üreme performanslarını azaltır. Sıcaklık stresi ile ilişkili olarak, azalan yem alımı ve artmış doku katabolizması nedeniyle azalan anabolik aktivite, çiftlik hayvanlarında büyüme geriliğinin başlıca nedenleridir. Koyun ve keçi yetiştiriciliğinde verimliliği etkileyen en önemli etmenin yavru verimi olduğu bilinmektedir. Küçükbaş hayvan yetiştiriciliğinde kuzu ve oğlak gelirleri döl verim düzeyi ile birlikte büyütülen kuzu ve oğlakların oranı ile kuzu ve oğlakların canlı ağırlıklarına bağlıdır. Doğumda kuzu ve oğlak sayısının yüksekliği ancak sütten kesim veya pazarlama dönemine kadar kuzu ve oğlak kayıplarının azlığı ile anlam kazanır. Bu nedenle büyütme sonuçlarına göre döl verim ölçütleri ekonomik olarak geçerlilik kazanır. Bu bağlamda bu çalışmada iklim değişikliğinin kuzu ve oğlaklarda büyüme özellikleri üzerine etkilerinin incelenmesi amaçlanmıştır.

Anahtar Kelimeler: İklim Değişikliği, Kuzu, Oğlak, Büyüme, Canlı Ağırlık



Bulgur: Production Process, Nutrition and Health Importance

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Abstract

Bulgur is a crucial food staple in many countries worldwide. Bulgur, which is quite popular in the cuisines of Central Asia, Turkey, the Middle East, and North Africa, is a wheat product that has been parboiled dried and partially debranned. Bulgur is widely considered a healthy food due to its content of B vitamins, dietary fiber, minerals, unsaturated fatty acids, and folate. Due to its color, flavor, aroma, texture, and both nutritional and economic value, bulgur is consistently appreciated and rediscovered by many people as a stable food. There are several types of bulgur around the world, depending on production techniques and raw materials. This study includes information about bulgur production and its importance in terms of nutrition and health.

Key Words: Bulgur, Durum wheat, Nutrition, Functional, Composition

Bulgur: Üretim Süreci, Beslenme ve Sağlık Açısından Önemi

Özet

Bulgur, dünya çapında birçok ülkede önemli bir gıda maddesidir. Orta Asya, Türkiye, Orta Doğu ve Kuzey Afrika mutfaklarında oldukça popüler olan bulgur, kaynatılıp kurutulmuş ve kısmen kepeksiz bir buğday ürünüdür. Bulgur, B vitaminleri, diyet lifi, mineraller, doymamış yağ asitleri ve folat içeriği nedeniyle yaygın olarak sağlıklı bir gıda olarak kabul edilmektedir. Rengi, lezzeti, aroması, dokusu ve hem besinsel hem de ekonomik değeri nedeniyle birçok insan tarafından istikrarlı bir gıda olarak sürekli olarak beğenilmekte ve yeniden keşfedilmektedir. Üretim tekniklerine ve hammaddelere bağlı olarak dünyada birkaç bulgur türü bulunmaktadır. Bu çalışma, bulgur üretimi ve bulgurun beslenme ve sağlık açısından önemi hakkında bilgiler içermektedir.

Anahtar Kelimeler: Bulgur, Durum buğdayı, Beslenme, Fonksiyonel, Bileşim

Giriş

Bulgur, binlerce yıl öncesine dayanan geçmişe sahip, pek çok kültür ve toplumda yer almış, ilk üretiminden günümüze kadar yöntem olarak değişikliğe uğramamış, lezzetli, besleyici ve doğal bir üründür. Bulgur sadece yemeklerin ana malzemesi olmanın dışında sevinç ve kederde, varlık ve yoklukta, yaşam ve ölümden kültürün bir parçası olarak varlık göstermiştir (Döşlü, 2022). Bulgur, kuru ve yaş olarak temizlenmiş, pişirilip-kurutulmuş, kabuğu soyulmuş, öğütülmüş ve sınıflandırılmış buğday ürünü olarak tanımlanmaktadır (Bayram ve ark., 2004). Anadolu'nun temel gıda maddelerinden birisi olan bulgur, Dünya'da ilk işlenen gıda maddelerinden bir tanesidir. Türkçe kökenli olarak bilinen bulgur, Anadolu dillerinden Orta doğu ve Batı dillerine bulgur, burgul olarak geçmiştir. Günümüzde dünyaya yayılan bulgur, farklı isimlerle de anılmaya başlanmış olup, bulgur, boulgur, burghoul gibi isimleriyle de karşımıza çıkabilmektedir. Kökeni Bereketli Hilal olarak bilinir. Bereketli Hilal, Orta Doğu'da hilal şeklinde bir bölgedir ve günümüzde Irak, Suriye, Lübnan, Ürdün, İsrail ve Filistin'i, Türkiye'nin güneydoğu bölgesini ve İran'ın batı kısmını kapsamaktadır. Bereketli Hilal, Fırat ve Dicle nehirleri tarafından beslenmiş ve en eski insan medeniyetlerinden bazılarının evi olmuştur. Moğol imparatoru Cengiz Han'ın uzun seferlerinde taşınması kolay ve uzun süre bozulmadan kalabilen bulguru, ordu erzakları arasında bulundurduğu bilinmektedir. Babil, Hitit ve İbraniler 4 bin yıl önce, Mısırlılar ve Doğu Akdeniz uygarlıklarının ise 3 bin yıl önce pişirilmiş kurutulmuş buğdayı kullandıkları belirlenmiştir (Bayram, 2023; Dönmez ve ark., 2004). Ülkemizde bulgur üretimi, önceleri köylerde sadece ailelerin ihtiyaçları doğrultusunda küçük ölçeklerde ve geleneksel yöntemlerle gerçekleşirken, zamanla gelişmiş ve günümüzde bir sanayi dalı haline gelmiştir. İlk fabrikasyon üretim Karaman'da I. Dünya Savaşı'nda Ordu ihtiyacını karşılamak amacıyla yapılmıştır. Türkiye, ABD, Fransa, Lübnan, Yunanistan, Irak ve Suriye gibi birçok ülkede üretilmektedir. Türkiye'deki bulgur fabrikası sayısı yaklaşık 150'dir. Bulgur üretiminin büyük bir kısmı Güneydoğu Anadolu'daki illerde yapılmakta olup sırasıyla Gaziantep, Mardin, Şanlıurfa, Diyarbakır olmak üzere ayrıca Karaman, Mersin ve Konya illerinde üretim tesisleri mevcuttur. Bulgur üretiminde ve ticaretinde Türkiye'nin en büyük rakibi ABD'dir. Yıllık üretim



Türkiye’de yaklaşık 1.5 milyon ton, ABD’de ise 250.000-300.000 tondur (Bayram, 2023; Döşlü, 2022; Özboy 1998). Ülkemizde üretilen bulgur sarı renkte, parlak, kırımı düzgün ve tadı damak tadına uygun olduğu için oldukça önemli miktarda ihracatı da yapılmaktadır. Türkiye’nin yaptığı bulgur ihracatı 2008 yılında yaklaşık 71 bin ton iken, 2022 yılında bu miktar yaklaşık 253 bin tona çıkmıştır. Ülkemiz 2022 yılında 105 farklı ülkeye toplamda 253.358 ton bulgur ihracatı yapmıştır. Bu ülkelerden ilk sırayı 73.7 bin ton ile Irak almıştır. Bu ülkeyi sırasıyla Suriye, Rusya Federasyonu, Almanya, Belçika, Lübnan, İsrail, Ukrayna, Ürdün, Fransa ve diğer ülkeler izlemiştir (Anonim, 2024a).

Bulgur Üretimi

Bu bölümdeki bilgiler birkaç kaynaktan (Bayram, 2023; Döşlü, 2022; Erbaş ve ark., 2016; Evlice & Özkaya, 2020; Evlice & Özkaya, 2019; Rasheed ve ark., 2023; Savas & Basman, 2016; Singh ve ark., 2014; Stone ve ark., 2020; Yaralı & Akın, 2023) yararlanılarak hazırlanmıştır.

Sarı pigment içeriği, sertlik, su emilimi ve pişme gibi üstün özellikleri nedeniyle ekmek buğdayından ziyade bulgur üretiminde genellikle durum buğdayı (*Triticum durum*) kullanılmaktadır. Sarı renk, Türkiye’de tüketici tercihini etkileyen bulgurun önemli bir kalite parametresidir. Bu nedenle üreticiler müşterilerin talebini karşılamak için daha sarımsı bulgur rengi elde etmeye çalışırlar (Evlice & Özkaya, 2020). Üretim yöntemi binlerce yıllık serüvene sahip olmasına rağmen değişime uğramamıştır. Bulgur üretiminin genel akış şeması Şekil 1’de gösterilmiştir; ancak bulgur üretmek için evrensel olarak kullanılan standart bir prosedür bulunmamaktadır. Sert buğday (*Triticum durum*), taş ve yabancı maddelerden ayrıldıktan sonra yıkanarak temizlenir, temizlenen buğday suyunu tamamen çekene kadar pişirilir, sert ve kuru hale gelene kadar kurutulur, değirmenlerde öğütülerek kırılır, tane büyüklüğüne ve kullanım amacına göre eleklerden geçirilerek sınıflandırılır (Döşlü, 2022; Evlice & Özkaya, 2019). Öğütme ve kurutma işleminden sonra bulgur, geniş bir sıcaklık aralığında (37°C gibi yüksek bir sıcaklığa kadar) en az 6-8 ay depolanabilir; ancak depolama bağıl nemi %70’in altında ve bulgurun nem içeriği %10’un altında (kuru bazda) tutulmalıdır (Erbaş ve ark., 2016; Singh ve ark., 2014).



Şekil 1. Bulgur Üretim Aşamaları

Bulgur üretiminde geleneksel, otoklav ve mikrodalga olmak üzere üç farklı yöntem kullanılabilir. Ancak, geleneksel (atmosferik basınç altında pişirme) ve otoklav pişirme yöntemleri literatürde en sık kullanılan yöntemlerdir. Bulgurdaki parlak sarı renk, geleneksel pişirme yöntemi kullanılarak elde edilen ve tüketiciler tarafından istenen bir özelliktir. Ancak geleneksel yöntemde taneler deforme olma eğilimindedir. Otoklav pişirme yöntemi ise bulgurun renginin koyulaşmasına neden olmaktadır. Bulgur geleneksel olarak pişirildikten sonra açık havada güneşte kurutulur, ancak bu kurutma yöntemi kontaminasyon sorunlarına ve bulgurun kalitesinin düşmesine neden olabilmektedir. Sıcak havada kurutma, hem üretim kapasitesini artırmak hem de kontaminasyonu önlemek için modern bulgur tesislerinde sıklıkla kullanılan yöntemdir (Rasheed ve ark., 2023; Savas & Basman, 2016).



Bulgur üretim teknolojisi, üretim sırasında nem ve sıcaklıktaki önemli değişiklikler nedeniyle oldukça zordur. Bu nedenle, iyi kaliteli bulgur elde etmek için proses kontrolünde kapsamlı bilgi ve deneyim gereklidir. Su, hava, buhar, pnömatik hava ve sıcak su üretimin ana girdileridir. Taş, toz, atık su, yabancı maddeler ve metaller bulgur üretimi sırasında oluşan başlıca atıklardır. Ayrıca, kırık taneler, yabancı tohumlar, saman parçaları, boş/buruşuk taneler, bulgur unu ve kepek yan ürünlerdir ve bunlar genellikle hayvan yemi olarak kullanılır. Türkiye’de bulgur üretim yöntemleri esas olarak iki gruba ayrılır: Antep ve Karaman (Mut) (adını bulgur üreten önemli illerden almaktadır) yöntemleri. Her iki yöntemde de temizleme ve bulgurlama (pişirme ve kurutma) adımları aynıdır ancak öğütme sistemleri farklıdır. Öğütme sırasında kullanılan tavlama şartları (kepek ayırma işleminden önceki aşama) ve değirmenin tipi esas olarak bu bulgur türlerinin özelliklerini belirler. Antep ve Karaman tipi bulgurların bulgur parçacıklarının rengi ve şekli oldukça farklıdır. Antep üretim yöntemi 15-30 dakika gibi nispeten kısa bir tavlama süresi içerir ve bulgurun nem oranı %15-17 civarındadır. Buna karşılık, Karaman (Mut) tekniği çok daha uzun bir tavlama süresine (8-14 saat) sahiptir ve bu da nem oranının %20-24’e yükselmesine olanak tanır. Her iki durumda da pişmiş tanelerin tavlama kepek ayırma aşamasında kepek ayrılmasını kolaylaştırır. Karaman (Mut) tekniğinde kepek ayırma ve öğütme, geleneksel olarak taş değirmen kullanılarak tek bir işleme adımı olarak gerçekleştirilen, Antep tekniğinde öğütme, kepeği ayrılmış bulgur üzerinde bağımsız işleme adımlarında gerçekleştirilir. Karaman usulü üretimde yüksek kalitede son ürün elde etmek daha zor olduğundan ve daha fazla nem gerektiğinden dolayı Antep usulü üretim daha yaygın olarak kullanılmaktadır (Bayram, 2023; Stone ve ark., 2020).

Temizleme

Buğday alımı sırasında hektolitreye ağırlığı, renk, yabancı madde, protein ve nem içerikleri belirlenir. İşleme başlangıcında buğdayda, kaba ve ince yabancı maddeleri çıkarmak için ön eleme ve aspirasyonla temizleme işlemleri gerçekleştirilir. Daha sonra havalandırılmalı silolarda depolanır. Tekniğine uygun buğday seçimi yapıldıktan sonra buğdaylar bulgurun kalite özelliklerini bozan sap, saman, taş, toprak, metal, yabancı tohum ve hububat danelerinden manyetik ayırıcılara sahip temizleme makinalarında (elekler ve taş ayırıcılar) temizlenir. Buğday, hijyenik ve kolay çalıştırılması nedeniyle genellikle pnömatik konveyörler kullanılarak taşınır.

Islatma

Temizlenmiş buğday, tekdüze bulgur rengi elde etmek için farklı renklerdeki taneleri ayırmak üzere renk ayırıcılarından (isteğe bağlı) geçirilir. Daha sonra, tane üzerindeki toz ve kirli maddeleri gidermek için yıkanır. Temizlenen ve yıkanan buğdaylar ıslatma kazanlarına alınarak ıslatma işlemine tabii tutulurlar. Islatmanın faydası danede bulunan nişastanın bünyesine gerekli suyu alarak pişme sırasında çabuk jelatinleşmeyi sağlamaktır. Islatmada dikkat edilecek husus; ıslatma suyunun temiz ve fazla sert su olmamasıdır.

Piştirme

Piştirme, tüm nişasta jelatinize olana ve nem içeriği %40-50’ye (ıslak bazda) ulaşana kadar atmosferik veya basınçlı piştirme kullanılarak gerçekleştirilir. Temizlenmiş buğday, atmosferik pişirmede kaynar suya eklenir. Su oranı buğdaydan daha yüksektir (1.5-2 kat). Pişirmeden sonra kalan su atıktır ve çevreye boşaltılmadan önce arıtılmalıdır. Bunun yanı sıra, suda çözünen vitamin ve minerallerin bir kısmı piştirme suyunda kaybolabilmektedir. Bu nedenle, bazı bulgur üreticileri pişirmeden sonra kalan su miktarını azaltmaya veya piştirme suyunun tahıl tarafından neredeyse tamamen emilmesini sağlamaya çalışmaktadır. Bu nedenle, pişirmenin başlangıcında su seviyesini azaltmaya çalışırlar. Pişirilen ürüne “hedik” denir. Buğday pilavına benzer. Bu nedenle, yumuşak ve yapışkandır. Bu ürünün işlenmesi çok kritiktir. Bu nedenle, pişmiş buğday (hedik), yapışkanlığı önlemek için kısmen nişastanın retrogradasyonu yoluyla daha sert bir dış katman elde etmek için ortam havası kullanılarak mümkün olan en kısa sürede soğutulur. Piştirme seviyesi geleneksel olarak çekirdeğin ortasından kesilerek incelenir ve nişastanın jelatinleşip jelleşmediğinin belirlenmesiyle yapılır. Bu durumda tamamen pişmiş buğday yarı saydamdır. Ortası beyaz olan çekirdekler ise eksik jelatinleşmeyi gösterir. Son derece deneyimli operatörler, buharlaştırılmış piştirme suyunun duyu özelliklerinin (renk ve koku) öznel değerlendirmesi yoluyla da piştirme derecesini belirleyebilirler.

Kurutma

Kurutma, pişen buğday tanesinin su oranını (nemini) %10-12 civarına indirmek için uygulanan bir işlemdir. Pişen buğdaylar kurutma kulesinde veya geleneksel olarak güneşte kurutulabilmektedir. Ancak güneşte kurutmada kontaminasyon açısından belirgin kalite sorunları bulunduğu ticari bulgur üretiminde yasaklanmıştır. Kurutma kulesinde vantilatörlerle 60-70°C’lik kuru hava verilerek bulgurlar 4-5 saatte kurutulabilir. Ancak burada dikkat edilecek husus sıcaklığın çok yüksek tutulmamasıdır. Aksi takdirde bulgurun rengi koyulaşmaktadır. Bazı tesislerde farklı kurutucular da kullanılmaktadır. Örneğin tünel kurutucu, yüksek kapasitesi, enerji verimliliği ve güvenilir performansı nedeniyle tercih edilmektedir.



Kabuk Soyma

Piştirilmiş ve kurutulmuş bulgur, tane kepeğinin en dış katmanlarını çıkarmak için kısmen kepekten arındırılır. Kepekten arındırmadan önce bulgurun nem içeriği yaklaşık %12-17'ye çıkarılacak şekilde tavlama işlemi yapılır, böylece sürtünme/aşınma yoluyla elde edilen kepek kolaylıkla ayrılmaktadır. Bu işlem adımı, eklenen su miktarının ve bulgurun dinlenmeye bırakıldığı sürenin kritik kontrolü son derece önemlidir, çünkü bu parametreler pişmiş buğdayın suyu almasını ve dolayısıyla kısmi kepekten arındırma sırasında perikarpın taneden kolay soyulmasını belirler. Tavlama nemi ve kepek ayırma süresinin yanı sıra, buğday çeşidi, pişirme ve kurutma yöntemlerinin tümü bu adımda ne kadar kepek çıkarılacağını etkilemektedir. Bulgurun kabuğu evlerde taş dibeklerde ağaç tokmaklarla dövülerek soyulurken, işletmelerde dik taşlarla veya kırma makinalarından geçirilerek kabukları soyulur.

Öğütme (Kırma)

Öğütme (kırma), bulgur üretiminde önemli bir aşamadır. Öğütme işlemi, bulgurun renk, parçacık boyutu (iri, ince, vb.), şekil ve yüzey özellikleri nihai görünümünü belirlemektedir. Öğütmeyi her zaman, farklı boyutlardaki bulgur fraksiyonlarını oluşturmak için farklı büyüklükteki elekler kullanılarak boyut sınıflandırması takip eder. Öğütmede istenilen şekil, düzgün yüzeyli, düzgün oval parçacıklardır; kesin boyut ise hangi tür bulgurun istendiğine (iri, orta, vb.) bağlıdır. Kabuğu soyulmuş bulgur, disk veya silindir değirmenler kullanılarak öğütülür. Öğütme işleminden önce, öğütme verimini artırmak ve kayıpları önlemek için nem içeriği % 1-3 oranında artırılır. İsteğe bağlı olarak, öğütme işleminden önce farklı renklerdeki taneleri ayırmak için bir renk ayırıcı kullanılabilir. Öğütme işleminden sonra, bulgur ununu ayırmak için uygun boyuttaki elekler kullanılır; 0.5 mm'den küçük parçacık boyutu (bulgur unu) öğütme işleminin bir yan ürünü olarak kabul edilir, ancak yine de yem katkı maddesi olarak satılabilir ve bazı mutfaklarda bir bileşendir.

Diğer Aşamalar

Öğütme işleminden sonra, bulgurun parlak sarı rengini ve dolayısıyla pazar rekabet gücünü artırmak için ek bir parlatma aşaması eklenebilmektedir. Öğütülen kırık taneler bir şafta bağlı bir dizi kanatçık bulunan yatay bir parlatıcı kullanılarak parlatılmaktadır. Parlatmadan önce nem içeriği tavlama yoluyla %15-17'ye çıkarılır. Parlatma sırasında bulgur parçacıkları şaft üzerindeki karıştırma kanatlarına düşerek ve kanatların karıştırma ve aşındırıcı etkisine maruz kalarak parlatıcıya girer. Parçacıkların yüzeyleri (özellikle keskin kenarlar ve köşeler) birbirlerine, kanatlara ve parlatıcının iç yüzeyine sürtünerek aşınır. Bu nedenle parçacıkların kenarları/yüzeyleri keskin değil yuvaraktır ve parlak sarı renktedir. Ürün parlatıcıdan sonra daha açık bir renge sahip gibi görünür. Daha açık renk ayrıca sistemdeki sürtünme ve hidrasyondan kaynaklanan ısı nedeniyle pigmentlerin tahrip olmasından da kaynaklanıyor olabilir.

Öğütülmüş bulgur, kullanım amaçlarına göre (örneğin, iri, orta, ince ve ultra ince) sınıflandırılır. Türkiye'de bulgur sınıflandırma boyutları, ilgili Gıda Kodeksi tebliğinde tanımlanmıştır. Ayrıca bulgurun sınıflandırılması için diğer ulusal standartlar ve uluslararası spesifikasyonlar da bulunmaktadır.

Ambalajlama ve Depolama

Bulgurlar yeni ve içerisindeki maddeyi bozmayacak çuval, bez torba vb. uygun ambalajlara konarak depolanmaktadır. Bulgurun depolandığı yerin serin ve rutubetsiz olmasına özen gösterilmelidir. Ortam rutubetli olursa ya da bulgur iyi kurutulmamışsa, bulgurda küflenme ve diğer bozulmalar oluşabilmektedir. Ortamın sıcaklığı 30-35°C'nin üzerinde olursa 4-5 ayda bulgurlarda ekşime ve acılaşıma olmaktadır. Bulgurun bekletildiği yer direk güneş ışığı almıyorsa ve ortam sıcaklığı 20°C civarında tutulursa bulgur gıda değeri bozulma olmadan bir yıl dayanabilmektedir.

Bulgur Çeşitleri

Bulgur rengine göre esmer/siyah ve sarı olmak üzere iki ana kategoriye ayrılmaktadır. Ülkemizde yetiştirilip işlendiği bölgelere göre de Antep tipi ve Karaman – Mut tipi olmak üzere sınıflandırılmaktadır. Genellikle durum buğdayından yapılan bulgur ekmeklik buğdaydan da yapılabilir. Esmer bulgur genel olarak özel çiğköfte yapımı için kullanılan bir çeşit olup esmer ekmeklik buğday kullanılarak aynı yöntemlerle üretilmektedir. Ayrıca tarihi bir özellik olarak esmer bulgur sınıfına giren siyez bulguru ise, Kastamonu bölgesi ve çevresinde üretilmektedir. Siyez bulguru tarihi bir buğday çeşidi olan Siyez buğdayından (Einkorn) yapılmakta ve hem pilav hem de köfte türü ürünler için kullanılmaktadır. Farklı ürünlerden elde edilen soya bulguru gibi çeşitler de bulunmaktadır. Ayrıca, marketlerde çeşnili bulgur da görülmektedir. Çeşnili bulgur içerisinde salça ve baharatlar bulunmaktadır. Boyutlarına göre ise mutfakta kullanılacağı alanlara uygun isimler alan bulgur, özellikle Anadolu mutfaklarında çorba, pilav, kebab ve köfte gibi yemeklerin her biri için farklı boyutlarda tercih edilmektedir. Boyutlarına göre bulgur çeşitleri şöyle sıralanabilmektedir (Şekil 2) (Anonim, 2016a):



- ✓ *İri pilavlık/kabuksuz pişmiş buğday*: Genelde pilav için kullanılan en büyük boy bulgur tipidir. Hemen hemen buğday boyutundadır ve sadece diri bulgurun kepeğinin soyulmuş halidir.
- ✓ *Pilavlık/Kalın bulgur (1.6-3.55mm Türkiye’de)*: Çok az kırılmış pilavlık bulgurdur. Genellikle Gaziantep civarında pilavlarda kullanılmaktadır.
- ✓ *Orta Pilavlık (2.5 - 3.5mm Suriye’de)*: Mardin, Midyat ve Arap kesimlerine hitap eden Midyat tipi olarak da bilinen bulgur tipidir, İç Anadolu Bölgesi’nin de tercihleri arasındadır.
- ✓ *Köftelik/ kısırlık (1.25-2.25mm Suriye’de, 0.5-2.00 Türkiye’de)*: Bu boyuta Antep’te simit bulgur denilmekte ve genellikle kebablarda kullanılmaktadır.
- ✓ *Çiğ köftelik (0.5-1.25 mm)*: Köftelik bulgurun biraz daha incesidir. Çiğ köfte yapımında kullanılmaktadır.
- ✓ *Sitti simit (<0.5 mm)*: En ince bulgur tipidir. Çoğunlukla çorbalarda ve hamurlarda kullanılmaktadır.



Şekil 2. Bulgur çeşitleri (Anonim, 2024b)

Ülkemizde Türk Gıda Kodeksi’ne göre bulgur, pilavlık ve köftelik olarak iki sınıfa ayrılmaktadır (Çizelge 1).

Bulgurun Beslenme ve Sağlık Açısından Önemi

Bulgur, salatalarda, çorbalarda, fırınlanmış ürünlerde, dolmalarda, güveçlerde ve vejetaryen tariflerde ete ikame olarak kullanılabilen çok amaçlı bir üründür. Kuzey Amerika’da popülaritesi artmaktadır çünkü pirinç için daha sağlıklı, daha hızlı pişen bir ikame olarak kullanılmaktadır. Bulgurun, üretim sırasında pişirilme şekli nedeniyle başlangıçtaki besin bileşenlerinin çoğu korunmaktadır. Bulgur işleme sırasında (ıslatma ve pişirme), tanenin kepek ve aleuron katmanlarında bulunan suda çözünür besin bileşenlerinin çoğu endosperme doğru yayılır ve böylece bulgurun başlangıç besin bileşenlerinin yüksek bir oranını korumasına olanak tanır. Buna karşılık, dış katmanlardaki minerallerin bir kısmı kısmi kepek ayırma adımı sırasında kaybolur. Tam tahıl konseyinin (WGC) bulguru tam tahıl olarak kabul etmesinden itibaren Amerika Birleşik Devletleri ve Avrupa’da yaygın olarak bulunur hale gelmiştir (Rosentrater & Evers, 2018; Shah ve ark., 2022). Bulgur, uzun raf ömrü, düşük maliyeti, kolay hazırlanışı, yüksek besin değeri ve lezzetiyle hazır veya yarı hazır gıda kategorisine yer aldığı için dünya çapında ticari olarak üretilmektedir. Bulgur tipik olarak %9-13 su, %10-16 protein, %1.2-1.5 yağ, %76-78 karbonhidrat, %1.2-1.4 kül içermektedir (Rasheed ve ark., 2023).

Buğdayın, esas olarak tiamin (B1), riboflavin (B2), niasin (B3), pantotenik asit (B5) ve piridoksin (B6) olmak üzere önemli bir B vitamini kaynağı olduğu bilinmektedir. Bu vitaminler çoğunlukla tahılın embriyo ve aleuron tabakalarında toplanmıştır (Kamal-Eldin, 2008). Tahılın bu kısımları bulgur üretimi sırasında tamamen ayrılmaz ve bu vitaminlerin yüksek miktarı bulgurda kalır. Ancak, bu vitaminlerin bulgurda kalma miktarları büyük ölçüde bulgur üretim tekniklerine bağlıdır (Kadalkal ve ark., 2007).



Çizelge 1. Bulgurun Tane İrilikleri (Anonim, 2016b)

Özellikler	Değer					
	Pilavlık Bulgurlar				Köftelik Bulgurlar	
	Tane Bulgur	İri Pilavlık	Pilavlık	İnce Pilavlık	Köftelik	İnce Köftelik
3.50 mm'lik kare delikli tel elek altına geçen kısım % (m/m)		En az %80				
3.00 mm'lik kare delikli tel elek altına geçen kısım % (m/m)			En az % 80			
2.80 mm'lik kare delikli tel elek altına geçen kısım % (m/m)	En çok %10					
2.50 mm'lik kare delikli tel elek altına geçen kısım % (m/m)				En az %80	En az % 90	
2.00 mm'lik kare delikli tel elek altına geçen kısım % (m/m)		En çok %10				
1.60 mm'lik kare delikli tel elek altına geçen kısım % (m/m)			En çok %10	En çok % 20		En az % 80
0.50 mm'lik kare delikli tel elek altına geçen kısım % (m/m)	En çok %0.5	En çok %0.5	En çok %0.5	En çok % 1	En çok %2	En çok %2

Diyet lifinin (DL) sağlık geliştirici etkilerine dair artan kanıtlar ve tüketicilerin sağlıklı gıdalara olan ilgisi, daha yüksek DL'ye sahip gıda ürünlerine olan talebin artmasına yol açmıştır (Jacobs ve ark., 2016). Bulgurun mükemmel bir DL kaynağı olduğu bildirilmiştir, ancak DL'nin önemli bir kısmı kepek ayırma ve kırma işlemlerinin bir sonucu olarak kaybolmaktadır. Bu işlemlerden sonra bile, bulgurda kalan DL oranı hala diğer birçok gıdadan daha yüksektir (Savas & Basman, 2016). Bulgur 100 g'ında 18.3 g diyet lifi içermektedir. Diyet lifi içeriği sırasıyla pirinç, buğday unu, tam buğday ekmeği ve yulaf ezmesinden 3.5, 6.8, 2.3 ve 1.8 kat daha yüksektir. Ayrıca bulgur, dirençli nişasta tip III içerir ve buğday pişirildiğinde nişasta jelatinize olur ve buğday kurutulduğunda jelatinize olmuş nişasta retrograde hale gelir. Ayrıca bulgur, besin değeri ve böcek ve küf aktivitesine karşı direnci sayesinde uygunsuz koşullarda bile uzun süreli saklanabilme özelliği nedeniyle WFP (Dünya Gıda Programı) tarafından kıtlık bölgelerine gıda yardımı olarak kullanılmaktadır (Erbaş ve ark., 2016). Buğday, çoğu tahıl ve baklagilde fosforun ana depolama formu olan yüksek miktarda fitik asit (PA , $C_6H_{18}O_{24}P_6$, miyoinositol hekzafosfat, IP_6) içerir. Fitik asit, minerallerle stabil kompleksler oluşturduğu ve gastrointestinal sistemde minerallerin biyoyararlanımını azalttığı için bir anti-besin olarak kabul edilir. Bu tür bilinen olumsuz etkilerinin yanı sıra PA , antikanser ve antioksidan ajan olarak insan sağlığında önemli roller de oynayabilmektedir (Ma ve ark., 2013). PA 'nın olumsuz etkilerini azaltmak için gıda işlemede kabuk soyma, çimlendirme, fermente etme, otoklavlama, mikrodalgada ısıtma ve ısılatma gibi farklı işlemler uygulanmaktadır. Bulgur yapımı sırasında özellikle pişirme aşamasında önemli miktarda PA biyolojik olarak parçalanmaktadır (Evlice & Özkaya, 2020). Bulgur, yüksek enerjiye sahip olmasına rağmen düşük glisemik indeks değerine sahiptir, bu nedenle kandaki şeker oranını yavaş yükseltir. Beriberi hastalığı gibi sinir ve sindirim sistemi hastalıklarının önlenmesinde önemli rol oynayan B1 vitaminlerinin yapısında bulundurulur. İçerdiği folik asitler bakımından hem hamilelik hem de erken çocukluk dönemlerinde oldukça önemli bir gıda kaynağıdır. Kolesterol içermediği, doymamış yağ bulundurduğu ve toplam yağ oranı düşük olduğu için kalp dostudur. Yapısında bulunan lifler ve minerallerden dolayı sindirim sisteminin çalışmasına destek olur. Radyasyona karşı direnç göstermesinden dolayı olası nükleer savaş ve sorunlarda hem askeri hem de sivil amaçlar için besin maddesidir. İşlenmiş bir gıda olmasına rağmen üretim sırasında rüçeym bertaraf edilmediği için besleyiciliği azalmamaktadır (Döşlü, 2022). Tablo 1'de bulgurun besin değerleri verilmiştir.

Türkiye'de kişi başına yıllık tüketimi yaklaşık 15 kg'dır ve Türkiye'nin Doğu ve Güney kesimlerinde, Suriye, İran, Irak, Lübnan, İsrail ve Arabistan'da bu değer oldukça yüksektir (kişi başına 25-35 kg). Türkiye'de bulgur tüketimi sırasıyla makarna ve pirinçten yaklaşık 2.5 ve 2.0 kat daha fazladır (Savas & Basman, 2016).

Ayrıca araştırmacılar, bulgurun besin üstünlükleri yanında birçok avantajlarının olduğunu ve bunların şöyle sıralanabileceğini bildirmişlerdir:



- ✓ Bulgur doğaldır. Durum buğdayından üretilir. Hiçbir katkı maddesi içermez, üretiminde sadece buğday ve su kullanılır.
- ✓ Makarna ve ekmeğe göre oldukça ucuzdur ve hazırlanması kolaydır.
- ✓ Pişirme ve kurutma işlemlerinden dolayı küf oluşturmaz, böcek ve larva gelişimi olmaz.
- ✓ Pişirme ve kurutma işlemleri enzimleri ve mikroorganizmaları etkisizleştirir.
- ✓ Pişirme ve kurutma sonucu raf ömrü birçok ürüne göre daha uzundur.
- ✓ Bulgur yıkanmaz! Üretim aşamasında yıkanıp kaynatıldığı için ambalajlı bulgurun pişirilmeden önce yıkanmasına gerek yoktur. Ayrıca pirinç gibi suda bekletilmez.
- ✓ Radyasyon emmez, sıcak ve rutubetli ortamlarda stoklanmaya elverişlidir.
- ✓ Embriyo kısmı ayrılmadığından ve burada bulunan besin maddeleri pişirme esnasında danenin içine geçtiğinden ekmek ve makarnaya göre besin değeri daha yüksektir.
- ✓ Tane pişirilince, nişasta jelatinize, proteinlerde koagüle olarak birbiriyle kaynaşır. Böylece hazmı daha da kolay bir hal alır.
- ✓ Kolesterol içermez ve doymamış yağa sahip olduğundan sağlıklı beslenme açısından önemlidir.
- ✓ İçerdiği folik asitten dolayı çocuk ve hamile kadınlar açısından çok önemli bir gıda maddesidir. Çocukların beyin gelişiminde çok önemli bir etkiye sahiptir.
- ✓ Bulgur, yüksek posa içeriğiyle doygunluk verir, sindirimi kolaylaştırır, enerji verir.
- ✓ Bulgur glisemik indeksi düşük bir besin olduğu için, şeker hastaları tarafından da rahatça tüketilebilir.
- ✓ Yüksek mineral ve selülozdan dolayı besin emilimini hızlandırır; kabızlığı engeller ve bağırsak kanserini önlemede önemli etkiye sahiptir (Anonim, 2016c; Bayram, 2007; Dönmez ve ark., 2004).

Sonuç

Dünya çapındaki üretim ve tüketimi önemli ölçüde artmakta olan bulgur, sırasıyla Kuzey Afrika ve Orta Doğu halklarının diyetlerindeki başlıca temel gıda ve karbonhidrat kaynağı durumundadır. Gıda üretiminin sürdürülebilirliğini iyileştirmek için beslenmede bitki bazlı gıdaların miktarında önemli artışlar gerekmektedir. Bu nedenle, gelecekte insan diyetinin daha fazla tahıl ve bakliyat (yani nişastalı gıdalar) içermesi beklenmektedir ve bu alanda daha fazla araştırmaya ihtiyaç vardır. Bulgur, diyetle daha fazla dahil edilmesi durumunda gıda sürdürülebilirliğini iyileştirmek için büyük bir potansiyele sahip gibi görünmektedir. Bulgur, farklı tahıl ve baklagilleri hammadde olarak kullanarak yeni ürünler (bulgur benzeri ürünler) yaratmak için büyük bir inovasyon potansiyeline sahiptir. Bulgur sektörü, diğer gıda sektörlerine benzer şekilde yüksek teknoloji seviyelerine uyarlanması gereken modern işleme hatları ve ekipmanları geliştirmek için Ar-Ge ve çalışmalara ihtiyaç duymaktadır. Ayrıca bulgurun geleneksel lezzeti ve aroması, modern tesislerde seri üretim sırasında korunmalıdır. Ayrıca bulgur, diyet lifi, vitaminler ve mineraller de dahil olmak üzere faydalı besinler açısından zengin bitki bazlı bir besindir. Bulgurun besinsel ve terapötik potansiyeli ve işleme parametreleriyle birlikte besin kalitesinin optimizasyonu yeterince incelenmemiştir. Bulgur, stabilitesi ve önemli besinsel profili nedeniyle işlevsel gıdaların geliştirilmesinde kullanılabilir. Ancak bulgurun işlevsel ve terapötik özelliklerini keşfetmek için daha fazla araştırmaya ihtiyaç vardır. Bulgur, binlerce yıllık bir geçmişe sahip olup, birçok kültür ve toplumda önemli bir yer edinmiştir. Üretim yöntemi yüzyıllardır aynı kalmış bu besin, hem lezzeti hem de besleyiciliğiyle her dönemde sofralardan eksik olmamıştır. Bulgur, hem üzüntüde hem de sevinçte, kısacası yaşamın her anında yanımızda olmuş, sadık bir dost gibi bize eşlik etmiştir.

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Spatial Distribution of Natural and Anthropogenic Areas in Kastamonu Province (Northern Türkiye)

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Abstract

Identifying parts of terrestrial ecosystems that are vulnerable or remote to human influence; It is extremely important for long-term land use planning such as conservation, sustainability and resource management. In this study, the spatial distribution and density of natural/anthropogenic areas within the administrative borders of Kastamonu province were examined. Factors reflecting human impact; It was determined as settlement areas and density, population density, current land use and road density. These four basic factors were transformed into spatial factor maps with the help of Geographic Information Systems (GIS). The resulting map of the distribution and density of the member layers suitable for the fuzzy logic model was obtained by the fuzzy overlay method. Accordingly, a large part of the province is open to human influence. Settlements and agricultural activity areas in their immediate surroundings are the areas where anthropogenic impact is most intense. However, two large mountain ranges (Küre and Ilgaz Mountains) and parts of the rugged terrain have remained free from human influence. It is expanding its area with human-induced change areas, road construction, mining and forestry. Areas suitable for economic activity are areas of potential human-caused degradation.

Key Words: Natural areas, Anthropogenic areas, Distribution, Degradation, Kastamonu

Kastamonu İlinde Doğal ve Antropojen Alanların Mekânsal Dağılımı

Özet

Karasal ekosistemlerin insan etkisine açık veya uzak bölümlerinin belirlenmesi; koruma, sürdürülebilirlik ve kaynak yönetimi gibi uzun dönemli arazi kullanım planlamaları için son derece önemlidir. Bu çalışmada, Kastamonu ilinin idari sınırlarındaki doğal/antropojen alanların mekânsal dağılımı ve yoğunluğu incelenmiştir. İnsan etkisini yansıtan faktörler; yerleşim yerleri ve yoğunluğu, nüfus yoğunluğu, güncel arazi kullanımı ve yol yoğunluğu olarak belirlenmiştir. Bu dört temel faktör, Coğrafi Bilgi Sistemleri (CBS) yardımıyla mekânsal faktör haritalarına dönüştürülmüştür. Bulanık mantık modeline (fuzzy overlay analysis) uygun faktör katmanlarının bindirme (fuzzy overlay) yöntemiyle dağılımına ve yoğunluğuna ait sonuç haritasına ulaşılmıştır. Buna göre, ilin geniş bir bölümü insan etkisine açıktır. Yerleşim yerleri ve yakın çevrelerindeki tarımsal faaliyet alanları, antropojen etkinin en yoğun olduğu alanlardır. Bununla birlikte, iki büyük dağ sırası (Küre ve Ilgaz Dağları) ve engebeli arazinin uzandığı bölümler, insan etkisinden uzak kalabilmiştir. İnsan nedenli değişim alanları, yol yapımı, madencilik ve ormancılık gibi çalışmalar ile alanını genişletmektedir. Ekonomik faaliyete uygun alanlar, insan nedenli potansiyel bozulma alanlarıdır.

Anahtar Kelimeler: Doğal alanlar, Antropojen alanlar, Dağılım, Bozulma, Kastamonu

Giriş

Doğallık veya doğal alan; “insan etkisinden uzak olmak” anlamına gelecek şekilde tanımlanmıştır (Angermeier 2000; Povilitis, 2002). İnsan müdahalesi ile doğallığı bozulmuş veya bozulma sürecinde olan alanlar ise antropojen (insan etkisindeki) alanlar olarak ifade edilebilir.

Denge/düzen üzerine kurulu doğal sistemlere insanın etkisi, günümüzden en az 3000 yıl öncesine kadar uzanabilir. Bu süreçte özellikle karasal ekosistemlerin antropojenik dönüşümü, küresel boyuttadır (Elis, 2015; Newbold et al. 2015; Elis, 2021). Dünya insanlık tarihinde göçler, savaşlar, tarım ve hayvancılık sistemleri, medeniyetlerin kurulması ve yıkılmasında doğal ortamın önemli etkileri bulunmaktadır. Doğal ortamla insan arasındaki ilişkiler kurulmaksızın ya da doğal ortamın özellikleri yeterince bilinmeden tarihi olayların seyri ve arkeolojik sitlerin ve ilk yerleşmelerin kuruluşunun açıklanması, layıkıyla ortaya konulması mümkün değildir (Atalay, 2022).

Doğal ortamda kurulu ekosistemler üzerinde insan faaliyetleri, biyolojik çeşitliliğin azalmasına, doğal kaynakların bozulmasına yol açan çok çeşitli etkiler ile ortaya çıkar. Su kaynaklarındaki antropojenik etkiler, dikkat çekici boyutlardadır. Bu durum, insan nedenli iklim değişikliğinin de katkısı ile gelecekteki etkilerinin çok daha büyük



boyutlara çıkacağı tahmin edilmektedir (Findell et al. 2017; Morelli et al. 2020). İnsan refahı/tüketimi için kullandığı doğal ortamın bozulması, kendi geleceği üzerinde de olumsuz sonuçları kaçınılmazdır. Arazi kullanımındaki/örtüsündeki bozulma, nüfus artışı ve sanayileşmeyle de doğrudan ilişkilidir (Duran&Güneş, 2007; Findell et al. 2017) Küresel olarak, yeryüzünün yaklaşık yüzde 41'inin insan kaynaklı arazi bozulmasına maruz kalmıştır. Etkilenen arazilerin beşte biri Sahra altı Afrika'dadır. Güney Asya en çok etkilenen bölgedir. Yüzölçümünün yüzde 41'i etkilenmiştir. Etkilenen alanın yüzde 70'i ciddi biçimde bozulmuştur. Bunu Güneydoğu Asya, Batı Asya ve Güney Amerika takip etmektedir. Bu tahminlere çöller dâhil değildir. İnsan nedenli bozulma, tarım arazilerinin yüzde 34'ünü etkilemektedir. Tarımsal alanların marjinal arazilere genişlemesi ile toprak erozyonu ve toprağa bağlı canlı çeşitliliğini azaltmaktadır. Tarım topraklarının yoğun inorganik gübrelerle işlenmesi, drenaj sistemlerini etkileyerek su kaynaklarındaki bozulmaya da katkıda bulunmaktadır (FAO, 2024). Bu çalışma ile Kastamonu ilindeki doğal ortam ile insan faaliyetleri arasındaki ilişkilerin mekânsal düzeyde incelenmesi amaçlanmıştır. İnsan nedenli doğal alan tahribi ile ilgili farklı bilim disiplinlerinden çalışmalar bulunmaktadır (Lambin et al 2001; Reba et al. 2016; De Jong et al. 2021). Kastamonu ili idari sınırlarındaki kapsamlı coğrafya çalışması, Kurter (1982) tarafından "Kastamonu ve Çevresinin Doğal Görünümü" isimli kitapta incelenmiştir. Bu kitapta yörenin yapısal ve morfolojik özellikleri detaylı olarak incelenmiştir. Ayrıca, ilin korunması gerekli doğal güzellikleri ile ilgili yayınlar da bulunmaktadır (Şen & Erkan Buğday, 2015; Tunçkol et al. 2020; Altunel et al. 2021). Ancak, bu çalışmalarda insan etkisini yansıtacak mekânsal yoğunluk üzerine bir çalışma yapılmamıştır. Çalışma alanı olarak idari sınırların belirlenmesi, çok yönlü (entegre) planlamalar ve mekânsal kararlar için önemli olmaktadır. Uzun dönemli arazi kullanım modellerine dönük idari kararlara olanak sağlayacaktır. Doğal alanlarının insan nedenli tahribinin sınırlanması, sürdürülebilir bir şekilde planlanması ve yönetilebilmesi etüt ve envanterin yapılmasına bağlıdır. Bu nedenle, Kastamonu ilinde yoğun insan faaliyetleri ile bu faaliyetlerden uzak alanların mekânsal yoğunluğunu ortaya koymak, literatüre katkı sağlayacaktır.

Materyal ve Yöntem

Çalışma alanı

Kastamonu ili idari sınırları, Küre ve Ilgaz sıradağlarının oluşturduğu yüksek alanları içerir. Bununla birlikte, Gökırmak, Araç ve Devrez vadilerinin genişlediği alanlarda alçak düzlükler bulunur. Topografyadaki çeşitlilik, arazi kullanımı/örtüsüne de yansımıştır. Dağlık alanlar, ormanlarla kaplı iken, akarsuların oluşturduğu alüvyonlar üzerinde tarımsal bitkiler yaygındır. Yine engebeli alanlarda, mera, verimsiz orman, açık-çıplak kayalıklar gibi alanlarda dikkat çeker. Küre Dağlarının orta bölümünü, Devrekâni platosunu oluşturur. Devrekâni Çayı, platonun orta bölümünden D-B doğrultusunda akar. Kastamonu, Karadeniz'e en uzun kıyısı olan ildir. İlin coğrafi konumu, 41°31'10"-41°47'45" Kuzey enlemleri ile 33°31'00"-34°08'25" Doğu boylamları arasındadır. Kastamonu ilinin merkez ilçe ile birlikte toplam yirmi ilçe yerleşimi vardır. TÜİK verilerine göre, toplam 1054 köy yerleşimine sahiptir. Kastamonu ili, batıda Bartın ve Karabük, güneyde Çankırı, güneydoğuda Çorum, doğuda Sinop illeri ile idari sınırını paylaşır (Şekil 1). Kastamonu'n idari sınırları, yaklaşık 13108 km² alanı kapsar. ADKNS'ye göre (2023 yılı) toplam nüfusu 388990 kişidir. Kastamonu ili, doğal alanlar açısından ön plandaki illerden biridir.

Yöntem

Kastamonu ilinde doğal ortam üzerindeki beşeri etkileri belirleyebilmek için; Harita Genel Müdürlüğünün 1/25000 ölçekli topografya haritaları ve 10 m çözünürlüklü sayısal yükseklik modeli (DEM), Orman Genel Müdürlüğünün 1/25000 ölçekli Meşcere tipleri haritaları kullanılmıştır. TÜİK veri tabanlarından nüfus ve yerleşim yerlerine ilişkin veriler elde edilmiştir.

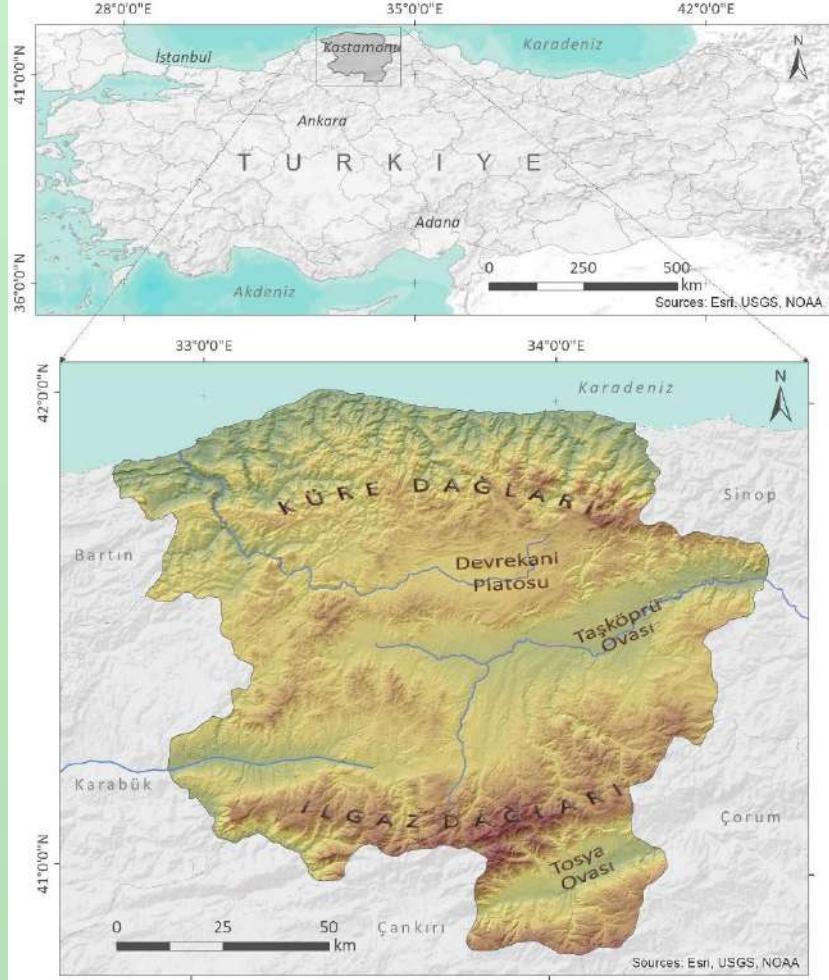
İnsan faaliyetlerinin mekânsal olarak yansıtan başlıca 4 temel ölçüt belirlenmiştir. Bu ölçütler; yerleşim yerleri ve yoğunluğu, nüfus yoğunluğu, karayolu yoğunluğu ve arazi kullanım biçimleri şeklindedir. Her bir ölçüt, CBS ortamında bir faktör katmanı olarak belirlenmiştir.

Çalışmada, çok kriterli analiz modellerinden Fuzzy Logic Overlay (Bulanık Mantık) yöntemi kullanılmıştır. Bulanık mantık yöntemi, kesin sınırlar yerine belirsizlik ve bulanıklık içeren problemleri modellemek için tercih edilmektedir. Bu yöntem, doğal ortam üzerindeki insan nedenli etkileri keskin hatlar yerine daha tedrici mekânsal tanımlama için seçilmiştir. Farklılığı ortaya koyabilmek için belirlenen kriterlerin bulanık üye modelleri (fuzzy membership) oluşturulmuştur. Bu üyelerin çakıştırılması ile mekânsal deseni ortaya koyan sonuç haritası elde edilmiştir.

Doğal ortam bozulması, antropojenik etmenlerin varlığına göre tanımlanabilir. İnsan nedenli farklı faktörlerle örtüşen ortamlardaki bozulma eğilimi, yüksek düzeydedir. İnsan nedenli etkenlerin yokluğu ise, mekânsal ortam bozulmasının düşük düzeyde olduğunu göstergesidir. Bu çalışma kapsamında, yerleşim yerleri ve tarım alanları, insan etkisine açık arazi kullanım alanları olarak tasnif edilmiştir. Ormanlar, insan etkisinden uzak alanlardır. Mera, açık alanlar ve verimsiz orman alanları ikinci derece insan etkisindeki alanlardır. Yerleşim yerlerinin mekânsal dağılımında yerleşimlerin yoğunlaştığı alanlar, insan etkisini de yansıtır. Bu etki, nokta yoğunluk enterpolasyonu yoluyla CBS katmanı oluşturulmuştur. Nüfus yoğunluğunun yüksek olduğu alanlar, insan etkisinin de yoğun olduğu alanlardır. Nüfus yoğunluğunun azaldığı kesimler ise insan etkisinden uzaktır. Nüfus



yoğunluğunu belirleyebilmek için Thiessen Çokgen çıkarma yöntemi kullanılmıştır. Bu yöntemde, iki nokta yerleşim yeri arasındaki mesafenin ortasından geçen hatlar ile yerleşimler arası sınırlar oluşturulmuştur. TUİK'in Adrese dayalı nüfus kayıt sistemindeki nüfus verilerinin elde edilen çokgen sınırlara bölünmesiyle nüfus yoğunluk haritası oluşturulmuştur. Bir başka faktör, karayolu yoğunluğudur. İnsanın ulaşılabilirliğini sağladığı için karayolunun varlığı ve oluşturduğu yoğunluk, insan etkisini yansıtan bir özellik olarak belirlenmiştir. Bu faktörü tanımlayabilmek için çizgi yoğunluk enterpolasyonu (line density) kullanılmıştır.



Şekil 1. Kastamonu ilinin lokasyon haritası

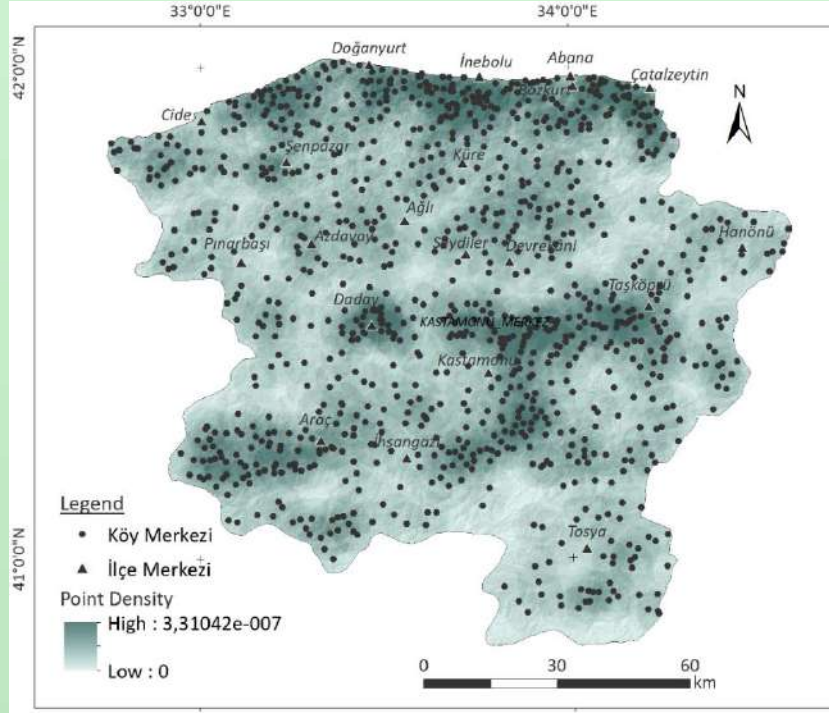
Bulgular

Yerleşim yerleri ve mekânsal yoğunluk

İlin yerleşim yerleri, dağlık engebeli arazide, kıyıda ve akarsu çevrelerindeki daha düzlük alanlarda kurulmuştur. Yerleşmeler, ilin genelinde dağınık bir desene sahiptir. Karaçomak çayının uzandığı güzergâh (merkez ilçe yerleşimi), Daday çayının uzandığı güzergâh (Daday ilçe yerleşimi) ve her iki çayın birleşerek oluşturduğu Gökırmak nehri güzergâhı (Taşköprü ilçe yerleşimi ve Taşköprü ovası), en yoğun yerleşimler bulunur. Kıyıda ve yakın alanlarda kurulmuş yerleşim yerleri de diğer yoğunluk oluşturan bölümdür. Kıyıya yakın bölümler ile yüksek alanlarda yazlık kullanım için 2. konutların inşası da yerleşimlerin genişlemesinde etkilidir (Şekil 2).

Yerleşim yerleri, akarsuların yüksek araziden taşıyıp yığıldığı alüvyonlar üzerinde daha geniş alanlara yayılmıştır. Kırsal yerleşimler, kentsel yerleşimlerden daha az altyapı sistemine sahiptir. Son yıllardaki doğal ortam koşullarıyla uyumlu olmayan (doğal afete açık) yapılaşma baskısı da dikkat çekici şekilde artmıştır. Yerleşimlerin, doğal çevre üzerindeki olumsuz etkisini azaltacak planlamalar ile heyelan, sel ve deprem gibi doğal risklerin de önüne geçilebilir.

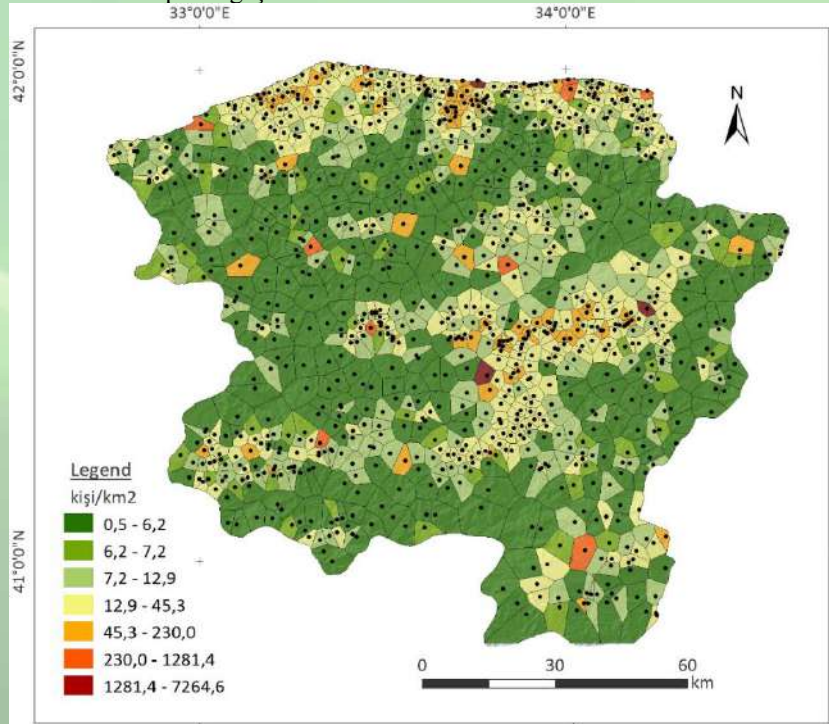




Şekil 2. Yerleşim yerleri ve mekânsal yoğunluk haritası (nokta yoğunluk enterpolasyon)

Nüfusun mekânsal yoğunluğu

Nüfus yoğunluğu, bir yerleşim yerindeki toplam nüfusun yerleşim biriminin kurulduğu alanın (ya da idari sınırın) toplam yüzölçümüne bölünmesiyle elde edilmektedir. Kastamonu ilindeki nüfus yoğunluğu tespit edilirken yerleşim yerlerinin idari sınırları yerine mesafeyi referans alan coğrafi Thiessen çokgenleri kurulmuştur. İki komşu köy yerleşimi arasındaki mesafeyi ortasından bölerek oluşturulan sınırlar, köy sınırı olarak belirlenmiştir. Bu sınırların oluşturduğu alandaki nüfus oranı, mekânsal nüfus yoğunluk faktörünü oluşturmuştur. Barındırdıkları nüfusla orantılı olarak İl merkezi, Taşköprü ve Tosya ilçe merkezlerinin sınırlarını oluşturan alanlar, nüfus yoğunluğunun en yüksek olduğu alanlardır (Şekil 4). Kırsal yerleşim, şehir ve kasabaların dışındaki yerleşim yerleridir. Nüfus, genellikle tarım ve hayvancılık faaliyetlerine katılır. Yöresel özelliklere göre, ormancılık ve madencilik de ön plana geçebilir.

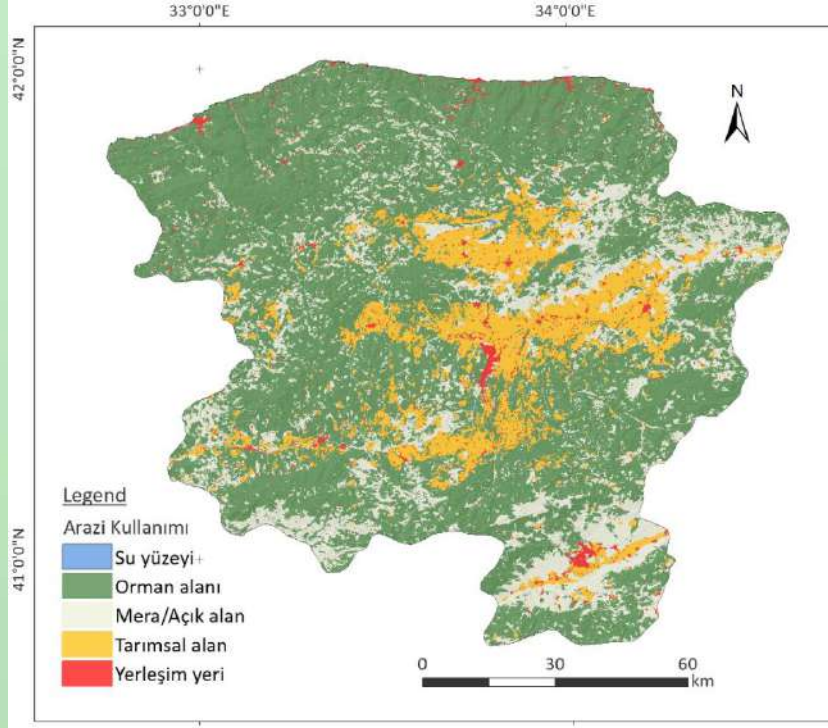


Şekil 3. Thiessen polygonlar yardımıyla oluşturulan nüfus yoğunluk haritası



Mevcut arazi kullanımı

Kastamonu ilindeki arazi kullanımı, topografyaya bağlı olarak şekillenmiştir. Dağlık, tepelik arazinin etekleri ile akarsuların yığıldığı alüvyonların genişlediği, sulanabilen sahalarda tarım alanları oluşturulmuştur. İlin farklı kesimlerindeki (Gökırmak, Devrez, Araç ve Devrekani gibi) başlıca akarsuların oluşturduğu alüvyonlar, tarım ve yerleşim olarak kullanımdadır. Yüksek arazilerin farklı yönelimli eğimli yamaçları, orman örtüsü ile kaplıdır. Tarım ve orman kullanımları dışında kalan, çoğunlukla kalker formasyonların olduğu, orta eğimli ve toprak örtüsünden yoksun kesimlerde, verimsiz orman-mera veya açık alan olarak kullanımlar yaygındır. Kullanım sınıflarındaki lokal değişkenlik, topografyaya bağlı olarak şekillenir (Şekil 5). En yoğun insan faaliyetleri, yerleşim yerleri ve yakın çevrelerindedir. Bu alanların etrafında oluşturulmuş tarım alanları da insan faaliyetinin yüksek olduğu diğer arazi kullanım alanlarıdır. Daha düşük düzeyde kalmakla birlikte insan faaliyetinin etkisindeki mera, verimsiz orman, açık alanlar bulunur. İnsan etkisinin en az olduğu alanlar ise orman alanlarıdır. Ulaşım güçlüğü yanında engebeli topografya şartları, ormanları insan etkisinden uzak tutmaktadır.



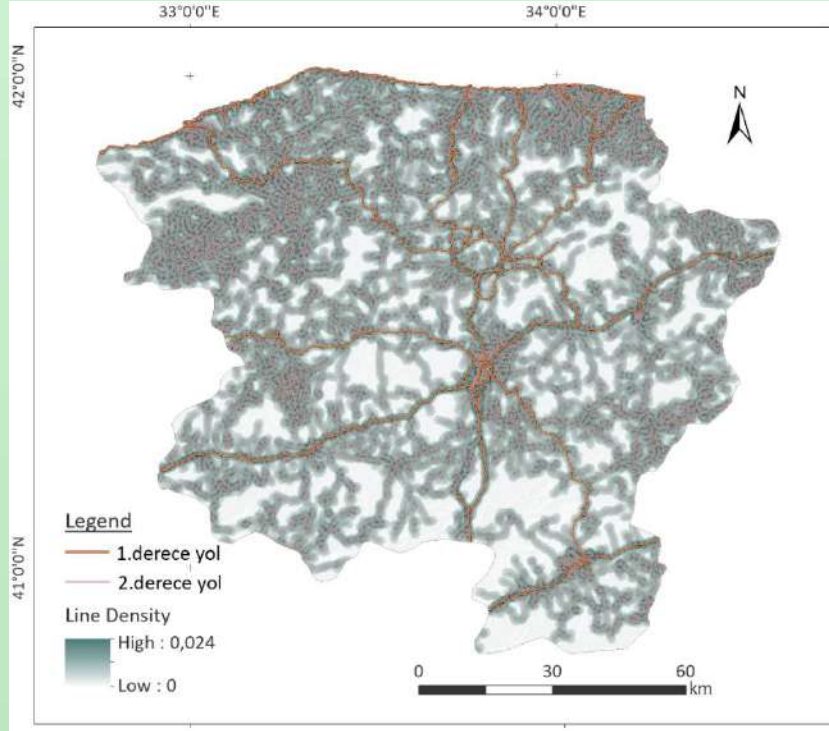
Şekil 4. İnceleme alanının mevcut arazi kullanımı

Kaynak: OGM

Karayolu ağı ve yoğunluğu

Kastamonu ili karayolu ağı, ilin topografik yapısından kaynaklı düzensizdir. Karayolu ağının yoğunluğu, çizgi yoğunluk analizi (line density) ile elde edilmiştir. Yol yoğunluğu, genellikle merkez ilçeden diğer ilçe merkezleri doğrultusundaki 1. derece ana karayolu hatları boyuncadır. Ana hatlara bağlanan daha çok köy yerleşimlerine ulaşımı sağlayan 2. derece karayolu hatları kurulmuştur. Bu güzergâhlar içinde, Araç ilçe merkezi ile Merkez ilçe, Taşköprü ve Hanönü ilçe merkezlerini birleştiren yol güzergâhında yol yoğunluğu artmaktadır. Kıyıya yakın iki farklı yöre, dikkat çekici yoğunluğa sahiptir. Bunlardan ilin KB yönündeki Pınarbaşı-Azdavay ilçelerin bulunduğu yöre, doğal oluşumların (Kanyonlar, Mağaralar, Gözlem terası, Şelaler vb.) bulunduğu alanlarla ilgilidir. Diğer KD yönündeki Çatalzeytin-Bozkurt ilçeleri arasında ise köy yerleşimlerinin sayısındaki fazlalıkla ilgili olmalıdır. Ayrıca, ilin güneyindeki Tosya ilçe merkeziden geçen E80 karayolu ve bağlantı yolları da bu yörede yoğunluk oluşturmuştur. Kıydan ve merkezi yerleşim yerlerinden uzaklaştıkça karayolu ağında ve yoğunluğunda azalış görülür (Şekil 9).





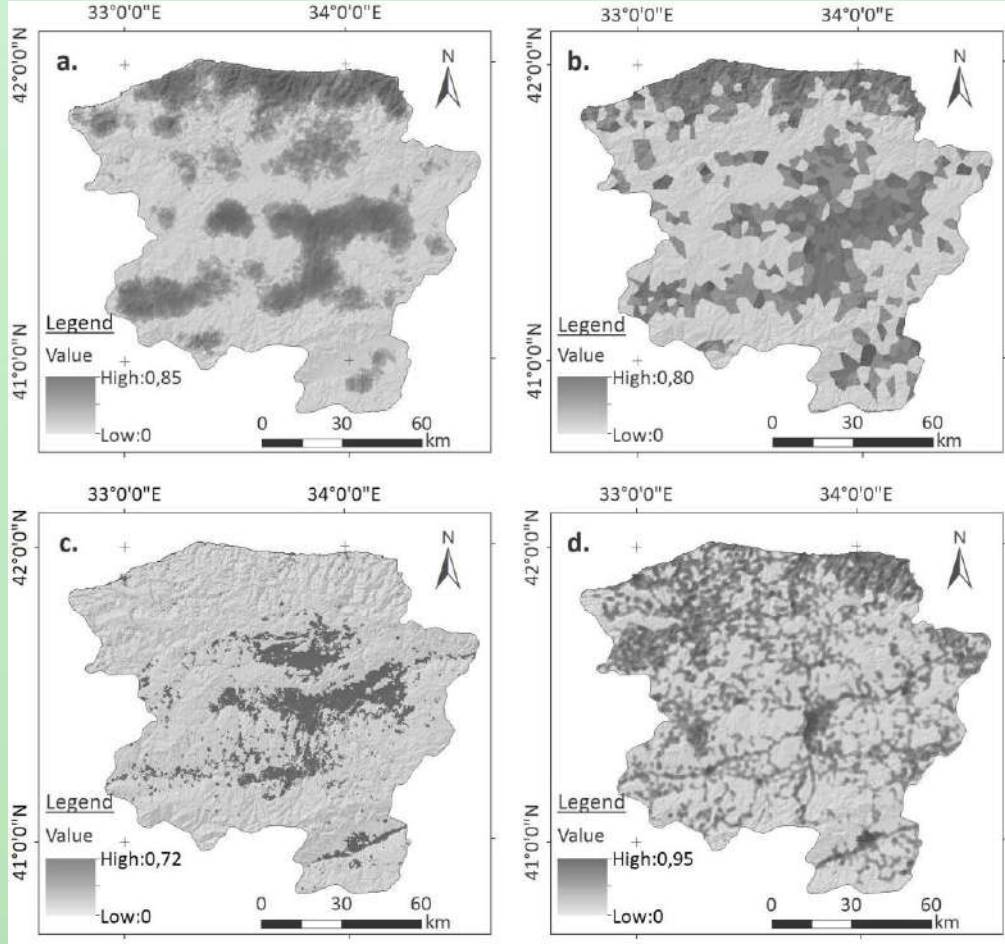
Şekil 5. İnceleme alanının mevcut arazi kullanımı

Kaynak: Openstreetmap

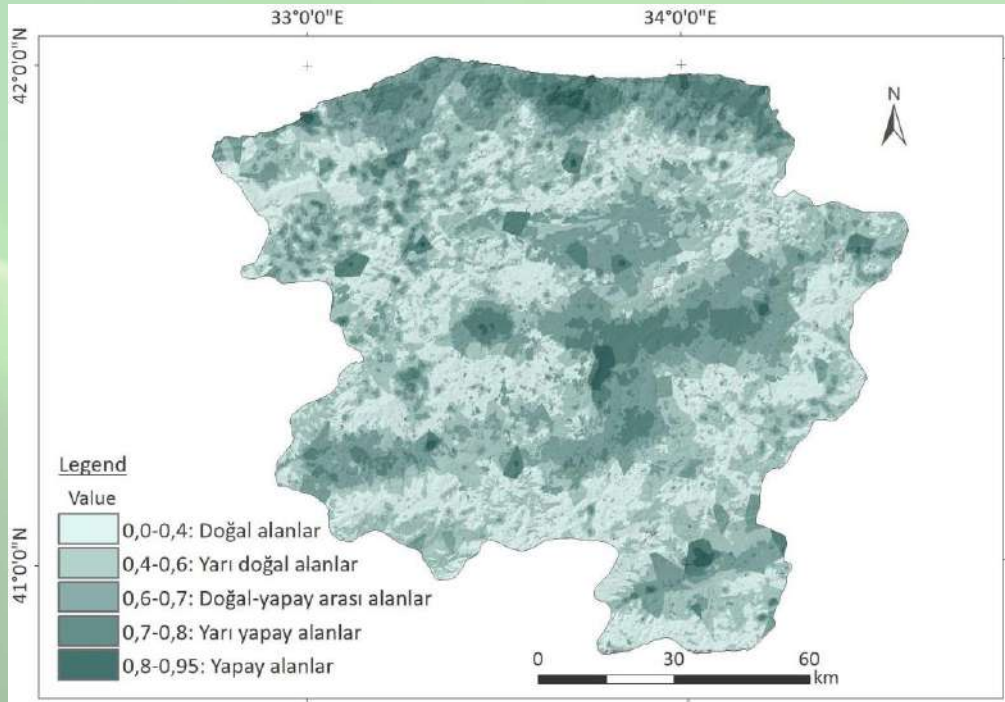
Doğal Alanların Coğrafi Dağılım Analizi

Herhangi bir arazi parçasının doğallık düzeyi, etkili unsurların varlığı/yokluğuna göre belirlenebilir. Bu nedenle, çok kriterli karar verme yöntemleri bu tür değerlendirmeler için yaygın olarak kullanılmaktadır. Bu kriterlerin bir araya getirildiği mekânsal kümelenmeler (desen), ön plandaki yöre/alt yöre tasniflerine yardımcı olmaktadır. Bu çalışmada da, dört temel mekânsal kriter (litoloji, eğim, yükselti ve mevcut kullanım) belirlenmiştir. Her bir kriter, bulanık üyeye dönüştürülmüştür (Şekil 6). Bu üyelerin üst üste birleştirilmesiyle sonuç haritası elde edilmiştir. Bu haritaya göre; insan nedenli arazi değişim alanları (antropojen alanlar), ilin orta bölümü ve kıyıya yakın alanlarda yoğunlaşmıştır. İnsan etkisinden uzak doğal alanlar, engebeli yüksek arazilerin ortaya çıktığı alanlardır. Engelibeli araziler; doğallık, su ve toprak koruma fonksiyonları gibi nedenlerle sürekli bitki örtüsüyle kaplı (mutlak orman), korunması gerekli doğal alanlardır. İnsan etkisinin sınırlı kaldığı yarı doğal alanlar, potansiyel bozulma alanlarıdır. İnsan etkisinin artması, bu alanların da antropojen alanlara dönüştürebilecektir. Bulanık mantık yöntemi, mekânsal tanımlamalarda daha tedrici geçişi görselleştirir. Doğal alanlar ile antropojen alanlar arasında kesin sınırlar belirlemek olanaksızdır. Günümüzde, insanın ulaşılabilir koşulları, teknik/teknolojik imkânları doğal alanların korunmasını güçleştirir (Şekil 7).





Şekil 6. Dört ana faktörün bulanık üyeleri (a. Yerleşim yeri faktörünün bulanık üyesi b. Nüfus yoğunluk faktörünün bulanık üyesi c. Aktüel arazi kullanımı faktörünün bulanık üyesi d. Yol yoğunluk faktörünün bulanık üyesi).



Şekil 7. Kastamonu ili doğal ve yapay alanların dağılım haritası (insan nedenli mekânsal farklılaşma deseni)



Sonuç

Kastamonu ili, fiziki coğrafyasındaki çeşitlilik/zenginlik ile ön plandaki illerden biridir. İnsan etkisini sınırlayan doğal ortam şartlarıyla, doğallık oranı yüksektir. Ancak, doğallığın insan çekiciliğinin de bir unsurunu oluşturması, gelecekteki bozulma tehlikesini de gündeme getirir. Sürdürülebilir arazi kullanımı/yönetimi için; korumada öncelikli alanları belirlemek, doğal ortamdaki bozulma sürecinin mekânsal hassasiyet düzeyini ve yönünü göstermek doğru kararlar için yardımcı olur. Ayrıca insan kaynaklı bozulma alanlarında, iyileştirme çalışmalarına katkı sağlar.

Kastamonu ilindeki arazi kullanım sınıfları, topografyadaki değişkenliğe göre şekillenmiştir. Akarsuların taşıyarak oluşturduğu alüvyonlar, yoğun tarımsal faaliyet altındadır. Taşköprü, Tosya ovaları ve Devrekâni Platosu en geniş tarımsal faaliyet alanlarıdır. İlin kuzeyindeki ve güneyindeki yüksek dağlık alanlar (Küre ve Ilgaz dağları), orman örtüsüyle kaplıdır. Tarım ve yerleşim alanları, insan etkisiyle dönüştürülmüş sahalardır. Orman alanları ise, insan etkisinden uzak arazilerdir. Mera/Seyrek Bitki alanları, Çıplak kayalıklar, doğal ve insan nedenli yarı doğal alanlardır.

Belirli bir arazinin doğallık düzeyi, insan etkisi ile ilişkilendirilebilir. Yoğun insan etkisindeki alanlar, düşük doğallık oranına sahiptir. Bu tür alanlar, insan etkisinde dönüştürülmüş alanlardır. Bu çalışma kapsamında, doğallık düzeyi Kastamonu ili örneğinde incelenmiştir. Bulanık mantık yöntemiyle beş farklı doğallık düzeyi elde edilmiştir. Mekânsal sonuçlara göre, eğimli-engebeli alanlar, doğallığın yüksek olduğu korumada öncelikli sahalardır. Orta eğimli, genellikle seyrek bitki örtüsü ile kaplı alanlar, yarı doğal alanlardır. Bu alanlar, karma (agroforestry-silvopastoral) modeller için uygun alanlardır. Düz ve düze yakın eğimdeki araziler (genellikle alüvyonlar) üzerinde yerleşimler ve tarımsal faaliyet alanları iç içedir. Bu tür alanlar insan nedenli dönüştürülmüş doğal olmayan alanlardır. Eğimli-engebeli araziler, sosyo-ekonomik (tarım ve otlatma) baskıdan da uzak tutmaktadır. Ayrıca, pastoral/rekreatif özellikler de ön plana çıkmaktadır. Arazi kullanım plan ve politikalarında, özellikle ekolojik kısıtlara sahip alanlarda, çok yönlü yönetim modellerine yer verilerek ekosistemin devamlılığına, verimliliğe ve kırsal kalkınmaya katkı sağlanabilir.

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Effect of chitosan enriched with orange essential oil on the quality of refrigerated fish burger

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Abstract

Seafood has a limited shelf life and is very perishable. Endogenous chemical and enzymatic reactions are just a few of the numerous responses that occur during storage and cause quality changes. Shelf life and safety are associated with pathogenic microorganisms, and food decomposition impacts both shelf life and safety. Synthetic additives are widely used in fish preservation to increase shelf life while maintaining quality and safety. Research has shown that naturally occurring preservatives from plants, animals, and microbes may effectively replace manufactured antimicrobials. Antimicrobials derived from plants may lessen lipid oxidation and lengthen the shelf life of fish. Edible films and coatings improve food quality and the shelf life of almost any food system. The fish burger is one of the most popular processed fish flesh products, offering a simple taste and adding a variety of flavors to fish-eating habits. This study aims to mix chitosan films with orange essential oil (OEO) and examine how they affect the chemical makeup and refrigerated fish burgers' microbiological and sensory analysis. We used OEO emulsions with chitosan to prevent oxidation and maintain fish burgers' chemical and microbial quality. Incorporating OEO into the films enhanced its antioxidant characteristics. For sensory analysis, the chitosan with EO coating treatment achieved the highest scores in both color and scent, surpassing even the control group. Acquired taste and acceptance declined gradually. Adding OEO to the chitosan coating increased its antioxidant properties, giving the fish burgers a better color and flavor.

Key Words: chitosan, essential oil, seafood, burger, antioxidant

Introduction

Fresh fish degrade rapidly after being collected due to contamination, endogenous enzymes, and microbial development. As a result of their decomposition, several fish components release new compounds. Moreover, protein oxidation, breakdown, and changes in the fish's taste, texture, and odor are caused by compositional changes during decomposition. Therefore, the necessity to create efficient preservation techniques to increase fish shelf life is rising (Mei et al., 2019). Soft or mushy fish are less marketable since they usually have a shorter shelf life. Storage temperature, oxygen levels, protease activity (both microbial and endogenous), and moisture content during postmortem handling can negatively affect fish's color, odor, texture, and flavor. Traditionally, fish have been kept cold and preserved using ice slurries, flake ice, chilled seawater, or chemical treatments. The fisheries industry continues to seek innovative preservation techniques to extend shelf life and maintain optimal sensory and nutritional quality for consumers (Rey et al., 2012).

The growing demand for minimally processed foods, changing dietary habits, and concerns over food safety continue to shape food packaging systems. Foods with less processed components risk containing harmful bacteria that compromise their safety and quality. Fadiji et al. (2023) state that consumer preferences for minimally processed foods with few synthetic chemicals and the need to extend shelf life and prevent food-borne illnesses motivate the development of innovative solutions, such as antimicrobial packaging. A cuisine item made from minced fish flesh is a fish burger. Usually, it is marketed and stored cold. The product's flavor, texture, smell, and appearance change due to microbial growth, protein degradation, and fat oxidation. This shortens the product's shelf life while being stored (Shahinfar et al., 2017). Along with the technological developments in the world, significant technological developments have been made in the fish processing sector. Studies show that storage below -12°C inhibits microbial growth, and enzymatic activity slows down (Rodriguez-Turiénzo et al., 2011). However, cooling or freezing alone is insufficient to prevent lipid oxidation, protein denaturation, and microbial activity completely. For this reason, it has become common to use multiple processing and packaging technologies together today. Packaging technology is widely used to extend shelf life and maintain hygiene and quality, especially in foods sensitive to microbial and oxidative spoilage (Ahmad et al., 2012).

The increased consumer demand for natural, environmentally friendly, and preservative-free goods presents issues for the food business. Studies on "naturally derived" antimicrobials for food packaging have increased due to this change and tighter laws governing artificial or chemical preservatives. Studies on using essential oils in this sector have recently increased. In earlier research, many essential oils have demonstrated potential as antioxidants, antimicrobials, anti-cancer agents, and eco-friendly food preservatives. Moreover, essential oils have been



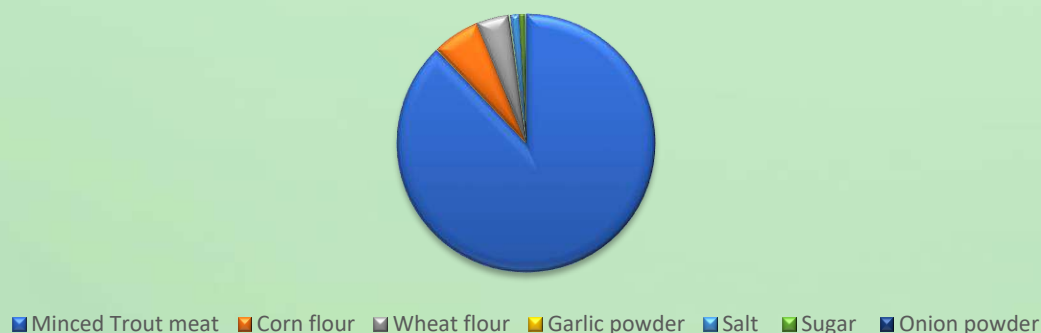
successfully incorporated into biodegradable films as antimicrobial agents, helping to control microbial growth on food surfaces, prolong shelf life, and maintain product quality (Zhang et al., 2021). While several reviews have highlighted progress in antimicrobial packaging research, including the biological properties of chitosan and essential oils and their use in food packaging, there is limited information on the latest advancements in applying these antimicrobial methods for food preservation (Sharma et al., 2021). This study aimed to evaluate the effects of chitosan films enriched with orange essential oil on the quality of fish burgers during refrigerated storage. To achieve this, the fish burgers coated with chitosan films containing orange essential oil emulsions were periodically assessed for their sensory qualities throughout the storage period.

Materials And Methods

Materials: Orange essential oil (OEO) was purchased from the local market in Turkey, and the fish was bought fresh from a farm in the Niğde region.

Fish burger preparation: All fresh fish were first beheaded, gutted, and thoroughly washed. The fish flesh was then minced using a meat mincer with a pore size of 1.0 mm. The minced fish meat was prepared for fish burger formulation following the method outlined in Figure 1, mixed thoroughly, and divided into three equal portions, serving as control and treated groups, as detailed (A: control, B: OEO; C: chitosan with OEO). Each portion was individually packed (with each pack containing 50 g), shaped into burgers using a hamburger press machine, and stored at $4\pm1^{\circ}\text{C}$ for 21 days.

Figure 1: Ingredients of fish burgers



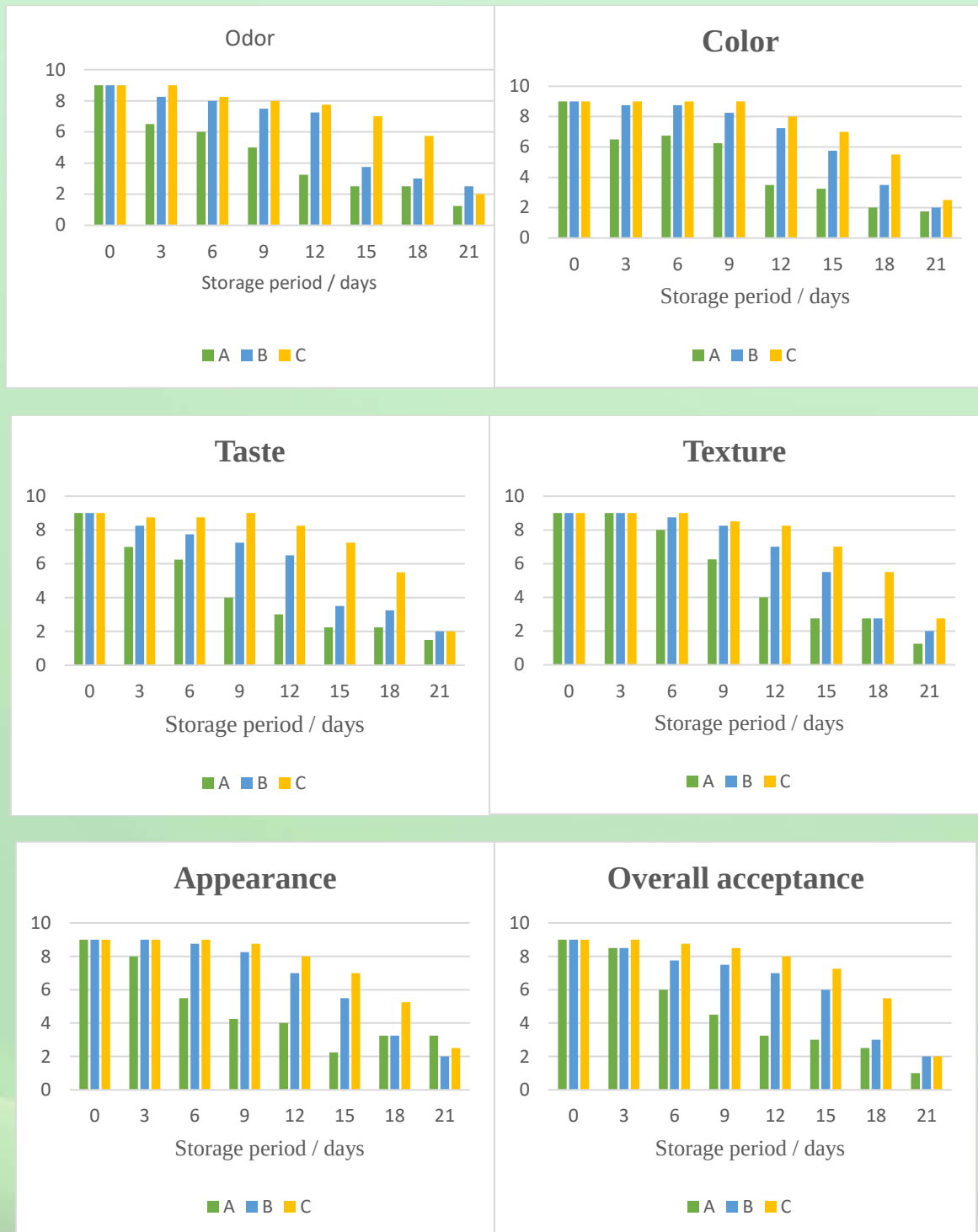
Sensory Evaluation: Fish burgers were cooked following the method described by Dreeling et al. (2000). Briefly, both sides of each burger were fried on a hot plate for 10 minutes until fully cooked. During storage, samples were fried regularly on days 0, 3, 6, 9, 12, 15, 18, and 21. Sensory evaluation was conducted on these same days using a 9-point hedonic scale. The panelists, who were first trained to understand the product characteristics, assessed the samples based on color, odor, taste, texture, and overall acceptability. The scoring system ranged from 1-3 (unacceptable), 4-6 (good), 7-8 (very good), and 9 (excellent).

Statistical Analysis: Each group's sensory indices were expressed as median (minimum, maximum) values and standard deviation by using SPSS software (version 21).

The results

A sensory analysis measures the qualities and perceptions of food by analyzing and interpreting the senses of sight, smell, taste, hearing, and touch. Sensory assessments are always crucial when assessing the freshness and quality of fish (Doğan & İzci, 2017). The sensory results of the fish burger are presented in Figures 1 to 6. 5 experienced panelists evaluated the sensory analysis of fish burgers, and a hedonic scale from 9 to 1 was used. After cooking, fish burgers were evaluated by giving points for some parameters, including taste, texture, smell, appearance, and overall acceptance. The sensory evaluation of fish burgers immersed in chitosan solution supplemented with a 1% concentration of OEO. Fish meat was considered safe for humans until sensory value reached 4 (Ojagh et al., 2010). The sensory panelists' ratings are based on the Taste, smell, texture, appearance, and overall acceptance of control and chitosan-coated fish burgers during 21 days of storage. The control samples were unacceptable in all sensory measures after the 9th day of storage. The ratings ranged from 3.5 to 2.0, indicating that the samples were rotten, prompting panelists to reject control samples on the ninth day of storage. Similarly, after 18 days of storage, other chitosan coating samples were found unacceptable, even though the values were in the middle of 4 to 5. Compared to control samples, the chitosan coating samples supplemented with essential oils extend the shelf life of fish burgers by nine days. Chitosan coatings supplemented with OEO at concentrations of 1 % were deemed "appropriate" for humans eating up to an 18-day storage duration; the scores were in the middle (4.0 to 6.0).





Figures 1, 2,3,4,5, and 6: Changes in sensory scores of fish burgers during storage at 4 °C.

As expected, the sensory scores of fish burgers with OEO-enriched chitosan membranes showed higher values than those of the control and non-chitosan oil groups. The results of our sensory analysis showed that appearance, color, taste, odor, and texture all decreased with storage duration for all groups. According to the sensory evaluation, control samples A were rejected on the ninth day, while Group B and C samples were rejected on the eighteenth day. The quality of the fish burger in Groups B and C maintained its quality for nine more days compared to the control samples. Compared to the control group, it was found that combining OEO with chitosan positively affected fish burgers, as the B and C groups were more favored, and their sensory scores were higher. At the same time, the direct oil addition b results were better than those of the control group but less than those of the c Group. The control sample had the lowest results, whereas those that combined the usage of chitosan and OEO had the highest scores. The findings showed that adding chitosan and OEO to fish burgers enhanced their sensory appeal. These findings are consistent with research conducted by Carbo et al. (2009), which examined the



use of thyme oil and modified atmospheric packing to reduce microbial deterioration in packaged fresh cod hamburgers, and Mahmoudzadeh et al. (2010), which assessed sensory scores of fish items treated with rosemary extract. Similarly, the application of biopolymer EOs boosted fish fillets' overall acceptability (Ojagh et al., 2010; Jouki et al., 2014). Fan et al. (2009) stored silver carps coated with a 2% chitosan solution at -3C for 30 days. They discovered that the shelf life had been extended while the quality remained intact. Changes in sensory characteristics, such as taste, odor, texture, color, appearance, and overall acceptability, can result from compositional variation and influence the acceptability of fish as food by influencing microbial development. By applying chitosan and orange oils together, the acceptance feature of fish burgers during cold storage was extended to 18 days.

Conclusion

It was aimed to minimize undesirable microbial, oxidative, and chemical changes throughout the storage. As mentioned earlier, the study concluded that OEO has good antioxidant factors, which help prevent the growth of microorganisms and lipid oxidation. Therefore, these essential oils can be used to extend the shelf life of fish. According to sensory assessment, the shelf life of fish burgers was nine days for the control group, 18 days for the B group, and C. It can be concluded that the quality of fish burgers can be better preserved after using OEO in chitosan films. Based on all the above results, our project successfully concluded that the antioxidant and antimicrobial effects of chitosan coatings prepared with OEO emulsions were effective for storing and preserving fish burgers.

Acknowledgments

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ID: 460

Toxic effects of some inert dusts on *Agonoscena pistaciae* (Psyllidae: Hemiptera)

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Abstract

Pistachio psyllid *Agonoscena pistaciae* Burckhardt and Lauterer (Hemiptera: Psyllidae) has emerged as a significant pest of pistachio in recent years. This pest feeds on pistachio trees (*Pistacia vera*) from the Anacardiaceae family during its nymph and adult stages, leading to a reduction in both the quality and quantity of the product. Although various insecticides belonging to different groups have been used to control this pest, alternative control methods are needed due to concerns over the environmental impact of insecticides and residue issues. In this study, the toxic effects of inert dusts (diatomite, kaolin, sepiolite, borax, halloysite, and zeolite) obtained from Türkiye were investigated against the pistachio psyllid. The inert dusts at the concentration of 7.5% (w/v) were applied to third-instar nymphs by using a hand sprayer. The mortality results were recorded at 24-hour intervals for 144 hours. Among the tested inert dusts, kaolin and diatomite (Detech® 95 WP) caused mortality in the nymphs, while no mortality was observed with the other inert dusts throughout the incubation period. Detech® 95 caused 95% mortality in the first 24 hours, and the mortality rate increased to 100% by the end of the 48-hour incubation period. While no mortality was observed with kaolin treatment in the first 48 hours, 7% mortality rate was recorded at 72 hours and this increased to 10% at 96 hours. This study showed that the commercial formulation Detech® 95 WP, containing diatomite, has potential for use in controlling pistachio psyllid nymphs.

Key Words: Pistachio psyllid, inert dusts, diatomite, kaolin, contact toxicity

Bazı inert tozların *Agonoscena pistaciae* (Psyllidae: Hemiptera) üzerindeki toksik etkileri

Özet

Antep fıstığı psillidi *Agonoscena pistaciae* Burckhardt ve Lauterer (Hemiptera: Psyllidae) özellikle son yıllarda antep fıstığı ağaçlarında önemli bir zararlı olarak ortaya çıkmaktadır. Bu zararlı Antep fıstığı (*Pistacia vera*) Anacardiaceae ağaçlarında nimf ve ergin dönemde beslenerek üründe kalite ve kantitenin düşmesine neden olmaktadır. Zararlı ile mücadelede farklı insektisit gruplarında çok sayıda aktif madde kullanılmaktadır fakat insektisitlerin çevre ve doğaya olan etkileri ile birlikte kalıntı problemlerinden dolayı alternatif mücadele yöntemlerine ihtiyaç duyulmaktadır. Bu çalışmada, ülkemiz coğrafyasından elde edilen inert tozlar (diatomit, kaolin, sepiyolit, boraks, halloysit ve zeolit) Antepfıstığı psillidine toksik etkileri araştırılmıştır. Inert tozların % 7.5 (w/v) konsantrasyonları el pulvarizatörü kullanılarak 3. Dönem nimflere uygulanmıştır. Meydana gelen ölümler 24 saat aralıklarla 144 saate kadar kayıt altına alınmıştır. Test edilen inert tozlardan kaolin ve diatomit (Detech® 95 WP) nimflerde ölüme neden olurken diğer tozlarda tüm inkübasyon süresinde herhangi bir ölüm gözlemlenmemiştir. Detech® 95 ilk 24 saate %95 ölüme neden olurken bu oran 48 saat inkübasyon süresi sonunda %100'e çıkmıştır. Diğer inert toz kaolin de ise ilk 48 saate herhangi bir ölüm gözlenmezken, 72 saate %7, 96 saate %10 ölüm oranı gözlenmiştir. Bu çalışma sonunda diatomit içeren Detech® 95 WP ticari isimli formülasyonun özellikle Antep fıstığı psillid nimfleri ile mücadelede kullanılma potansiyelinin olduğu saptanmıştır.

Anahtar Kelime: Antep fıstığı psillidi, inert toz, diatomit, kaolin, kontak toksisite



ID: 461

Standardisation in Gocmen Cheese Production, Evaluation of Microbiological Quality and Sensory Properties

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Abstract

Gocmen cheese, one of the leading flavours of Balkan cuisine, is among the local products produced and consumed in Türkiye. The flavour known as Gocmen cheese is also known by names such as Soka, Long, Pepper pickle, Pepper curd, Pepper curd cheese and pickled pepper with milk. Traditionally produced by Balkan immigrants with different production methods, this flavour is a traditional dairy product that has not been commercialised. The aim of this study was to evaluate the microbiological quality and sensory properties of different recipes in addition to the definition of standard recipes in the production of Gocmen cheese produced in the central districts of İzmir province. In the study, taste, odour, consistency and general taste characteristics of the products produced with 4 different recipes as curd, yoghurt, curd-yoghurt and curd-milk were evaluated with hedonic scale (1-9). For the curd, yoghurt, curd-yoghurt and curd-milk samples, the average of general appreciation were 7.63, 4.32, 6.63 and 7.84, respectively. Similarly, the Lactobacillus counts are 8.18; 6.11; 6.41 and 7.34 cfu/g, the Lactococci counts are 7.44; 7.51; 7.35 and 7.36 cfu/g and the yeast counts were 4.41; 5.61; 4.71 and 2.85 cfu/g respectively, E. coli counts of curd, yogurt, curd-yoghurt and curd-milk were determined as 4.06, 0.00, 3.78 and 3.58 cfu/g, respectively. S. aureus counts in traditional products produced with curd, yoghurt, curd-yoghurt and curd-milk were detected 2.06, <10, 3.78 and 2.58 cfu/g, respectively. E. coli was reported as <10 cfu/g in all samples searched. Gocmen cheese, which is important as a fermented milk product among traditional products, is a cultural heritage transported from the Balkan lands to Anatolia. It is important that standard recipe studies focus on local tastes in order to protect the food culture that reflects the societies, to transfer it to future generations, and to revive gastronomy tourism.

Keyword: Recipe standardization, Local cuisine, Gocmen cheese

Göçmen Peyniri Üretiminde Reçete Standardizasyonu, Mikrobiyolojik Kalite ve Duyusal Özelliklerin Değerlendirilmesi

Özet

Balkan mutfağının önde gelen lezzetlerinden biri olan göçmen peyniri Türkiye’de sevilerek üretilip tüketilen yerel ürünler arasındadır. Göçmen peyniri olarak tanınan lezzet Soka, Long, Biberli turşu, Biberli lor, Biberli lor peyniri ve sütlü biber turşusu gibi isimlerle de anılmaktadır. Balkan göçmenleri tarafından farklı üretim yöntemleri ile geleneksel olarak üretilen bu lezzet ticarileşme imkanı bulamamış geleneksel bir süt ürünüdür. Bu çalışmanın amacı, İzmir ili merkez ilçelerinde üretilen Göçmen peyniri üretiminde standart reçetelerin tanımlanmasına ek olarak farklı reçetelere sahip üretimlerin mikrobiyolojik kalitesi ve duyusal özelliklerinin değerlendirilmesidir. Araştırmada Lor, Yoğurt, Lor-yoğurt ve Lor-süt olarak 4 farklı reçete ile üretilen ürünlerde tat, koku, kıvam ve genel beğeni özellikleri hedonik skala (1-9) ile değerlendirilmiştir. Lor, Yoğurt, Lor-yoğurt ve Lor-süt örnekleri için sırası ile genel beğeni puanı ortalaması sırası ile 7,63; 4,32; 6,63 ve 7,84’dır. Benzer şekilde Lor, Yoğurt, Lor-yoğurt ve Lor-süt ile üretilen geleneksel ürünlerde Laktobasil sayısı sırası ile 8,18; 6,11; 6,41 ve 7,34 kob/g; Laktokok sayısı sırası ile 7,44; 7,51; 7,35 ve 7,36 kob/g ve maya-küf sayısı sırası ile 4,41; 5,61; 4,71 ve 2,85 kob/g olarak tespit edilmiştir. Lor, Yoğurt, Lor-yoğurt ve Lor-süt ile üretilen geleneksel ürünlerde S. aureus sayısı sırası ile 2,06; <10; 3,78 ve 2,58 kob/g olarak tespit edilmiştir. E.coli aranan tüm örneklerde <10 kob/g olarak bildirilmiştir. Geleneksel ürünler içerisinde fermente süt ürünü olarak önemli olan göçmen peyniri Balkan topraklarından Anadolu’ya taşınan bir kültürel mirastır. Topluları yansıtan yemek kültürüne sahip çıkmak, gelecek nesillere aktarılmasını sağlamak, gastronomi turizmini canlandırmak amacı ile standart reçete çalışmalarının yerel lezzetler üzerine yoğunlaşması önem arz etmektedir.

Anahtar kelime: Reçete standardizasyonu, Yerel mutfak, Göçmen peyniri



Determining and predicting the current potential and future distribution of Mediterranean fruit fly [*Ceratitis capitata* (Wiedemann)] in Niğde and its region using maximum entropy algorithm

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Abstract

Mediterranean fruit fly [*Ceratitis capitata* Wied. (Diptera: Tephritidae)] is one the important pests of fruit and vegetables found in the world and Türkiye. It is predicted that this pest will spread in different regions of Türkiye due to the effect of climate change. This study was carried out in apple orchards in Çamardı, Altunhisar and Merkez districts in 2022-2023 in order to determine the presence of Mediterranean fruit fly in Niğde province. Mass trapping (Decis trap – Bayer®) were used to determine the population density of Mediterranean fruit fly in the region. Mass trapping were placed in the southeastern part of the trees, 1-1.5 m above the ground in the direction of the prevailing wind, 1/4 of the inner part of the crown projection, in a way that would represent the entire orchards and at different points. Adult populations of the pest were checked week intervals through June –October. The presence of the species in the region was detected in both years. In this study, Maximum Entropy Modeling (MaxEnt – 3.4.4) algorithm produced maximum entropy models for the distribution areas of Mediterranean fruit fly due to global climate change in the period of 2050 (for the average of 2041-2060) and 2070 (for the average of 2061-2080). As a result of the study, it was determined that the flights of Mediterranean fruit fly, which is known to have high damage on peach and pear fruits in Niğde province, first started in July. It was observed that the density of the pest increased in mid-September and maintained its situation until the end of October, and that it was found on apple fruit because it could not find another suitable host in the region during this period. However, the pest did not cause any visible damage in apple orchards in the current situation. The presence of Mediterranean fruit fly was high in the region where the study was conducted. Therefore, it is thought that the damage rate may increase in the near future years. This study is a report revealing the presence of the Mediterranean fruit fly in apple orchards in Niğde province and will have an important place in terms of the future spread of the pest.

Key Words: Mediterranean fruit fly, Maxent, Apple, Population, Climate change

Akdeniz meyve sineği'nin [*Ceratitis capitata* (Wiedemann)] mevcut potansiyelini ve gelecekte Niğde ve bölgesinde dağılımını maksimum entropi algoritması kullanarak belirleme ve tahmin etme

Özet

Akdeniz meyve sineği [*Ceratitis capitata* Wied. (Diptera: Tephritidae)] dünyada ve Türkiye'de bulunan önemli meyve ve sebze zararlılarından biridir. Bu zararlının iklim değişikliğinin etkisiyle Türkiye'nin farklı bölgelerinde yayılacağı öngörülmektedir. Bu çalışma, 2022-2023 yıllarında Niğde ilinde Akdeniz meyve sineğinin varlığını belirlemek amacıyla Çamardı, Altunhisar ve Merkez ilçelerindeki elma bahçelerinde yürütülmüştür. Bölgede Akdeniz meyve sineğinin popülasyon yoğunluğunu belirlemek için kitle yakalama tuzakları (Decis trap – Bayer®) kullanılmıştır. Kitle yakalama tuzakları, bahçelerin tamamını temsil edecek şekilde ve farklı noktalarda, ağaçların güney-doğu kısmına, hâkim rüzgâr yönünde yerden 1-1.5 m yüksek, taç izdüşümünün ¼'lük iç kısmına yerleştirilmiştir. Zararlının ergin popülasyonları Haziran-Ekim ayları boyunca haftalık aralıklarla kontrol edilmiştir. Her iki yılda da türün bölgede varlığı tespit edilmiştir. Bu çalışmada, Maksimum Entropi Modelleme (MaxEnt – 3.4.4) algoritması, küresel iklim değişikliğine bağlı olarak Akdeniz meyve sineğinin yayılış alanları için 2050 (2041-2060 yılları ortalaması) ve 2070 (2061-2080 yılları ortalaması) döneminde maksimum entropi modelleri üretmiştir. Çalışma sonucunda, Niğde ilinde şeftali ve armut meyvelerinde yüksek oranda zarar yaptığı bilinen Akdeniz meyve sineğinin uçuşlarının ilk olarak Temmuz ayında başladığı belirlenmiştir. Zararlının yoğunluğunun Eylül ayı ortalarında arttığı ve Ekim ayı sonuna kadar durumunu koruduğu, bu dönemde bölgede uygun başka bir konukçu bulamaması nedeniyle elma meyvesinde bulunduğu görülmüştür. Ancak zararlı, mevcut durumda elma bahçelerinde gözle görülür bir zarara yol açmamıştır. Çalışmanın yapıldığı bölgede Akdeniz meyve sineğinin varlığı yüksek düzeydedir. Bu nedenle yakın gelecek yıllarda zarar oranının artabileceği düşünülmektedir. Bu çalışma, Akdeniz meyve sineğinin Niğde ilinde elma bahçelerinde varlığına ilişkin bir rapor olup, gelecekteki yayılış açısından önemli bir yere sahip olacaktır.

Anahtar Kelimeler: Akdeniz meyve sineği, Maxent, Elma, Popülasyon, İklim değişikliği





Efficacy of various insecticides and bio-control agent (*Trichogramma chilonis*) against tobacco budworm (*Helicoverpa armigera*) infesting flue cured virginia tobacco

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Abstract

An experiment regarding the efficacy of synthetic insecticides and biocontrol agent (*Trichogramma chilonis* Ishii) against tobacco budworm (*Helicoverpa armigera*) was carried out at Gohati village, Swabi, Khyber Pakhtunkhwa under field conditions during the year 2023. For this purpose, seedlings of tobacco cultivar “K-399” having 10 cm heights were transplanted into the field in the month of March. The experiment was laid out in RCBD having 5 treatments (Thiamethoxam, Chlorantraniliprole, Emamectin benzoate, *T. chilonis* and control) replicated three times. A total of three spray were done during the crop growth period. Results revealed that after 1st, 2nd and 3rd spray of applications, significantly lowest mean numbers of tobacco budworms (0.97, 0.77 and 0.56) larvae plant⁻¹ were recorded from tobacco plots treated with Emamectin benzoate, followed by Chlorantraniliprole, Thiamethoxam, and *T. chilonis*, respectively where (1.76, 1.31, 1.13) (1.89, 1.36, 2.70) and (3.03, 2.70, 2.58) mean numbers of budworm larvae were recorded respectively. However, statistically highest mean numbers of tobacco budworms (6.25, 11.09 and 17.92 larvae plant⁻¹) were recorded from control plot. Similarly, data regarding time intervals showed that statistically lowest mean number of tobacco budworm (1.42, 2.25 and 3.27 larvae plant⁻¹) was recorded 1-day post-treatment time interval, while significantly highest mean number of tobacco budworm (4.44, 5.28 and 6.71 larvae plant⁻¹) was recorded after 14 days of treatment application. The interaction demonstrated that significantly maximum number of tobacco budworm (8.86, 13.20 and 21.20 larvae plant⁻¹) was recorded from the interaction of control with 14 days post-treatment application, while significantly minimum number of tobacco budworm (0.31, 0.10 and 0.08 larvae plant⁻¹) was recorded from the interaction of emamectin benzoate with 1-day post-treatment application. Mean data regarding the efficacy of various synthetic insecticides and *T. chilonis* on mean percent plant damaged by *H. armigera* showed that after of 1st, 2nd and 3rd sprays statistically lowest mean percent damage (2.37%) was recorded from Emamectin benzoate treated plants. While, statistically highest mean percent damage (12.72%) was recorded from Control plot. The plot treated with *T. chilonis* resulted in 6.19% mean percent damage. Statistically maximum leaf area (789.65 cm²) and number of leaves (24.72 leaves plant⁻¹), Grade index (74.14%), Sugar content (18.11%), Nicotine content (2.44%) and cured leaf yield (3271.2 kg ha⁻¹) was recorded from Emamectin benzoate treated plots. The plot treated with *T. chilonis* resulted in 684.70 cm² leaf area, 21.40 numbers of leaves, 66.20% grade index, 14.31% sugar content, 2.00% nicotine content and 2721.90 kg ha⁻¹ yield. While significantly minimum leaf area (609.86 cm²), number of leaves plant⁻¹ (20.07 leave plant⁻¹), Grade index (53.68%), Sugar content (12.02%), Nicotine content (1.76%), and yield (2319.7 kg ha⁻¹) was recorded from control plot. Emamectin benzoate was found to be significantly effective among tested treatments against budworm infestation and hence can be used in combination with *T. chilonis* against tobacco budworm in tobacco fields.

Key Words: Tomato fruit borer, *Trichogramma*, FCV, Emamectin, Thiamethoxam





ID: 464

Host Preference Study of Fruit Fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) and Parasitism Potential of *Diachasmimorpha longicaudata* on Different Hosts under Laboratory Condition

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Abstract

The present study was conducted at Agriculture Research Institute (ARI) Swat-Mingora under controlled laboratory condition during 2021. The research was focused on the host preference of fruit fly, *Bactrocera dorsalis* (Hendel) (Diptera: Tephritidae) and parasitism potential of *Diachasmimorpha longicaudata* on different hosts. The *B. dorsalis* adults were reared individually on peach, mango, zucchini and bitter gourd and the life parameter were recorded. The results showed that the peach was noted as the most preferred host as compared to other hosts by recording maximum numbers of male and female fruit flies of *B. dorsalis* (42.75 and 47.50), followed by mango and zucchini, while lower number of male and female fruit flies were recorded on bitter gourd (4.50 and 6.50) respectively. The results further showed that highest numbers of punctures fruits were produced by *B. dorsalis* when reared on peach (17.00), followed by mango (12.50) and bitter gourd (7.50), while the least numbers of punctures (3.75) were recorded in zucchini. Similarly, significantly maximum mean numbers of pupae (61.50), deformed adults (31.75) and pupal weight (14.61mg) of *B. dorsalis* were obtained in peach followed by zucchini, mango and bitter gourd. The results further showed that significantly maximum percent parasitism of *D. longicaudata* was recorded on *B. dorsalis* reared on peach (33.92%) followed by mango and zucchini with 28.12% and 18.67% respectively while minimum was recorded on bitter gourd (10.01%). The present study reveals that the *B. dorsalis* preferred peach host for oviposition. Also *D. longicaudata* parasitoids reported maximum parasitism of *B. dorsalis* when reared on peach. Therefore, peach can be used as a host for rearing of *B. dorsalis* and mass culturing of *D. longicaudata* under laboratory conditions.

Key Words: Host preference, Peach, *Bactrocera dorsalis*, *Diachasmimorpha longicaudata*, Parasitism



ID: 465

Research on the Use of Basil Plant Extract (*Ocimum Basilicum Odoratum*) in the Incubation of Chukar Partridge (*Alectoris Chukar*) Eggs

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Abstract

This study was conducted to investigate the effects of basil plant extract (*O. basilicum odoratum*) on incubation outcomes and the behavior of chukar partridges (*Alectoris chukar*) during the prenatal and postnatal periods. A total of 160 eggs were collected from chukar partridges aged 14 weeks. The eggs were divided into groups based on the application of basil extract via spraying: control (K), distilled water (F0), 1% extract (F1), and 5% extract (F5). The incubation yields for the groups (K, F0, F1, and F5) were determined to be 70.66±1.51%, 75.00±0.01%, 78.33±2.88%, and 81.00±1.00%, respectively. The hatching success was highest in the F5 group at 98.41±1.12%, while the lowest was observed in the K group at 93.00±1.00%. No significant effects were noted on hatchling weight. The F5 group achieved the highest scores for Tona (98.92±0.23) and Pasgar (9.57±0.08). In conclusion, the application of 5% basil plant extract to partridge eggs enhances incubation yield and hatching success, reduces the rate of malformations, and has a positive effect on chick quality. Furthermore, results from open field and runway behavior tests indicated a potential reduction in fear and stress in newly hatched chicks.

Key Words: Basil, Chukar Partridge, *Alectoris chukar*, Pasgar and Tona Scores, Open Field Test

Keklik (*Alectoris Chukar*) Yumurtaların İnkübasyonunda Fesleğen Bitki Ekstraktının (*O. Basilicum Odoratum*) Kullanım Olanaklarının Araştırılması

Özet

Bu araştırma, fesleğen bitki ekstraktının (*O. basilicum odoratum*) kınalı kekliklerde (*Alectoris chukar*) prenatal ve yeni çıkımı içeren postnatal dönemlerde olmak üzere, kuluçka sonuçları ile keklik davranışlarına etkisinin araştırılması amacıyla yürütülmüştür. Çalışmada 14 haftalık yaşta bulunan kınalı kekliklerden elde edilen 160 adet yumurta kullanılmıştır. Yumurtalara spreyleme uygulanan fesleğen kullanımına göre gruplar; kontrol (K), saf su (F0), %1 ekstrakt (F1) ve % 5 ekstrakt (F5) şeklinde oluşturulmuştur. Grupların (K, F0, F1 ve F5) kuluçka randımanları sırasıyla %70.66±1.51, %75.00±0.01, %78.33±2.88 ve %81.00±1.00 olarak belirlenmiştir. Çıkım gücü ise en yüksek % 98.41 ±1.12 ile F5 de, en düşük %93.00±1.00 ile K grubundadır. Çıkım ağırlığı üzerine etki gözlenmemiştir. F5 grubunda en yüksek Tona (98.92±0.23) ve Pasgar (9.57±0.08) skorları elde edilmiştir. Sonuç olarak keklik yumurtalarına %5'lik fesleğen bitki ekstraktı uygulamasının kuluçka randımanı ve çıkım gücünü artırdığı, malformasyon oranını düşürdüğü, civciv kalitesi üzerinde olumlu bir etkiye sahip olduğu bulunmuştur. Ayrıca açık alan ve pist davranış testleri sonuçlarına göre yeni çıkan civcivlerde korku ve stresi azaltma potansiyeli görülmüştür.

Anahtar Kelimeler: Fesleğen, Keklik, *Alectoris chukar*, Pasgar ve Tona Skoru, Açık Alan testi



Effects of Basil (*Ocimum basilicum odoratum*) Plant Extract Application on Japanese Quail (*Coturnix japonica*) Eggs

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Abstract

The aim of this study was to investigate the effect of spraying basil (*Ocimum basilicum odoratum*) plant extract on hatching eggs of Japanese quail (*Coturnix japonica*) on incubation performance, chick quality, and chick behavior. A total of 160 Japanese quail hatching eggs used in the study were randomly divided into four equal groups. The groups were formed as control (K) with no treatment, pure water sprayed without basil extract (SS), pure water + 1% extract (F1), and pure water + 5% extract (F5). At the end of incubation, in the F5 group, hatchability (HB), chick hatching weights (CHW), and chick quality (CQ) increased significantly, while embryonic mortality, malformation (MF), and malposition (MP) rates improved. Furthermore, according to the results of behavioral tests conducted, it was observed that low-dose plant extract application (F1 group) reduced fear and stress in chicks, while high-dose application (F5 group) contributed positively to feeding behaviors such as searching for feed and reaching food compared to other groups.

Key Words: *Coturnix japonica*, *Ocimum basilicum odoratum*, Püskürme, İnkübasyon

Kuluçkalık Japon Bildircını (*Coturnix Japonica*) Yumurtalarına Fesleğen (*Ocimum Basilicum Odoratum*) Bitki Ekstraktı Uygulamasının Etkileri

Özet

Bu çalışmanın amacı, kuluçkalık Japon bildircını (*Coturnix japonica*) yumurtalarına fesleğen (*Ocimum basilicum odoratum*) bitki ekstraktı püskürtülmesinin, kuluçka performansı, civciv kalitesi ve civciv davranışları üzerindeki etkisini araştırmaktır. Çalışmada kullanılan toplam 160 adet kuluçkalık Japon bildircını yumurtası eşit olarak rastgele dört grubuna ayrıldı. Gruplar, hiçbir muamele uygulanmayan kontrol (K) ile fesleğen ekstraktı içermeyen saf su püskürtülen (SS), saf su + %1 ekstrakt (F1) ve saf su + %5 ekstrakt (F5) şeklinde oluşturulmuştur. Kuluçka sonunda F5 grubunda, çıkım gücü (ÇG), civciv çıkım ağırlıkları (CÇA) ve civciv kalitesi (CK) anlamlı derecede artarken, embriyo ölümleri, malformasyon (MF) ve malpozisyon (MP) oranlarının ise iyileştiği tespit edilmiştir. Ayrıca yapılan davranış testleri sonuçlarına göre; düşük doz bitki ekstraktı uygulamanın (F1 grubu) civcivlerde korku ve stresi azalttığı görülürken, yüksek doz uygulamanın (F5 grubu) ise civcivlerde yemi arama ve yeme ulaşma gibi beslenme davranışlarında diğer gruplara nazaran pozitif yönde katkısı görülmüştür.

Anahtar Kelimeler: *Coturnix japonica*, *Ocimum basilicum odoratum*, Püskürme, İnkübasyon

Giriş

İnsanlar genellikle günlük olarak tükettikleri gıdaların sağlıklı olmasını tercih eder. Bazen bilmeyerek bazen de önemsemeden toksik öğeler tüketilebilmektedir. Buna karşın normal sağlıklı kişilerde akut bir zehirlenme her zaman görülmez. Bu durumda insanlar “bana bir şey olmaz” denilen yanılığa kendilerini kaptırabilirler. Bir şey olmaz yanılığının kaynağı, çoğunlukla düşük yoğunluklu alıma bağlı olabileceği gibi bazen de insanların tolere sınırları içerisinde olmasındandır. Örneğin uzun yıllar kozmetik ürünlerde serbest olan “2-(4-tert-butylbenzil) propionaldehit (BMHCA)” bileşeninin üreme sistemine ve anne karnındaki bebeklere zarar verdiği ve cilt hassasiyetine yol açabileceği yakın zamanda Avrupa Komisyonu’nun “Safety Gate” isimli sistemi üzerinden A12/02639/24 numarasıyla 12 Eylül 2024’te bildirilmiştir (Anonim, 2024).

Kimyasalların kullanımına bağlı oluşan zararlı etkilerin endişe verici bir boyut ulaşması ve her gün bunlara yenilerinin eklenmesi, ülke yönetimlerini sağlık amaçlı kullanılanlarda dahil olmak üzere üretimde ve yetiştiricilikte kullanılan tüm kimyasalların kullanımı konusunda yeni önlemler almak zorunda bırakmıştır. Bunun sonucunda birçok kimyasalın yasaklanması veya kullanımının sınırlandırılması gibi pek çok radikal tedbir alınmış. Bu tedbirlerin uygulanması başta kanatlı sektöründe olmak üzere verim düşüklüğü oluşabileceği şüphesini artırmış ve tedbir olarak sektörde bu amaçla kullanılabilecek yeni alternatif doğal ürünlere olan ilginin ve araştırmaların artmasına sebep olmuştur.



Kullanımları antik dönemlere kadar dayanan baharatlar ve ıtırli bitkiler, bu amaçla kullanılabilecek önemli kaynaklardır. Baharat özelliğinin yanında çok çeşitli amaçlar için kullanılan Ballıbabagiller (*Lamiaceae*) familyası içerisinde yer alan Fesleğen (Reyhan) (*Ocimum basilicum* L.) bu potansiyele sahip önemli bir türdür. Geleneksel olarak sindirim ve böbrek bozukluklarında (spazım çözücü), soğuk algınlığı, arı ve yılan sokmalarında kullanılmaktadır. Ayrıca antimikrobiyal, antibakteriyel ve antifungal özelliğinin yanında böcekleri ortamdaki uzaklaştırıcı etkisine sahip olduğu bilinmektedir (Günay ve Telci., 2017; Shahrajabian ve ark., 2020; Brandão ve ark., 2022). Bu yüzden Fesleğen bitkisinin yaş ve kuru formları başta gıda, ilaç, baharat olmak üzere parfümeri, aromaterapi, kozmetik ve geleneksel tıp alanında da kullanılmaktadır (Labra ve ark., 2004; Dumanoglu., 2021). Fesleğenin dünya genelinde üretimi ve tüketimi çok yaygındır ve yaklaşık 65 türü, pek çok alt tür ve varyetesi vardır. (Ekren ve ark., 2009; Yıldız ve ark., 2017). Çalışmada kullandığımız kokulu fesleğen (*Ocimum basilicum odoratum*) önemli bir türdür. Bu tür diğerlerinden ayıran en önemli özelliği anason kokmasıdır (Makri ve Kintzios., 2008).

Bıldırcın, sülüngiller (*Phasianidae*) familyasının *Coturnix*, *Anurophasis*, *Perdicula*, *Ophrysia* cinsinden küçük yapılı kuş türlerinin ortak adıdır. Bıldırcınlar deney hayvanı kullanımları yanında daha çok et ve yumurta için yetiştirilirler. Bu amaçla en çok Japon bıldırcınları (*Coturnix japonica*) tercih edilmektedir. Yumurtlamaya başlama yaşları 6-8 haftadır, yıl boyunca yumurtlar ve 9-12 gr ağırlığında 250-300 yumurta verebilirler (Raddish ve ark. 2003; Sarica ve ark., 1995). Ağırlıkları 120-150 gr ulaşınca (5-6 haftalık) kesime alınırlar. Etleri koyu renkli, yumuşak ve lezzetlidir. B1, B2, B6 vitaminleri, Niasin, mineral ve yağ asitleri ile Pantotenik asit yönünden zengindir. Kuluçka süreleri 16-17 gündür (Ainsworth ve ark., 2010).

Bu çalışmada bıldırcın yumurtaları ile oluşturulan deney modeli ile kanatlı yumurtaların inkübasyon işlemi sırasında fesleğen (*O. basilicum odoratum*) bitki ekstraktının kullanımının kuluçka özelliklerine ve yavru davranışlarına olan etkisinin araştırılması amaçlanmıştır.

Materyal ve Yöntem

Çalışma Kırşehir Ahi Evran Üniversitesi Ziraat Fakültesi, Zootekni Bölümü Hayvan Fizyolojisi ve Histolojisi laboratuvarında gerçekleştirilmiştir. Çalışma için Tarım Orman İl Müdürlüğünden Proje Bazlı İzin ve Üniversite Yerel Etik Kurulundan etik kurulu izni alınmıştır.

Bitkisel Materyalin Hazırlanması

Çalışmada Tarsol® ticari isimli tohumlar kullanılarak yetiştirilen bitki örnekleri kullanılmıştır. Hasat işleminden sonra toplanan bitki örnekleri yıkanarak fiziksel kirlerden temizlendikten sonra gölgede kurutulmuştur. Kuru numuneler parçalanarak 10 gr/200 mL metanol olacak şekilde erlene konulmuş ağzı kapalı bir şekilde manyetik karıştırıcı yardımıyla çözünmesi sağlanmıştır. İşlem sonucunda karışım süzülerek içerisindeki alkol evaporatör yardımıyla 40°C'de uzaklaştırılarak bitki ekstraktı elde edilmiştir. Bitki ekstraktın bir kısmı saf su ile sulandırılarak (%1 ve %5) çalışmada, diğer kısmı ise fitokimyasal analizlerde kullanılmıştır.

Fitokimyasal Analizler

Çalışmada bitki numunesinin Gallik aside eşdeğer olarak toplam fenolik madde miktarı (Folin-Ciocalteu metodu) (mg GAE/g) ve kuersetine eşdeğer olarak toplam flavonoid madde miktarı (Alüminyum Nitrat Metodu) tespiti yapılmıştır. Ayrıca bitki ekstraktının DPPH• Serbest radikal giderme aktivitesi ve Fe³⁺-Fe²⁺ kapasite azaltma (FRAP) gücü belirlenmiştir (Ergün 2022).

Yumurtaların İnkübasyon

Çalışma dört grup olarak planlanmıştır ve toplam 160 Adet Japon bıldırcın (*C. japonica*) yumurtası kullanılmıştır (Tablo 1). Yumurtalar Kırşehir'de faaliyet gösteren Tarım ve Orman Bakanlığından ruhsatlı ev ve süs hayvanları satış yerinden temin edilmiştir.

Yumurtalara inkübasyon öncesi dezenfeksiyon işlemi uygulanmamış ve gruplar arasındaki dağıtım tesadüfi olacak şekilde yapılmıştır. Uygulama yapılan gruplardaki yumurtalara ilk günden itibaren üç gün ara ile beş kez püskürtme şeklinde 20'şer mililitre bitki ekstraktı uygulanmıştır. Kontrol grubuna (K) uygulanma yapılmazken, (SS) grubuna ise saf su uygulanmıştır. Yumurtaların inkübasyon işlemi 4 adet kuluçka makinası (Çimuka® marka aynı marka ve model) ile yapılmıştır. Bu işlem ilk 15 gün 37.7 °C'de ve % 60 nemde sürdürülmüştür (Yumurtalar günde 24 kez 45 derecelik açıyla döndürülmüştür). Çıkım için yumurtalar 15. günden sonra çıkım sepetlerine (37-37.2°C sıcaklık, % 70 nispi nem) alınmıştır

Tablo 1. Çalışma grupları

Gruplar	Uygulama
K (Kontrol)	-
SS (Saf su)	Saf su uygulaması yapılan grup (Püskürme)
F1 (Düşük doz grubu)	%1 bitki ekstrakt uygulaması yapılan grup (Püskürme)
F5 (Yüksek doz grubu)	%5 bitki ekstrakt uygulaması yapılan grup (Püskürme)



Kuluçka Özellikleri Belirlenmesi

Çalışmada; kuluçka özelliklerinden Kuluçka randımanı (KR), Çıkış gücü (ÇG), Erken dönem embriyo ölümleri (EDÖ), Orta dönem embriyo ölümleri (ODÖ), Geç dönem embriyo ölümleri (GDÖ), Cıvciv kalitesi (CK), Malformasyon (MF) ve Malpozisyon (MP) oranları belirlenmiştir (Ergün ve ark., 2023).

Cıvciv Özelliklerinin Belirlenmesi

Çalışmada Cıvciv çıkım ağırlığı (CÇA) ve Cıvciv kalitesi (CK) belirlenmiştir. Cıvciv kalitesinin belirlenmesinde Tona ve Pasgar skor parametreleri kullanılmıştır (Willemsen ve ark., 2008; Boerjan, 2002).

Davranış Analizleri

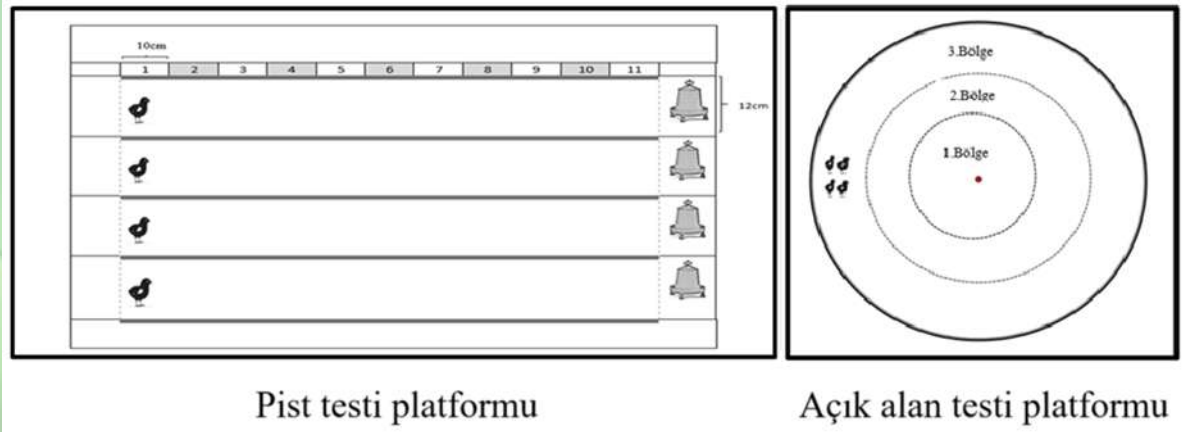
Davranış analizlerinde genel prensip olarak; Analizler aynı gözlemci tarafından yapılmış ve analiz sırasında devamlı beyaz önlük giyilmiştir. Ayrıca analizi olumsuz etkileyebilecek davranışlardan, dikkat çekici renkli elbise, farklı koku gibi etkenlere dikkat edilmiştir.

Açık Alan Testi (OFT)

Çalışmada kuluçkadan çıkan cıvcivlerin (0 günlük) açık alana karşı tepkileri ölçülmüştür. Çalışmada Ergün ve Taşkın (2022)'nın muhabbet kuşları için kullandıkları platform kullanılmıştır (Şekil 1). Bu platform merkezden periferie doğru 3 bölge olarak tasarlanmıştır. Platforma yerleştirilen cıvcivin 3 dakika boyunca hareketleri kamera yardımıyla kaydedilmiştir. Böylece cıvcivin bölmelerde geçirdikleri süre ve merkeze olan ziyaretleri hesaplanmıştır. Bu işlem her grup için farklı cıvcivler kullanılarak beş kez tekrarlanmıştır.

Pist Testi

Çalışmada yumurtadan çıkan cıvcivlerin yem arama ve yeme ulaşma davranışları bu test yardımıyla ölçülmüştür. Test için kullandığımız platform Mezrai ve ark.'nın 2022 yılındaki çalışmalarında kullandıkları kuş yolu platformunun modifiye edilmesiyle çalışma için özel olarak ahşaptan tasarlanmıştır (Şekil 1). Test platformu bitişik vaziyette 20 cm yüksekliğinde 4 adet koridordan (110x12x20 cm) oluşmaktadır. Ayrıca platformunun final kısmında 4 adet yemlik bulunmaktadır. Her bir koridor 10 cm aralıklar 11 sanal bölmeyle ayrılmıştır. Farklı 4 kutu içerisinde getirilen her gruba ait bir cıvciv 30 saniye bekletildikten sonra kutuların kapakları açılmış ve 3 dakika beklendikten sonra cıvcivlerin ulaştıkları mesafe kaydedilmiştir. Süre sonunda kaydedilen cıvcivlerin başlangıca göre bulundukları mesafe aralığı cıvciv skoru olarak değerlendirilmiştir. Cıvcivlerin herhangi birinin yeme ulaşması durumu süre sonu olarak kabul edilmiştir (Bertin ve ark.,2010). Bu test her gruptan farklı cıvcivler kullanılarak 10 tekrar yapılmıştır.



Şekil 1. Davranış analiz platformları

İstatistik Analizleri

Çalışma sonunda elde ettiğimiz verilerin analizinde SPSS 22 V istatistik paket programı kullanılmıştır. Çalışmada tek yönü varyans analizi olarak (ANOVA) çoklu karşılaştırma testlerden ise Duncan testi kullanılmıştır (Genç ve Soysal, 2018; Duggan ve ark., 2017).

Bulgular ve Tartışma

Çalışmada grup yumurtalarının kuluçka randımanları, çıkış güçleri, erken, orta ve geç dönem embriyo ölüm oranları, malformasyon ve malpozisyon oranları belirlenmiştir (Tablo 2). Gruplar arasında kuluçka randıman oranları arasında farklılıkların $P < 0.05$ düzeyinde anlamlı değildi. En yüksek değer yüksek doz uygulanan grupta



tespit edilirken en düşük değer kontrol grubunda bulunmuştur. Yumurtaların kuluçka çıkım güçleri gruplar arasında farklılık göstermiştir ($P<0.05$). Çıkım gücü değerleri sırasıyla kontrol grubunda 82.53 ± 3.26 , düşük doz uygulanan grupta 83.70 ± 3.33 , saf su grubunda 88.58 ± 0.50 ve yüksek doz uygulanan grupta ise 90.08 ± 3.17 olarak hesaplanmıştır. Bu durum yüksek doz fesleğen bitki ekstraktı uygulaması bildirilen yumurtalarının çıkım gücünü olumlu yönde etkiler şeklinde açıklanabilir. Japon Bildiriciler üzerinde yapılmış çalışmada kuluçkalık yumurtalarının askorbik asit solüsyonuna daldırılmasının çıkım gücünü artırdığı bildirilmiştir (Fidan ve ark., 2012). Farklı bir çalışmada ise bildirilen yumurtaların dezenfeksiyonu amaçlı kullanılan *Origanum vulgare* L. esansiyel yağının çıkım gücünü artırdığı rapor edilmiştir (Yıldırım ve ark., 2003). Benzer şekilde yapılmış farklı çalışmada ise kiraz yaprağı ekstraktının ördek yumurtalarının ve kekik esansiyel yağının ise tavuk yumurtası çıkım gücünü artırdığı belirtilmiştir (Copur ve ark., 2010; Bekhet ve Sayed, 2021).

Tablo 2. Kuluçka özellikleri ve verim tablosu (%)

	KR (%)	ÇG (%)	EDÖ (%)	ODÖ (%)	GDÖ (%)	MF (%)	MP (%)
K	75.50±0.50 ^a	82.53±3.26 ^c	8.13±0.44 ^a	1.99±0.31 ^a	1.93±0.35 ^c	7.24±0.05 ^b	5.43±0.15 ^c
SS	76.00±2.83 ^a	88.58±0.50 ^{ab}	5.43±0.16 ^b	3.41±0.16 ^a	7.24±0.43 ^b	10.91±0.33 ^a	7.26±0.08 ^a
F1	76.66±1.73 ^a	83.70±3.33 ^{bc}	8.15±0.07 ^a	2.02±0.28 ^b	8.36±0.62 ^a	11.58±1.01 ^a	6.11±0.20 ^b
F5	77.00±1.70 ^a	90.08±3.17 ^a	1.92±0.28 ^c	1.77±0.08 ^b	1.19±0.10 ^c	4.21±0.74 ^c	4.18±0.47 ^d

*: Aynı harfle gösterilen ortalamalar arasındaki farklar $P<0.05$ düzeyinde önemsizdir; *: **K** (Kontrol), **SS** (Saf su), **DD** (Düşük doz grubu) (%1 bitki ekstrakt uygulaması yapılan grup), **YD** (Yüksek doz grubu) (%5 bitki ekstrakt uygulaması yapılan grup); *: **KR** (Kuluçka randımanı), **ÇG** (Çıkış gücü), **EDÖ** (Erken dönem embriyo ölümleri), **ODÖ** (Orta dönem embriyo ölümleri), **GDÖ** (Geç dönem embriyo ölümleri) **MF** (Malformasyon oranı) ve **MP** (Malpozisyon oranı)

Çalışmada erken orta ve geç dönem embriyo ölüm oranları, malformasyon ve malpozisyon oranları belirlenmiş ve gruplar arasındaki farklar anlamlı bulunmuştur ($P<0.05$). En düşük erken orta ve geç dönem embriyo ölüm, malformasyon ve malpozisyon oranının yüksek doz uygulama grubunda (F5) tespit edilmiştir. En yüksek erken dönem ölüm oranı kontrol grubunda, en yüksek orta dönem ölüm ve malpozisyon oranı saf su (SS) grubunda, en yüksek geç ölüm ve malformasyon oranının ise düşük doz uygulama grubunda (F1) olduğu bulunmuştur. Bildirilen yumurtalarına sarımsak yağı püskürtülmesinin erken ve geç embriyo ölüm oranını düşürdüğü bilinmektedir (Abo-Samaha ve Basha., 2021). Fidan ve ark. (2012) yılında bildirilen yumurtaları ile yaptıkları çalışmada inkübasyon öncesi yumurtaların askorbik asit solüsyonuna daldırılmasının erken ve orta ölüm oranını etkilediğini bildirmişlerdir. Farklı bir çalışmada ise bildirilen yumurtalarının dezenfeksiyon işleminde kullanılan sarımsak ekstraktının (*Allium sativum*) erken ölüm oranını düşürdüğü rapor edilmiştir (Baylan ve ark., 2018). Bulduğumuz sonuçlar literatürde bildirilen sonuçlarla benzerlik göstermektedir.

Çalışmada bildirilen yavrularının çıkım ağırlıkları ve Tona ve Pasgar skor parametreleri kullanılarak civciv kalitesi belirlenmiştir (Tablo 3). Grupların yavru çıkım ağırlıkları arasındaki farklılıklar anlamlı bulunmuştur ($P<0.05$). Yavru çıkım ağırlıkları sırasıyla K, F1, SS ve F5 de 7.86 ± 0.51 gr, 8.25 ± 0.46 gr, 8.52 ± 0.42 gr ve 8.93 ± 0.38 gr olarak ölçülmüştür. Bildirilen yavru çıkım ağırlığı değeri Japon bildiricileri için 6.16-11.34 gr (Yılmaz ve Çağlayan, 2008), 9–11 gr (Gürçan ve Çağlar., 2012), 8.3 gr (Balcioğlu ve ark., 2005) olarak bildirilmiştir. Çalışmada elde ettiğimiz değerler Yılmaz ve Çağlayan (2008)'nin ve Balcioğlu ve ark. (2005)'nin bildirdiği değerlerle uyumlu iken Gürçan ve Çağlar (2012)'nin bildirdiği değerlere kısmen uyumludur. Japon bildirilen yumurtalarına uygulanan biberiye esansiyel yağının civciv çıkım ağırlığını artırıcı etkisine sahip olduğu bilinmektedir (Aberbour ve ark., 2022). Ayrıca sulu bitki özlerinin (zencefil, sarımsak, kekik, tarçın) bildirilen yumurtalarının inkübasyon öncesi dezenfeksiyon amaçlı kullanıldığı bir çalışmada kullanılan bitki özlerinin civciv çıkım ağırlığını artırdığı bildirilmiştir (Al-Shammari ve ark., 2022).

Çalışmada tona ve pasgar skorları kullanılarak çıkan civcivlerin kalitesi belirlenmiştir (Tablo 3). Tona skorunda 80 ile 100 değerleri arasında olan civcivler ve Pasgar skorunda ise 8 ile 10 değerleri arasında olan civcivler yüksek kaliteli civciv olarak kabul edilirler (Willemsen ve ark., 2008; Boerjan, 2002). Gruplara ait civcivlerin tona ve pasgar skor değerleri anlamlı farklılıklar göstermiştir ($P<0.05$). En yüksek tona ve pasgar skor değeri yüksek doz uygulanan grupta, en düşük skor değerleri ise negatif kontrol grubunda tespit edilmiştir. Bu durum fesleğen bitki ekstraktının civciv tona ve pasgar skor değeri üzerine iyileştirici etkisinin olabileceği şeklinde açıklanabilir. Benzer şekilde tavuk yumurtaları kullanılarak yapılmış bir çalışmada tavuk yumurtalarına %2 lik *S. hortensis* bitki ekstraktı uygulamasının civciv kalite skorunu olumlu yönde yükselttiği bildirilmiştir (Ergün ve ark., 2023).

Çalışmada kuluçkadan yeni çıkmış bildirilen yavrularının farklı bir ortama karşı gösterdikleri tepki ve keşfetme düzeyleri açık alan testi uygulanarak tespit edilmiştir (Tablo 4).

Bu amaçla davranış analiz platformunun üç ayrı bölgesinde bildirilen yavrularının geçirdikleri süreler ölçülmüştür. Civcivlerin platformun merkezinde geçirdikleri süre çok önemlidir. Çünkü burada geçirdikleri sürenin uzunluğu yüksek düzeydeki keşif, düşük düzeydeki korku ve stresle ilişkilidir (Faure ve ark., 1983). Çalışmada civcivlerin platform merkezinde geçirdikleri süre oranları anlamlı farklılık göstermiştir ($P<0.05$). Bu farklılıkların



oluşmasında uygulama farklılıklarının etkili olduğu düşünülmektedir. Merkezde geçirilen süre oranları SS, K, F5 ve F1 de sırasıyla % 3.31±0.56, % 3.87±0.53, % 6.23±0.32 ve %7.30±0.36 olarak hesaplanmıştır. Ayrıca merkezde geçirilen süre bakımından en yüksek değerin düşük doz uygulanan grupta (F1) tespit edilmesi %1'lik fesleğen uygulamasının bıldırcın yavrularında kurku ve stresi azaltıcı etkisinin olabileceği şeklinde açıklanabilir.

Bıldırcın yavrularının yem arama ve yeme ulaşma davranışları, çalışma için özel olarak tasarlanmış pist platformu ile belirlenmiştir. Cıvcıvlerin yeme ulaşma ve arama davranışları arasındaki farklılıklar anlamlı bulundu ($P<0.05$). Yeni yavruların pist skor değerleri en yüksek değeri yüksek doz uygulanan grupta (F5) tespit edilirken en düşük değer ise kontrol grubunda bulunmuştur.

Çalışmada fesleğen bitkisinin bıldırcın yumurtalarının inkübasyon işleminde kullanım olanakları araştırılmıştır. Çalışmada bitki ekstraktı kullanımına bağlı herhangi bir olumsuzlukla karşılaşılmamıştır. Sonuç olarak fesleğen bitki ekstraktı kullanımının başta kuluçka özellikleri olmak üzere yeni yavruların cıvciv kalite özelliklerine ve davranışlarına olumlu etkisinin olduğu, kullanılması durumunda bıldırcın yumurtalarının inkübasyon işlemi sırasında verim artırıcı potansiyele sahip olduğu sonucuna varılmıştır.

Tablo 3. Cıvciv özellikleri ve verim tablosu (%)

Gruplar	CK		
	CÇA (gr)	Tona Skor	Pasgar skor
K	7.86±0.51 ^c	99.28±0.24 ^a	9.64±0.05 ^b
SS	8.52±0.42 ^{ab}	98.53±0.50 ^b	9.44±0.01 ^b
F1	8.25±0.46 ^{bc}	99.24±0.20 ^a	9.59±0.04 ^b
F5	8.93±0.38 ^a	99.30±0.26 ^a	9.71±0.03 ^a

*: Aynı harfle gösterilen ortalamalar arasındaki farklar $P<0.05$ düzeyinde önemsizdir; *: K (Kontrol), SS (Saf su), F1 (Düşük doz grubu) (%1 bitki ekstrakt uygulaması yapılan grup), F5 (Yüksek doz grubu) (%5 bitki ekstrakt uygulaması yapılan grup); *: CÇA (Cıvciv çıkım ağırlığı), CK (Cıvciv kalitesi)

Tablo 4: Açık alan ve pist testi skorları

Gruplar	Açık Alan Testi Süre (%)			Pist Testi (Erişilen skor)
	1.Bölge (Merkez)	2.Bölge	3.Bölge	
K	3.87±0.53 ^c	4.83±0.76 ^c	90.70±0.60 ^a	2.33±0.57 ^b
SS	3.31±0.56 ^c	6.06±0.55 ^b	90.66±0.66 ^a	2.66±0.56 ^{ab}
F1	7.30±0.36 ^a	5.55±0.50 ^{bc}	86.43±0.82 ^b	2.68±0.57 ^{ab}
F5	6.23±0.32 ^b	12.63±0.40 ^a	80.71±0.81 ^c	3.66±0.52 ^a

*: Aynı harfle gösterilen ortalamalar arasındaki farklar $P<0.05$ düzeyinde önemsizdir; *: K (Kontrol), SS (Saf su), F1 (Düşük doz grubu) (%1 bitki ekstrakt uygulaması yapılan grup), F5 (Yüksek doz grubu) (%5 bitki ekstrakt uygulaması yapılan grup)

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Effect of Using Enzyme-Added Wheat Instead of Corn in the Diet on the Performance and Slaughtering Characteristics of Broilers

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Abstract

Current research has been conducted to evaluate the effects of diets containing 50 and 100% wheat supplemented with 300 g/ton enzymes (phytase, xylanase, glucanase, amylase and protease) instead of maize on the performance and carcass characteristics of male broilers. A total of 120 male Ross 308 chicks of day-old age have been distributed into three treatment groups with four subgroups of ten birds each. Experimental groups have been composed of diets containing maize as the grain source (Wheat0), wheat with 300 g/ton enzyme added as 50% of maize (Wheat50) and wheat with 300 g/ton enzyme added as 100% of maize (Wheat100). Performance parameters have been determined on the 10th, 25th and 42nd days, and carcass and visceral weights have been determined at the end of the study (42nd day). The effect of using enzyme-added wheat in the diet on feed intake is statistically insignificant except for the 0-10th days period ($P>0.05$). Compared to the control group (Wheat0), body weight and feed conversion ratio have been improved with the use of enzyme-added wheat in the diet ($P<0.05$). The use of enzyme-added wheat instead of maize in the diet reduced the relative abdominal fat weight, and the relative liver weight increased in the Wheat100 group ($P<0.05$), but other slaughtering parameters have not been affected by the treatment groups ($P>0.05$). According to the results of this study, it has been determined that the use of wheat instead of all maize (100%) with the addition of enzymes in male broiler diets improved performance and reduced fatness.

Key Words: Broiler, Carcass, Enzyme, Performance, Wheat

Rasyonda Mısır Yerine Enzim İlaveli Buğday Kullanımının Broilerlerin Performansı ve Kesim Özellikleri Üzerine Etkisi

Özet

Bu çalışma mısır yerine 300 g/ton seviyesinde enzim (fitaz, xylanase, glucanase, amylase ve protease) katkılı %50 ve 100 seviyelerinde buğday kullanılan rasyonların erkek etlik piliçlerin performansına, karkas özelliklerine ve iç organ ağırlıklarına etkisini tespit etmek amacıyla yürütülmüştür. Çalışmada günlük yaşta 120 adet erkek Ross 308 piliçleri 3 muamele grubuna her birinde 10 civcivin bulunduğu 4 tekerrür olarak dağıtılmıştır. Muamele grupları tahıl kaynağı olarak mısır (Buğday0), mısırın %50'si oranında 300 g/ton enzim ilaveli (Buğday50) ile mısırın %100'ü oranında 300 g/ton enzim ilaveli (Buğday100) rasyonlardan oluşturulmuştur. Performans parametreleri 10., 25. ve 42. günde belirlenmiş, karkas ve iç organ ağırlıkları ise çalışma sonunda (42. gün) tespit edilmiştir. Rasyonda enzim ilaveli buğday kullanımının erkek etlik piliçlerin yem tüketimine etkisi ilk on günlük periyot hariç istatistiki olarak önemsiz olmuştur ($P>0.05$). Kontrol grubu (Buğday0) ile karşılaştırıldığında canlı ağırlık ve yem değerlendirme katsayısı rasyonda enzim ilaveli buğday kullanımı ile iyileşmiştir ($P<0.05$). Rasyonda mısır yerine enzim ilaveli buğday kullanımı abdominal yağ oranını azaltmış, Buğday100 grubunda ise karaciğer oranı artmış ($P<0.05$), ancak diğer kesim parametreleri muamele gruplarından etkilenmemiştir ($P>0.05$). Bu çalışma sonuçlarına göre erkek piliç rasyonlarında enzim ilavesi ile mısırın tamamı (%100) yerine buğdayın kullanımının performansı iyileştirdiği ve yağlanmayı azalttığı tespit edilmiştir.

Anahtar Kelimeler: Buğday, Enzim, Etlik piliç, Karkas, Performans

Introduction

Improvements in genetics and breeding conditions have significantly increased the growth rate of broilers today. However, enhancing the genetic and environmental criteria alone will not provide optimal output; diets centered around highly digestible and antinutritional factor-free products like soybean meal and maize meal are required. Concerns about sustainability are raised by this situation for both our nation and a few other nations where environmental demands make maize farming insufficient. The use of other energy sources such as wheat instead



of maize is still popular. Unfortunately, the usage of these products has been restricted due to the anti-nutritional components and biased advice present in them.

Because of its high starch and low cellulose content, wheat has the second-highest energy content of any grain, only surpassed by maize. But since it includes non-starch polysaccharides (beta glucan, arabinoxylan), wet litter and other issues are noticed, which causes loss of production. About 90% more energy is present in wheat than in maize. But wheat has nearly double the protein content of maize. In broiler diets, up to 25% of the feed can be wheat; with the addition of enzymes, this can be raised to 50%, or all of the maize.

Enzymes reduce feed costs by increasing the use of nutrients in feed materials. Grain-based feeds (wheat, barley, rye, oats) used in broiler production contain non-starch polysaccharides and anti-nutritional factors (Çiftçi, 2001). Since non-starch polysaccharides has a high water binding capacity, it increases intestinal viscosity. The increase in viscosity reduces the digestion of nutrients in the small intestine. In addition, high viscosity increases the amount of sticky stool, and as a result, health problems caused by wet litter problems arise. Enzyme addition reduces the water retention capacity of polysaccharides and viscosity decreases. Enzymes such as xylanase, β -glucanase, pectinases, cellulases, proteases, amylases, lipase, phytase, galactosidase, and β -mannanase can be used in feeds to increase feed efficiency and eliminate negative effects (Sevgili et al., 1999; Çiftçi, 2001). For this purpose, enzyme preparates used as feed additives are commercially produced to contain one or more enzyme activities (Sevgili et al., 1999). With the use of these enzymes, there is a decrease in small intestine viscosity, an increase in utilization of nutrients, an improvement in litter quality, a decrease in dirty egg problems, increase of endogenous enzymes activities and utilization of energy, protein and mineral substances as a result of more effective disintegration (Sevgili et al., 1999; Çiftçi, 2001). In this study, it has been aimed to determine the effect of using enzyme-added wheat instead of maize (instead of 50% and 100% of maize) on the performance and slaughtering characteristics of broilers.

Material and Method

Male broiler chicks (Ross 308) and feed materials have been purchased from commercial companies and the diets have been prepared in the Feed Unit located in Selçuk University, Faculty of Agriculture, Prof. Dr. Orhan Düzgüneş Animal Husbandry Research and Application Facility. In the study, 120 male broiler chicks have randomly been distributed into 3 treatment groups with 4 subgroups. A mixture of phytase, xylanase, glucanase, amylase and protease enzymes have been used as enzyme supplement in the study. These additives used in the studies have also been supplied by commercial companies. Treatment groups have been composed of diets containing maize as the grain source (Wheat0), wheat with 300 g/ton enzyme added as 50% of maize (Wheat50) and wheat with 300 g/ton enzyme added as 100% of maize (Wheat100) (Table 1).

Table 1. Treatment diets using different levels of barley and nutrient contents

Ingredients	Treatment diets								
	Wheat0			Wheat50			Wheat100		
	Starter (0-10. days)	Grower (11-25. days)	Finisher (26-42. days)	Starter (0-10. days)	Grower (11-25. days)	Finisher (26-42. days)	Starter (0-10. days)	Grower (11-25. days)	Finisher (26-42. days)
Maize	48.14	51.28	56.40	26.69	26.65	28.90	---	---	---
Barley	---	---	---	25.00	26.10	28.90	53.00	54.04	59.38
Soybean meal	42.70	39.00	33.80	35.40	37.00	31.80	33.44	35.00	29.50
Corn gluten	---	---	---	4.00	---	---	4.00	---	---
Soybean oil	5.40	6.30	6.80	5.00	6.80	7.40	5.65	7.50	8.10
Limestone	0.70	0.60	0.60	0.85	0.65	0.60	0.85	0.73	0.65
Dicalcium phosphate	2.20	2.00	1.75	2.08	1.95	1.75	2.05	1.85	1.68
Salt	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Premix	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L-lysine	0.17	0.26	0.12	0.30	0.28	0.12	0.33	0.31	0.16
DL-methionine	0.34	0.21	0.18	0.33	0.22	0.18	0.33	0.22	0.18
Calculated nutrient contents									
ME, kcal/kg	3003	3105	3203	3007	3101	3200	3008	3105	3203
Crude protein, %	23.012	21.530	19.496	23.052	21.496	19.541	23.082	21.504	19.508
Calcium, %	0.973	0.872	0.794	0.976	0.873	0.789	0.964	0.873	0.785
Available phosphorus, %	0.489	0.445	0.396	0.480	0.448	0.409	0.486	0.441	0.409
Lysine, %	1.288	1.291	1.063	1.288	1.283	1.042	1.291	1.284	1.046
Methionine, %	0.675	0.521	0.467	0.679	0.528	0.466	0.678	0.526	0.463
Methionine+cystine	0.974	0.899	0.815	1.057	0.915	0.823	1.065	0.922	0.829

¹ The premix provided the following per kg of diet: retinyl acetate, 4.0 mg; cholecalciferol, 0.055 mg; DL- α -tocopheryl acetate, 11 mg; nicotinic acid, 44 mg; calcium-D-pantothenate, 8.8 mg; riboflavin sodium phosphate, 5.8 mg; thiamine hydrochloride, 2.8 mg; cyanocobalamin, 0.66 mg; folic acid, 1 mg; biotin, 0.11 mg; choline, 220 mg; Zn, 60 mg; Mn, 60 mg; Fe, 30 mg; Cu, 5 mg; Iodine, 1.1 mg; Se, 0.1 mg.



During the experiment body weight and feed intake have been determined as g/chick by group weighings at the hatching, 10th day, 24th day, and final (42nd day) of the trial. Body weight gain and feed conversion ratio have been calculated according to the Gül and Yıldız (2024).

At the end of the experiment, two broilers at six weeks of age from each subgroup have been euthanized by cervical dislocation. Slaughtering traits have been determined according to the Gül and Yıldız (2024).

Data have been analysed in the SPSS 18.0 software package (SPSS Inc., Chicago, IL, USA) with a model of one-way ANOVA, using the group mean as an experimental unit. Differences among the group means have been determined by Duncan's range tests. A probability value of $P < 0.05$ has been considered statistically significant.

Results and Discussion

The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on performance is shown in Table 2.

Table 2. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the performance

Parameters	Treatments			Standard error	P-value
	Wheat0	Wheat50	Wheat100		
Body weight, g/bird					
Hatching	41.95	41.60	41.00	0.232	0.258
10 th days	251.2 ^b	252.7 ^b	265.9 ^a	2.55	0.015
25 th days	1176.3 ^b	1273.0 ^a	1308.5 ^a	20.57	0.007
42 nd days	3185.5 ^b	3447.8 ^a	3496.3 ^a	53.52	0.016
Body weight gain, g/bird					
0-10 th days	209.3 ^b	211.1 ^b	224.9 ^a	2.59	0.008
11-25 th days	925.0 ^b	1020.3 ^a	1042.6 ^a	19.08	0.009
26-42 nd days	2006.3 ^b	2174.8 ^a	2187.8 ^a	34.72	0.038
0-42 nd days	3140.6 ^b	3406.2 ^a	3455.3 ^a	53.51	0.015
Feed intake, g/bird					
0-10 th days	269.7 ^b	270.7 ^b	278.3 ^a	1.59	0.034
11-25 th days	1264.4	1285.1	1273.3	12.93	0.836
26-42 nd days	3349.6	3489.9	3434.4	35.53	0.291
0-42 nd days	4883.7	5045.8	4986.0	47.25	0.404
Feed conversion ratio					
0-10 th days	1.289	1.284	1.238	0.0109	0.097
11-25 th days	1.367 ^a	1.260 ^b	1.222 ^c	0.0194	<0.001
26-42 nd days	1.671 ^a	1.605 ^b	1.570 ^b	0.0148	0.003
0-42 nd days	1.556 ^a	1.482 ^b	1.443 ^c	0.0148	<0.001

Wheat0: Group without wheat and enzyme addition, **Wheat50:** Group containing 50% wheat with enzyme instead of corn, **Wheat100:** Group containing 100% wheat with enzyme instead of corn. ^{a,b}: The difference between the means shown with different letters in the same row is statistically significant ($P < 0.05$).

Hatching weights of chicks are statistically similar and vary between 41.00-41.95 g ($P > 0.05$). Body weights on the 10th, 25th, and 42nd days have been statistically affected by the treatment diets ($P < 0.05$). On the 10th day, the body weight of the Wheat100 group (265.9 g) is significantly higher than the Wheat0 and Wheat50 groups (251.2 g and 252.7 g, respectively). The 25th and 42nd days body weights of broilers are significantly higher in the Wheat50 (1273.0 g and 3447.8 g) and Wheat100 (1308.5 g and 3496.3 g) groups than in the Wheat0 group (1176.3 g and 3185.5 g). In the 0-10th days period of the study, the body weight gain of the Wheat100 group (224.9 g) has been found to be significantly higher than the Wheat0 and Wheat50 groups (209.3 g and 211.1 g, respectively). On the 11-25th, 26-42nd, and 0-42nd days body weight gain is significantly higher in Wheat50 (1020.3, 2174.8 and 3406.2 g) and Wheat100 (1042.6, 2187.8 and 3455.3 g) groups than in Wheat0 group (925.0, 2006.3 and 3140.6 g). Feed intake has been significantly affected by the treatment diets in the 0-10th days period of the study ($P < 0.05$) but has not been affected in the other periods ($P > 0.05$). Feed intake increased with wheat levels in the first period (0-10th days). This increase is significant in the Wheat100 (278.3 g) compared to the control (Wheat0 (269.7 g) and similar in the Wheat50 group (270.7 g). Feed intake of broilers is 1264.4-1285.1 g in the 11-25th days, 3434.4-3489.9 g in the 25-42nd days, and 4883.7-5045.8 g in total (0-42nd days). The feed conversion ratio of chicks in the first period (0-10th days) varies between 1.238-1.289 and there is no statistical difference ($P > 0.05$). However, in other periods, the feed conversion ratio has been statistically affected by the treatments ($P < 0.05$). In the 11-25th and 0-42nd days of the study, feed conversion ratio improved with the use of enzyme-added wheat instead of maize and this improvement is significant in each treatment group. In these periods (11-25th and 0-42nd days), feed conversion ratio has been determined as 1.367 and 1.556 in Wheat0, 1.260-1.482 in Wheat50, and 1.222-1.443 in Wheat100 groups. In the 26-42nd days period, the feed conversion ratio of broilers has been found to be significantly lower in the Wheat50 and Wheat100 groups (1.605 and 1.570) compared to the control (Wheat0) group (1.671). Similar to this study, earlier research has shown that broiler performance may be enhanced by



enzyme supplementation (Annison, 1992; Kırkpınar et al., 1996). In comparison to the control group, broilers given diets treated with enzymes showed improved feed efficiency, according to studies by Olukosi et al. (2007) and Woyengo et al. (2010). Once more, Thorat et al. (2015) reported that broiler body weight and feed efficiency were enhanced by enzyme supplementation. Furthermore, it has been clarified that the usage of enzymes tends to enhance body weight (Omojola and Adeschinwa, 2007; Kırkpınar et al., 2018). Using a variety of enzymes is advised to receive the most benefit from them, since they can each target a particular anti-nutritional element in diets (Adeola and Cowieson, 2011). It should be remembered, nevertheless, that the nature of the feed may affect how helpful the enzyme combination (Meng et al., 2005). Thorat et al. (2015) and Islam et al. (2010) have explained similar results, namely that broiler feed intake remains unchanged when enzymes are added to the diet. Chiang et al. (2005) reported that enzyme addition to wheat-containing broiler diets improved body weight but had no effect on other performance parameters. Tang et al. (2017) and Kırkpınar et al. (2018) stated that enzyme use in wheat-containing diets did not affect performance parameters. The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on slaughtering characteristics is demonstrated in Table 3.

Table 3. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the slaughtering characteristics

Parameters	Treatments			Standard error	P value
	Wheat0	Wheat50	Wheat100		
Carcass*	76.80	75.67	74.76	0.512	0.290
Thigh+drumstick**	27.33	27.01	28.08	0.486	0.695
Breast**	37.14	37.43	38.79	0.534	0.442
Abdominal fat*	1.41 ^a	0.52 ^b	0.57 ^b	0.148	0.005

Wheat0: Group without wheat and enzyme addition, **Wheat50:** Group containing 50% wheat with enzyme instead of corn, **Wheat100:** Group containing 100% wheat with enzyme instead of corn. *Given as a percentage of body weight. ** Given as a percentage of carcass ^{a,b}: The difference between the means shown with different letters in the same row is statistically significant (P<0.05).

The use of 50% and 100% wheat with enzyme supplementation instead of maize in the diet did not affect the carcass (74.76-76.80%), thigh+drumstick (27.01-28.08%), and breast (37.14-38.79%) ratios of broilers statistically (P>0.05). The use of enzyme supplemented wheat instead of maize in the diet affected the relative abdominal weight significantly (P<0.05) and the abdominal fat ratio of Wheat50 (0.50%) and Wheat100 (0.57%) groups has been found to be significantly lower than the control (Wheat0) group (1.41%). The effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of maize in broiler diets on visceral weights is given in Table 4.

Table 4. Effect of using 50% and 100% wheat with enzyme (300 g/ton) instead of corn in the diet on the visceral weights

Parameters*	Treatments			Standard error	P value
	Wheat0	Wheat50	Wheat100		
Liver	1.49 ^b	1.63 ^{ab}	1.84 ^a	0.059	0.033
Gizzard	1.25	1.54	1.31	0.076	0.278
Pancreas	0.214	0.213	0.191	0.0069	0.329

Wheat0: Group without wheat and enzyme addition, **Wheat50:** Group containing 50% wheat with enzyme instead of corn, **Wheat100:** Group containing 100% wheat with enzyme instead of corn. *Given as a percentage of body weight. ^{a,b}: The difference between the means shown with different letters in the same row is statistically significant (P<0.05).

The use of 50% and 100% wheat with enzyme instead of maize in the diet did not affect the gizzard (1.25-1.54%) and pancreas (0.191-0.214%) ratios of broilers statistically (P>0.05). The use of wheat with enzyme instead of maize in the diet affected the relative liver weights significantly (P<0.05) and the liver ratio of the Wheat100 group (1.84%) has been found to be significantly higher than the Wheat0 (control) group (1.49%). Kırkpınar et al. (2018) reported that the use of wheat in broiler diets did not affect internal organ weights. Omojola and Adeschinwa (2007) stated that the use of enzymes increased carcass yield but did not affect other slaughtering parameters. These studies are not consistent with the current study.

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The Future of Green Nanobiotechnology for Wheat Blast Control

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Abstract

Wheat is one of the most important staple crops globally. Being a destructive fungal disease, Wheat Blast caused by the pathogen *Magnaporthe oryzae* pathotype *Triticum* (MoT) has become a significant agricultural concern in South Asia, particularly in Bangladesh and parts of India. As of 2024, wheat blast continues to seriously threaten wheat production in South Asia. It first appeared in Bangladesh in 2016 and has since spread across South Asia. The disease can wipe out entire wheat fields under favorable conditions, which include high temperatures and humidity. Controlling blast pathogens raises the production cost and harms the environment. Therefore, biological based crop protection strategies must be considered to combat this pathogen. Smart innovations like nanobiotechnology are strongly required for agricultural growth to face global food security challenges and climate change. Historically, various endophytic bacteria have been explored as possible antagonists against various plant infections. Microbe-based NPs are advantageous over chemical and physical approaches because they are less poisonous and environmentally friendly. However, there is little evidence of the inhibitory effect of green synthesis of nanoparticles on the wheat blast pathogen. This article focuses on microbiology and nanobiotechnology to prevent further outbreaks and mitigate the economic impact on wheat farmers across the region. The article will also address various biosynthesized metal nanoparticles that can enhance the resistance against wheat blast pathogens.

Key Words: Wheat Blast, Nanobiotechnology, Endophytic bacteria, Nanoparticles





Microalgae- Role In Development Of Bio (H₂, Ethanol And Diesel) Fuels

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Abstract

Equilibrium between financial, agriculture and ecological progress could be made by using substitute fuel which should be economically inexpensive, technically feasible, readily obtainable and environmentally satisfactory. Biohydrogen, bioethanol and biodiesel obtained from biomass of renewable raw material has all the above mentioned properties. Microalgae (Chlorophytes) also known as 3rd generation biofuel producers are the photosynthetic organisms. Biodiesel is monoalkyl esters of long chain fatty acids, and several microalgal species have diverse types of lipids for production of biodiesel. Microalgae are direct ethanol secretors in the medium, also well known to produce biohydrogen. Thirty-three different microalgae isolates were obtained from different geographic regions of Pakistan. Lipids were extracted and quantified by transesterification. Light, Fluorescent and Confocal microscope was used for the observation and detection of lipids by using lipid staining dyes. FTIR analysis was also performed for the detection of lipids. Gas Chromatography was also performed for the lipids analysis. Biodiesel obtained from the isolates was also measured. Biohydrogen and bioethanol production potential of the strains was investigated under various culturing conditions (i.e., dark and light, glucose supplementation, nitrate effect). The maximum biodiesel productivity (120 mg L⁻¹ day⁻¹) was observed in the *Chlorococcum* sp. SM-MFUM-16 in nitrate-less BG11 media. 7.61 µm³ lipid droplets were measured in the cells of *Gloeocystis* sp. SM-MFUM-4. Maximum biohydrogen production was obtained as 357 µmol mg Chl-a⁻¹ h⁻¹ by *Chlorella* sp. SM-MFUM-22. UV treated *Dunaliella* sp. SM-MFUM-41 enhanced 380% H₂ production as compared to the respective unmutated strain. Maximum bioethanol secretion was 482 mg L⁻¹ acquired by *Chlorella* sp. SM-MFUM-22. Hence, the microalgal isolates showed varying ability to produce the three types of tested biofuels under different conditions.

Key Words: Biofuels, Lipids, Microalgae, Triglycerides, Biohydrogen, Bioethanol.



ID: 471

Seroprevalence of Newcastle virus in backyard poultry of Ardabil province, Iran

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Abstract

Backyard poultry can cause spread Newcastle virus to industrial poultry as reservoirs and vectors. The aim of this study was to survey seroprevalence of Newcastle virus in rural domestic poultry of Ardabil province, northwest of Iran. In this study, 943 blood serum samples were randomly collected from backyard poultry of 40 villages. The hemagglutination inhibition (HI) test was performed on the serum samples according to OIE protocol to detect Newcastle virus. In this study sera with titers ≥ 4 (i.e. $\log_2$) were considered positive. Out of 40 sampled villages, 57.5 % villages and out of 940 birds sampled, 23.5% birds were positive for ND virus. Among different bird species, the highest sero-positive prevalence belonged to chickens. The results of this study showed that seroprevalence of Newcastle virus and its circulation in rural domestic poultry of Ardabil province. The implementation of disease prevention and control measures such as compliance biosecurity principles, vaccination and continuous monitoring of circulating viruses in rural poultry to reduce the contamination of domestic poultry and prevent the spread of the virus to industrial poultry are necessary.

Keywords: Newcastle virus, rural poultry, HI, Ardabil province



Healthy Snacks: Chocolate

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Abstract

This study aims to underline the known positive effects of delicious and practical chocolate snacks on health by addressing the historical, chemical and health importance of cocoa and chocolate in detail. The healing journey of cacao and chocolate dates back to the use of cacao for ritual and therapeutic purposes by ancient civilizations such as Olmec, Aztecs to the discovery of America by Columbus and its arrival in Europe, where it became a popular food. Many active ingredients such as phenylethylamine, theobromine, caffeine, compounds in cocoa composition support chocolate's positive effects on health. These components show that chocolate positively affects antioxidant, anti-inflammatory, cardiovascular and neurological health. The product range of functional foods, which we can define as foods enriched with additional nutrients or ingredients that benefit human health, is vast. For example, snack chocolates enriched with probiotics, vitamins or minerals can strengthen the immune system or support bone health. Therefore, it is essential to create significant opportunities to improve the existing physicochemical properties of chocolate by using a variety of functional chocolates and innovative production techniques that will contribute to this diversity, which can increase its benefits to human health. The development of functional chocolates should not only focus on improving health benefits but also on maintaining the sensory properties and taste that consumers are used to. Therefore, the development and dissemination of functional chocolates will be essential in promoting healthy eating habits and preventing chronic diseases. This emphasis on consumer acceptance ensures that the audience feels included in the discussion and the decisions made in the food industry. In conclusion, considering the health importance of cocoa and chocolate, the development of functional chocolates and the application of innovative production techniques have great potential for the future of both consumers and the food industry.

Key Words: Healthy Snacks, Chocolate, Functional Food

Sağlıklı Atıştırmalıklar: Çikolata

Özet

Bu çalışmada, kakao ve çikolatanın tarihsel, kimyasal ve sağlık açısından önemini detaylı bir şekilde ele alarak, lezzetli ve pratik çikolatalı atıştırmalıkların sağlık üzerindeki olumlu etkilerinin vurgulanması amaçlanmaktadır. Kakao ve çikolatanın şifa yolculuğu, Olmekler ve Aztekler gibi eski uygarlıkların kakaoyu ritüel ve tedavi amaçlı kullanımlarından, Kolomb'un Amerika'yı keşfiyle Avrupa'ya getirilmesine ve burada popüler bir gıda haline gelmesine kadar uzanmaktadır. Kakaonun bileşiminde yer alan feniletamin, teobromin, kafein gibi çeşitli aktif bileşenler, çikolatanın sağlık üzerindeki olumlu etkilerine katkı sağlamaktadır. Bu bileşenler, çikolatanın antioksidan, anti-inflamatuar, kardiyovasküler ve nörolojik sağlık üzerinde olumlu etkiler yarattığını ortaya koymaktadır. Fonksiyonel gıdalar, insan sağlığına fayda sağlayan ek besin maddeleri veya bileşenlerle zenginleştirilen gıdalar olarak geniş bir ürün yelpazesine sahiptir. Örneğin, probiyotikler, vitaminler veya mineraller ile zenginleştirilmiş çikolatalı atıştırmalıklar bağışıklık sistemini güçlendirebilir veya kemik sağlığını destekleyebilir. Bu nedenle, çeşitli fonksiyonel çikolataların geliştirilmesi ve bu çeşitliliğe katkıda bulunacak inovatif üretim tekniklerinin kullanılmasıyla çikolatanın mevcut fizikokimyasal özelliklerinin iyileştirilmesi, insan sağlığına olan faydalarını artırma açısından önemli fırsatlar sunmaktadır. Bununla birlikte, bu geliştirme sürecinde, çikolatanın duyuşal özelliklerinin korunarak tüketici beklentilerini karşılaması önem arz etmektedir. Fonksiyonel çikolataların geliştirilmesi ve yaygınlaştırılması, sağlıklı beslenme alışkanlıklarının teşvik edilmesi ve kronik hastalıkların önlenmesi açısından da kritik bir adım olacaktır. Tüketicilerin bilinçli seçimler yapmalarını sağlamak, fonksiyonel çikolataların geliştirilmesiyle hem sağlık hem de gıda endüstrisi açısından büyük bir potansiyel taşımaktadır. Sonuç olarak, kakaonun ve çikolatanın sağlık açısından önemi dikkate alındığında, fonksiyonel çikolataların geliştirilmesi ve inovatif üretim tekniklerinin uygulanması, hem tüketicilerin hem de gıda endüstrisinin geleceği için büyük bir potansiyel barındırmaktadır.

Anahtar Kelimeler: Sağlıklı Atıştırmalıklar, Çikolata, Fonksiyonel Gıda



Introduction

It is located between 20 degrees north and south latitudes in a region with tropical climate characteristics known as the "cocoa belt" in the world; the origin of cocoa grown in today's Mexican territory dates back to 4000 BC.(Verna, 2013). The Olmec, Maya and Aztec peoples of the region placed cacao at the center of their rituals, associating it with birth, marriage and death themes (Martin, 2006). Believed to have been brought to these lands by the Aztec God Quetzalcoatl, cacao was initially dried and made into a paste with water, then flavored with cinnamon and pepper. This mixture, called Xocolatl, became a medicinal drink preferred by nobles, emperors and soldiers for its stimulating and invigorating effects rather than its flavor (Verna, 2013). Again, in Aztec inscriptions, a source of information about the New World (American continent), there is a source describing the medicinal properties of plants, and there is information that consuming chocolate gives positive results in cases such as loss of appetite, mental fatigue, insufficient breast milk, low sexual appetite(Dillinger et al., 2000). With the discovery of the region by Europeans, the popularity of cocoa and chocolate spread rapidly across continents. In his book 'Food of the Gods,' Head states that the health benefits of chocolate played an essential role in the increase of this popularity and emphasizes the benefits of cocoa such as quenching thirst, calming high fever, nourishing the body and weight gain. Chocolate was regularly included in the food list of the British Navy due to its nutritious properties(Head, 2005). It is known that Brillat-Savarin, one of the famous writers of the period, known in history with the saying "Tell me what you eat and I will tell you who you are," regularly consumed chocolate every morning and recommended it to his close circle. Brillat-Savarin argued that chocolate was good for feminine beauty and regular bowel movements. According to her, digestion is not only a physical process but also an essential factor influencing whether people are cheerful, sad, taciturn or talkative (Baker, 2015). The examples show that humanity has benefited from the favorable physical and psychological effects of cocoa and chocolate since its first contact with cocoa. Today, it is recognized that these positive effects are due to cocoa's excellent antioxidant properties, its high flavanol content and its known active ingredients, such as caffeine and theobromine (Wind, 2021). Therefore, in addition to cocoa's existing natural nutritional properties, innovative approaches, such as improving the ratio of fat and sugar or using alternative fat sources and sweeteners, will increase the bioavailability of cocoa products and offer significant development opportunities for human health and the food industry.

Chemical Compounds

"Chocolate" from the Spanish Nahuatl language (Dictionary.com, 2023) starts with the fermentation process of cocoa beans, the main component. The beans are dried and roasted, then removed from their shells and separated into cocoa butter and cocoa mass. After the conching process, it is passed through the tempering stage and made suitable for chocolate production(Chocolatemonthclub.com, 2024). In the structure of chocolate, there are more than 500 chemicals, such as phenylethylamine, anandamide, theobromine, caffeine, serotonin, and phenolics, in total. At the same time, there are components such as cocoa butter, sugar, and cocoa-containing milk powder, the most important of which is fat. Chocolate, which has anti-inflammatory and antioxidant properties, is also known for its aphrodisiac effect(Shikha et al., 2019). These chemical components in the structure of chocolate play an essential role in explaining the positive effects of chocolate on human health.

Phenylethylamine

Chocolate contains a compound called phenethylamine, which increases the secretion of the hormone dopamine, which triggers the "feel-good" effect in brain cells (Abbey, 2020). Phenethylamine, also known as a "love compound," is one of the most effective ingredients in chocolate. Although it is present in small amounts in the chocolate's structure, it stimulates the nervous system and triggers the release of endorphins. It also strengthens the activity of dopamine, which is directly related to sexual arousal and desire. Depending on the degree and duration of cocoa roasting, the properties of the components in cocoa biochemistry may vary(Wind, 2021). Therefore, the chemical structure of cocoa and chocolate can vary depending on the production processes, and these changes also determine the effects of chocolate on human health.

Theobromine & Caffeine

Theobromine is an alkaloid also found in coffee and tea. It is chemically similar to caffeine but has a stimulant effect on humans (Criobru.com, 2019). Both components are pharmacologically active chemicals, but theobromine has a slower and longer-lasting effect on the human body than caffeine and does not cause addiction. Caffeine, on the other hand, is faster, stronger and potentially addictive. Thanks to its theobromine content, Cocoa increases focus, provides quality sleep, improves blood flow by dilating blood vessels, and supports deep breathing by relaxing the lungs(Chocante, 2024).



Anandamide

Anandamide is a compound found in cacao that plays a role in essential functions such as pain perception and cravings. It functions as a regulator that keeps the body in homeostasis or balance. The endocannabinoid system is activated by anandamide, which protects against stress-related mental illnesses such as major depression, generalized anxiety and post-traumatic stress disorder. Therefore, it can be said that anandamide is a compound that provides natural happiness and mental balance. Consuming cocoa bean products to address its deficiency can increase levels of this critical neurotransmitter and thus support mental health(Case-Lo, 2020).

Serotonin & Tryptophan

Serotonin is a neurotransmitter that controls and balances your mood and the functions in your brain (Lamoreux, 2023). Serotonin, also known as 5-hydroxytryptamine (5-HT), is involved in human mood and behavior(Trisha A. et al., 2016). Low levels of serotonin in the body are known to have adverse effects on mental health. Therefore, consuming tryptophan-rich foods that trigger an increase in serotonin is crucial(Nerissa and Garry, 2011). Although foods such as cheese, chicken, peanuts, turkey, and peanuts are known to be rich sources of tryptophan, chocolate is also among the foods that attract attention because of its content of this amino acid. Therefore, it is essential to emphasize the potential benefits of chocolate consumption in terms of mental health(Andújar et al., 2012).

Phenolic

Phenolic compounds in cocoa may reduce platelet function, inflammation, and diastolic and systolic arterial pressures by regulating the glycaemic response and changing the lipid profile. When we consider these effects together, they may contribute positively to the risk of cardiovascular mortality. They may also have protective effects against diseases caused or contributed by oxidative stress, such as cancer (Natália et al., 2018). Research in this field shows that phenolic compounds in foods have antioxidant properties (Etaware, 2021). Therefore, chocolate consumption and strengthening the immune system can establish a positive relationship.

General Health Benefits

Cocoa beans contain many phytochemicals that offer a variety of health benefits. These compounds include anticholesterolemic (cholesterol-lowering), antidiabetic (anti-diabetic), hypotensive (blood pressure-lowering), promoting fat burning in the body, increasing intestinal contraction, preventing tumor formation, preventing bronchial asthma, improving proper brain function and preventing memory loss. In addition, it contains amino acids such as glutamine, arginine and leucine, which are beneficial for human health and can facilitate the healing process of cuts and wounds(Great Iruoghene et al.,2021). Therefore, the rich compounds in cocoa beans can positively affect overall health and are recognized as a valuable source of nutrition.

People throughout history have experienced many sources of nutritional problems and healing techniques(Dillinger et al., 2000). These sources also contain information on the relationship between cocoa and chocolate and various diseases. Today, diabetes, cardiovascular diseases, immune system disorders, psychological diseases and joint disorders(Hopkinsmedicine.org, 2024). It is known that chocolate consumption has positive effects on many health problems. Therefore, it can be said that chocolate can be supported by modern science and ancient medicine. Supporting chocolates enriched with functional or bioactive compounds with real studies in this field will contribute positively to human health.

Scientific Research on Functional Chocolates

It is possible to create a general title on the subject by updating the principle of "Let your food be your medicine and your medicine be your food," put forward by Hippocrates thousands of years ago, to "Let functional food be your medicine for health."(Danik and Jaishree, 2015) From another point of view," We can also draw a legal framework on the subject with the definition of "food that has health functions and contains an ingredient officially approved to claim its physiological effects on the human body(Alongi and Anese, 2021) This definition, which was developed to regulate the effects of functional foods on health and their use, provides an essential guideline for evaluating and regulating their use in terms of health. Within the diversity of functional foods, it is necessary to emphasize that snack chocolates should also be considered in this context. Many studies investigate the potential of functional chocolate as an innovative, healthy and tasty option. These studies support the positive effects of chocolate on health and the need to regulate its use. In this context, research to better understand the health benefits and uses of products such as functional chocolate provides essential information that will enable consumers to make informed choices.

In a study on functional spreadable chocolate by Narusorn et al.(2024), It was mentioned that excessive consumption of fats rich in saturated fatty acids (SFA) and trans fatty acids (TFA) used in standard production



plays a role in the development of non-communicable diseases. Therefore, the researchers developed a fatty acid blend containing rice bran oil, camellia oleifera seed oil, perilla seed oil and fish oil as an alternative approach to producing spreadable chocolate. According to the study results, favorable results regarding spreadability and hardness in these fatty acid mixtures prepared in different ratios were obtained. These findings emphasize the importance of using balanced fatty acid profiles in producing spreadable chocolate. More importantly, applying this approach has a potentially positive impact on reducing the consumption of saturated and trans fatty acids, risk factors for non-communicable and long-term slowly progressive chronic diseases, and favoring healthy fats. This suggests that it may contribute to developing a new method for healthy nutrition and preventing chronic diseases. Merve et al.(2022) The study examined the effect of chocolate on patients with anxiety disorders. The study emphasises that strengthening brain function to improve memory, regulate mood and reduce anxiety and depression is essential to holistic health. The study aimed to create a functional chocolate enriched with bacteria that produce aminobutyric acid (GABA), which has a calming effect on the brain. Lactacaseibacillus rhamnosus, known for its capacity to produce GABA, was microencapsulated with a whey-pullulan complex using a water-in-oil emulsion technique. The results showed that microencapsulated bacteria maintained higher viability compared to free bacteria. Furthermore, adding microencapsulated bacteria did not change chocolate's physical, chemical and sensory properties. This study supports the development of functional foods targeting the "Gut-Brain Axis," suggesting that chocolate may be an effective carrier for GABA-producing bacteria and offer potential therapeutic benefits for anxiety disorder patients.

By Samira et al.(2020) Another study aimed to develop a fruit snack formulation with dried fig powder and sugar-free chocolate coating. According to rheological evaluations, sugar-free chocolate containing 29.3% isomalt was chosen for the coating. Textural analyses showed that coating the core with hydrocolloids reduced the hardness and stickiness of the samples ($p < 0.05$). It was also observed that increasing the concentration of xanthan gum and Persian gum reduced the stickiness of the snacks ($p < 0.05$). Coating the beans with hydrocolloids also resulted in a decrease in the thickness of the outer chocolate shell ($p < 0.05$). The results of the sensory evaluation tests showed that the hydrocolloid-coated samples were the most preferred by the panelists.

In the study conducted by Anna et al.(2022) The development and analytical characterization of a new chocolate product functionalized with vitamin E for use with physical exercise to prevent malnutrition in elderly individuals was discussed. The study investigated the effects of vitamin E-functionalised chocolate with 70% cocoa content, physical exercise, and a protein-rich diet on muscle loss and protein-energy malnutrition (PEM) indicators. Preventing muscle loss was set as the primary goal, and it was suggested that vitamin E and cocoa polyphenols, together with physical activity, may prevent muscle loss in elderly individuals and age-related decline in muscle function. Therefore, it is essential to underline that functional foods can be utilized in improving joint disorders that occur in elderly individuals, and it is necessary to develop product diversity with studies to be carried out in this field.

Another study by Delli et al. (2024) focused on the fact that white chocolate does not contain valuable components such as polyphenols, minerals, vitamins and fibers compared to milk and dark chocolate. For this purpose, a notable blackberry grown in the Amazon forests was added to white chocolate, aiming to improve chocolate's physicochemical properties. As a result of the study, it was revealed that there was an increase in polyphenol and antioxidant activity. Although positive values support these results, it is worth underlining the importance of developing products that will appeal to consumers from a sensory point of view with innovative applications that can be used to add fruit to chocolates, as there is a loss of gloss and color change in the appearance of chocolate.

Conclusion

In conclusion, an in-depth examination of cocoa's health benefits and chemical compositions from its historical journey to the present shows that chocolate is a delicious snack and an essential source of nutrients that contribute to human health. Snack chocolates in the functional foods category, enriched with innovative production techniques, have the potential to protect heart health, strengthen the immune system and have positive effects on neurological health with their antioxidant and anti-inflammatory properties. Chocolates supported with additional ingredients such as probiotics, vitamins and minerals can contribute to the prevention of chronic diseases by promoting healthy eating habits.

Offering health-enriched products without compromising the sensory properties of chocolate increases consumer acceptance and offers innovative and valuable opportunities to the food industry. In this context, developing and disseminating functional chocolates both increase individuals' health awareness and contribute to healthy lifestyles. There is great potential for consumers and the food industry in the future with innovative approaches to further optimize these multifaceted benefits of chocolate.

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Effects of Hatching Systems and Flock Ages on Incubation Results and Chick Quality in Broiler Eggs

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Abstract

The aim of the study was to investigate the effects of 3 different hatching systems and 3 different flock ages on hatchability, embryo mortality, chick weight, hatching time, chick length and chick quality score. A total of 1350 eggs (450 from each flock) obtained from 30-week-old (Young: "G"), 40-week-old (Prime: "O") and 55-week-old (Old: "Y") parent flocks of Ross 308 genotype were used in the study. In 3 consecutive trials, eggs completed their development in the same machine (37.8 °C temperature and 55% relative humidity) during the first 18 days of incubation. After the elimination of candling infertile eggs, the remaining eggs were transferred to brooder (B), brooder with hatcher (BH) and hatcher (H) hatching systems in equal numbers. In the last 3 days of incubation, the temperature was applied equally in all systems as 37.5 °C. During the hatching period, relative humidity was 40% in B and 60% in BH and H. Eggs belonging to each group were marked as 8 replications and hatching results were analyzed accordingly. Chick characteristics were measured individually. While hatchability was highest in BH system (94.7%), B and H systems (90.5 and 90.4%) had similar means ($P<0.01$). According to flock age, hatchability was ranked from high to low as O (96.2%), G (94.8%) and Y (84.6%) ($P<0.01$). Late embryo mortality was lowest in BH system, again lowest in O age flocks ($P<0.01$). Hatching time was latest in H system and Y flock, while earliest hatching occurred in BH system and G flock ($P<0.01$). While the hatching system did not affect the chick weight ($P>0.05$), the lightest chicks were obtained from G flock ($P<0.01$). The highest chick length was obtained from BH system and O flock, while the lowest averages were found in H system and Y flock ($P<0.05$). There was no difference between flock ages in terms of chick quality score ($P>0.05$). According to the hatching systems, the quality score was calculated from high to low in BH (%97.1), H (%96.1) and B (%95.8) systems, respectively ($P<0.01$). As a result, it was determined that the best hatching system and flock age in terms of hatching results and chick quality was BH and O.

Key Words: Hatching System, Flock Age, Hatchability, Embryo Mortality, Chick Quality

Broyler Yumurtalarında Çıkım Sistemi ve Sürü Yaşının Kuluçka Sonuçları ve Cıvciv Kalitesine Etkileri

Özet

Çalışmanın amacı, 3 farklı çıkım sistemi ve 3 farklı sürü yaşının çıkış gücü, embriyo ölümü, cıvciv ağırlığı, çıkım zamanı, cıvciv uzunluğu ve cıvciv kalite skoruna etkilerinin irdelenmesidir. Çalışmada, Ross 308 genotipine ait 30 haftalık (Genç:"G"), 40 haftalık (Orta:"O") ve 55 haftalık (Yaşlı:"Y") ebeveyn sürülerinden elde edilen toplam 1350 yumurta (her sürüden 450) kullanılmıştır. Birbirini takip eden 3 denemede, yumurtalar kuluçkanın ilk 18 günü aynı makinede (37.8 °C sıcaklık ve %55 nispi nem) gelişimini tamamlamıştır. Lamba dölsüzlerinin ayıklanmasından sonra kalan yumurtalar brooder (B), brooder with hatcher (BH) and hatcher (H) çıkım sistemlerine eşit sayıda aktarılmıştır. Kuluçkanın son 3 günü tüm sistemlerde sıcaklık 37.5 °C olarak eşit uygulanmıştır. Çıkım periyodunda B'de nispi nem %40 iken BH ve H'de ise %60 olarak gerçekleşmiştir. Her bir gruba ait yumurtalar 8 tekrerrir olacak şekilde işaretlenerek kuluçka sonuçları buna göre analiz edilmiştir. Cıvcive ait özellikler bireysel olarak ölçülmüştür. Çıkış gücü en yüksek BH sisteminde (%94.7) bulunurken B ve H sistemleri (%90.5 ve 90.4) benzer ortalamaya sahip olmuştur ($P<0.01$). Sürü yaşına göre çıkış gücü yüksekten düşüğe doğru O (%96.2), G (%94.8) ve Y (%84.6) olarak sıralanmıştır ($P<0.01$). Geç dönem embriyo ölümü en düşük BH sisteminde bulunurken, yine en düşük O yaş sürülerde belirlenmiştir ($P<0.01$). çıkım zamanı en geç H sisteminde ve Y sürüde olurken, en erken BH sistemi ve G sürüde çıkım gerçekleşmiştir ($P<0.01$). Cıvciv ağırlığını çıkım sistemi etkilemezken ($P>0.05$), G sürüden en hafif cıvcivler elde edilmiştir ($P<0.01$). Cıvciv uzunluğu en yüksek BH sistemi ve O sürüsünden elde edilirken, en düşük ortalamalar H sistemi ve Y sürüsünde bulunmuştur ($P<0.05$). Cıvciv kalite skoru bakımından sürü yaşları arasında fark bulunmamıştır ($P>0.05$). Çıkım sistemlerine göre kalite skoru yüksekten düşüğe sırasıyla BH (%97.1), H (%96.1) ve B (%95.8) sistemlerinde hesaplanmıştır ($P<0.01$). Sonuç olarak, kuluçka sonuçları ve cıvciv kalitesi bakımından en iyi çıkım sistemi ve yaşın, BH ve O olduğu belirlenmiştir.

Anahtar Kelimeler: Çıkım Sistemi, Sürü Yaşı, Çıkış Gücü, Embriyo Ölümü, Cıvciv Kalite



Examples of Drought-Resistant Plants from the Lamiaceae Family for Use in Landscape Design Projects

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Abstract

In urban areas, plant selection is largely planned and designed based on their aesthetic and functional characteristics. In natural environments, it is important to create natural communities that are ecologically appropriate, considering the positive and negative attributes of plant species. Selecting natural plant species through a design that utilizes ecological interactions between species and applying them in an urban context not only appears aesthetically pleasing but can also reduce maintenance issues and enhance plant performance and resilience. Agricultural practices have long recognized the benefits of using species interactions to improve plant and soil health, deter pests, and increase resource use and diversity. However, the benefits of community-level plant design are rarely applied in urban contexts. In my study, planning and design practices that take advantage of natural species selection and interactions between species in urban environments are considered important for ecological sustainability. In this context, five key principles (efficient use of water, plant selection, appropriate design, species diversity, and plant-soil interactions) are prioritized. Selected species are proposed on how these principles are used in design areas.

Keywords: *Natural species, Lamiaceae, Sage, Thyme, Landscape planning and design*

Peyzaj Tasarım Çalışmalarında Kullanılabilecek Kuraklığa Dayanıklı Lamiaceae Familyasından rnek Bitkiler

zet

Kent alanlarında, bitki seęimi byk lęde estetik ve fonksiyonel zelliklerine gre planlanmakta ve tasarlanmaktadır. Doęal ortamlarda, bitki trlerinin pozitif ve negatif zellikleri dikkate alınarak, ekolojik zelliklere uygun, doęal topluluklar oluřturmak nemlidir. Trler arasındaki ekolojik etkileřimleri kullanan bir tasarım ile doęal bitki trlerinin seęimi, kentsel bağlamda uygulanması, sadece estetik olarak hoř grnmekle kalmaz, aynı zamanda bakım sorunlarını azaltabilir ve bitki performansını ve dayanıklılıęını artırabilir. Tarımsal uygulamalar, bitki ve toprak saęlığını iyileřtirmek, zararlıları engellemek ve kaynak kullanımı ile çeřitlilięi artırmak ięin tr etkileřimlerinin kullanılmasının faydasını uzun zamandır kabul etmiř durumdayız. Ancak, topluluk dzeyindeki bitkisel tasarım faydaları nadiren kentsel bağlamda uygulanmaktadır. Çalışmamda, kentsel ortamlarda doęal trlerin seęimi ve trler arasındaki etkileřimlerden yararlanarak planlama ve tasarım uygulamaları ekoloji srdrlebilirlik aęısından nemli grlmektedir. Bu kapsamda beř temel prensip (Suyun etkin kullanımı, bitki seęimi, uygun tasarım, tr çeřitlilięi ve bitki-toprak etkileřimleri) ilk sırada yer almaktadır. Bu prensiplerin tasarım alanlarında nasıl kullanıldığına dair seęilmiř trler nerilmektedir.

Anahtar Kelimeler: *Doęal trler, Lamiaceae, Adaęayı, Kekik, Peyzaj planlama ve tasarım*

Giriř

Lamiaceae familyası ballıbabagillerdendir. Çatak ve Atalay, 2020 de yaptıkları çalışmada, dnyada Lamiaceae familyasına ait 7000 tr olduęunu bildirmektedirler. İpek ve ark.'nın 2014'de verdikleri bilgilere gre, Lamiaceae familyasından Trkiye'de 45 cins, 546 tr ve 731 takson bulunmaktadır. Tbives 2024 kayıtlarına gre, Niğde ilinde 20 cins 64 tr yetiřmektedir. Genel olarak Trkiye'de var olan lamiaceae familyasına ait trlerin %11.7'si Niğde blgesinde bulunmaktadır. Oran deęerlendirildięinde Niğde kenti ve çevresinin Lamiaceae familyasına ait bitki trleri bakımından zengin bir blgedir.

Lamiaceae familyasına ait bitki cinsleri ve trlerinin bir kısmı tıbbi amaęla ve baharat olarak kullanılmaktadır. Lamiaceae familyasına ait trler, doęal ve çięekli bitkiler olması ve kuraklığa karřı dayanıklılıęları nedeni ile peyzaj tasarım çalışmalarında kullanılabilecek deęerli bitkilerdendir.

Doęa, farklı bitki trlerinin bir araya gelmesinin, belirli bir konumda rastgele bir tr oluřumu olmadıęını gstermiřtir. Kentsel tasarım ve peyzaj uygulamalarında, bitki başarısını etkileyen bazı temel bitki tr



etkileşimleri hakkında bir takım bilgiler vardır. Örneğin, gölge sağlayan ve alt bitki örtüsü için daha serin hava ve toprak yüzeyi sıcaklıkları azaltma etkisi sunan kanopi oluşturan türler önemlidir. Ancak, kentsel yeşillendirme alanındaki mevcut uygulamalar, büyük ölçüde belirli yetiştirme koşullarına uygun olan tür seçimine odaklanmıştır (Köppler ve Hitchmough, 2015).

Kentsel ekosistemler, bitki büyümesi için çeşitli zorluklar sunabilir ve bu nedenle doğal ekosistemler, benzer koşullarda büyüeyebilen bireysel türlerden seçilmelidir. Tür düzeyindeki yaklaşım mevcut durum olmasına rağmen, topluluk düzeyinde bitki seçimi (belirli bitki gruplarına dayalı bitki seçimi), kentsel planlama ve kentsel yeşillendirme için uygun bitki türü seçimi tasarım başarısı açısından çok daha büyük faydalar sağlayabilmektedir. Tasarım uygulamalarında kullanılan malzemeler veya ortamlar, verimliliği artırmak amacıyla tür etkileşimleri ve toplulukların kullanımı ekolojik prensiplere dayanmaktadır. Tür seçiminin sadece tek bitkilerin özelliklerine değil, aynı zamanda istenen özelliklere sahip türlerin bir araya getirilmesiyle ortaya çıkabilecek çevresel koşullara dayanabilecek ve sürekliliği sağlayabilecek tasarımlar gerçekleştirmek temel hedefler arasında yer almaktadır (Brooker ve ark., 2015). Aynı türden çok sayıda bitkinin bir arada bulunması, iki tür yada daha fazla bitki türünün bir arada, karışık veya şerit düzenlenmesinde planlanması; burada her türün birbiri ile uyumu tasarımın gücünü arttırmakta ve verimlilikle sonuçlanmaktadır.

Peyzaj planlama ve tasarım çalışmaları, doğanın sürdürülebilirliğini ve yaşanabilirliğini sağlamak için yapılan çalışmaları kapsamaktadır. Büyük ya da küçük ölçekte yeşil alan oluşturmak, çocuk, yetişkin yaşlı her bireye uygun ortamlar sunmak peyzaj çalışmalarının temel amaçları arasındadır. Kent ortamlarında betonlaşmanın hızla artması yeşil alanların azalmasına neden olmaktadır. Kentsel alanlarda yeşil mekânlar oluşturulması, parklar, sokaklar ve kentsel alanların bahçeleri gibi çeşitli ortamlar için bitki türlerinin seçilmesi ve uygun bitkilerin kullanılması tasarım faaliyetlerinde önemli kriterlerdendir. Günümüzde artan kuraklık, peyzaj bitki türlerini sınırlandırmaktadır. Kuraklığa dayanıklı estetik çekiciliği olan, alan için uygunluğu ve sürekliliği olan bitki türleri, tasarımı yönlendiren ana faktörler olmuştur. Benzer şekilde, bitki türlerinin özellikleri, kentsel alanlarda peyzaj planlama, tasarım ve uygulama aşamasında kuraklığa dayanıklı türlerin seçimine önem verilmektedir. Bu şekilde, tür karışımları veya bitki toplulukları genellikle yalnızca bir türün estetiği veya bir alan için uygunluğuna dayalı olarak tasarlanması ve uygulanması, türlerin birbirleriyle ve kentsel ortamdaki diğer organizmalarla nasıl etkileşimde bulunacaklarına ve belirli sonuçlar üreteceklerine dikkat edilmektedir (Köppler ve Hitchmough, 2015).

Çalışmanın amacı, kuraklığa dayanıklı ve doğal olan bitki türlerinin peyzaj planlama ve tasarım çalışmalarına kazandırmaktır. Tercih edilen bitki türlerinin sürekliliğini sağlamak ve tıbbi değeri olan bitki türlerinin peyzaj planlama ve tasarım çalışmalarında kullanmak hedeflenmektedir. Bu nedenle Niğde kenti ve çevresinde doğal olarak yetişen tıbbi ve görsel değeri olan Lamiaceae familyasına ait bitki türlerinin özellikleri hakkında bilgi verilmektedir.

Materyal ve Metod

Materyal

Araştırma alanı olarak Niğde kenti ve çevresi değerlendirilmiştir. Niğde; İç Anadolu Bölgesinin güneydoğusunda, Kapadokya bölgesinde yer almaktadır. (Şekil 1).

Niğde ili, 37° 57' 47.4768" enlem ve 34° 39' 34.3944" boylamları arasında ve 1.229 m yükseklikte yer almaktadır (Anonim, 2024). Niğde ilinin 7.400 km² yüz ölçümüne sahip olduğu bilinmektedir. 2023 verilerine göre ilin toplam nüfusu 377.080 kişidir ve 2024 yılında tahmini nüfusunun 380.013 kişi olacağı hesaplamalar sonucunda söylenmiştir (Anonim, 2024a). Niğde karasal iklime sahip olup, C5 karesinde yer almaktadır.

Method

Niğde kenti ve çevresinde yetişen bitki türlerinin belirlenmesi için literatür taraması ve gözlemler yapılmıştır. Peyzaj tasarım çalışmalarında kullanımı uygun, kuraklığa dayanıklı, kokulu ve tıbbi değeri olan Lamiaceae familyasında olan doğal türler belirlenmiştir. Çiçekli ve görsel değeri olan bitki türleri çalışmada önerilmiştir. Peyzaj tasarım çalışmalarında, ağaç ve çalı grupları ile kompozisyon oluşturmada vurgu etkisinden yararlanabilmek için gri renkli olan bitki türleri tespit edilerek gerekli modeller kullanılmıştır. Modellemede Autocad 2021, SketchUp Pro 2023, Lumion 10.5 programları kullanılmıştır.





Şekil 1. Niğde İl Sınırı Haritası (Erduran ve Şahin, 2024)

Araştırma Bulguları

Estetik ve ekonomik değeri olan doğal otsu veya çalı formunda olan bitkiler, kentleşmiş ya da kentleşmekte olan bölgelerin yeşil alanlarının ayrılmaz bir parçasıdır, ancak peyzaj mimarları tarafından genellikle göz ardı edilmektedir. Niğde Kenti'nde bitki çeşitliliği, biyolojik ve ekolojik özelliklerine göre farklı bitki türlerinin kullanılması yetersiz veya monoton kalmaktadır. Farklı morfolojik özelliklere sahip estetik değeri olan türlerin kullanılması, geniş bir çevresel faktör yelpazesinde dayanıklı, son derece dekoratif kompozisyonların oluşturulması doğal türlerin kullanım olanaklarını genişletmektedir.

Lamiaceae familyasına ait türler dünyada geniş bir yelpazeye sahiptir. Bu kategoride bulunan doğal bitki türleri ile yapılacak dekoratif tasarım alanları oluşturmak gerekmektedir. Günümüzde, peyzaj düzenlemelerinde standart bitki kullanımı süregelmektedir. Doğal ve ekonomik değeri olan Lamiaceae familyasına ait türler (*Origanum vulgare*, *Salvia caespitosa*, *S. cryptantha* (*S. absconditiflora*), *S. eriophora*, *S. heldreichiana*, *S. hypargeia*, *S. recognita*, *Sideritis libanotica*, *S. phlomoides*, *Thymus sipyleus*) ve özellikleri Çizelge 1'de verilmiştir.

Çizelge 1. Çalışmada Yer Alan Bitkiler ve Özellikleri



Şekil 2. *Origanum vulgare* Bitkisinin çiçekleri



Şekil 3. *Origanum vulgare* Bitkisinin Genel Görünümü

Latince Adı: *Origanum vulgare* alttür *hirtum*

Yapı: Ot

Çiçek rengi : Mor, pembe-beyaz

Toprak özelliği: Geçirgen

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Bol güneş alan alanlarda ve yarı gölgede

Çiçeklenme zamanı: Temmuz

Rakım: 0-2500m

Endemik: Endemik değil

Şekil (2,3)





Şekil 4: *Salvia caespitosa* bitkisinin çiçekleri (Anonim, 2024d)

Latince Adı: *Salvia caespitosa*
Yapı: Odunsu ot
Çiçek rengi: Açık pembe, lila
Toprak özelliği: Kayalık kireç taşı ve volkanik
Koku durumu: Kokulu
Peyzajda Kullanım Alanı: yamaçlar, taraçalar
Çiçeklenme zamanı: Haziran-Temmuz
Rakım: 1400-2400
Endemik: Endemik
(Şekil 4)



Şekil 5. *Salvia cryptantha* (Anonim, 2024e)



Şekil 6. *Salvia cryptantha* Bitkisinin Genel Görünümü (Anonim, 2024e)

Latince Adı: *S. cryptantha*
Yapı: Ot
Çiçek rengi: Pembe beyaz
Toprak özelliği: kayalık kireç taşı ve volkanik
Koku durumu: Kokulu
Peyzajda Kullanım Alanı: yamaçlar, taraçalar
Çiçeklenme zamanı: Mayıs-Temmuz
Rakım: 700-2500m
Endemik: Endemik
(Şekil 5,6)



Şekil 7. *S. eriophora* bitkisi (Anonim, 2024g)

Latince Adı: *S. eriophora*,
Yapı: Ot
Çiçek rengi: Mor-mavi Toprak özelliği: kireçtaşı
yamaçlar
Koku durumu: Kokulu
Peyzajda Kullanım Alanı: Kaya bahçesi
Çiçeklenme zamanı:
Mayıs-Haziran
Rakım: 1525-1880m
Endemik: Endemik





Şekil 8. *Salvia heldreichiana* (Anonim, 2024h)

Latince Adı: *Salvia heldreichiana**

Yapı: Çalı

Çiçek rengi: Mavi-pembe

Toprak özelliği: Kireçtaşı, kumlu killi

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: yamaçlar, hareketli kayalar, tarla kenarları

Çiçeklenme zamanı: Haziran-Ağustos

Rakım: 900-2000m

Endemik: Endemik

(Şekil 8)



Şekil 9. *S. hypargeia*, Bitkisi (Anonim, 2024i))

Latince Adı: *S. hypargeia*,

Yapı: ot

Çiçek rengi: pembemsi mavi eflatun

Toprak özelliği: Geçirgen ve nemli

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Kayalık, yamaçlar

Çiçeklenme zamanı: Haziran-Temmuz

Rakım: 800-2000

Endemik: Endemik

(Şekil 9)



S. recognita



Şekil 10. *S. recognita* Bitkisinin Genel Görüntüsü (Anonim 2024i)

Latince Adı: *S. recognita*

Yapı: Ot

Çiçek rengi: Leylak rengi-pembe

Toprak özelliği: Humuslu, İyi drene edilmiş ve kuru topraklarda

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Taş ve kayalar kireçtaşı ve volkanik yamaçlarda

Çiçeklenme zamanı: Temmuz-Ağustos

Rakım: 900-2200m

Endemik: Endemik

(Şekil 10).





Şekil 11. *Sideritis libanotica alttör linearis* bitkisi (Anonim, 2023)

Latince Adı: *Sideritis libanotica alttör linearis*

Yapı: Ot

Çiçek rengi: Mor-menekşe

Toprak özelliği: Açık, kuru, çimenli ve taşlı çayırlar ve kireçtaşı üzerinde sığ veya aşınmış topraklardaki kayalık alanlar

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: kireçtaşı kayalar ve çakıllı, kuru yamaçlar, bozkır

Çiçeklenme zamanı: Mayıs-Eylül

Rakım: 1100-2800m

Endemik: Endemik

Şekil 11.



Şekil 12. *Salvia phlomoides* Bitkisi (Anonim 2023a).

Latince Adı: *S. phlomoides*

Yapı: Ot

Çiçek rengi: sarı veya leylak renk

Toprak özelliği: Kireççe zengin kumlu-tınlı ve tınlı-kumlu

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Kayalık ve taşlık

Çiçeklenme zamanı: Nisan-Haziran

Rakım: 1800-2550m

Endemik: Endemik

(Şekil 12).



Şekil 13. *Thymus sipyleus* Bitkisinin Genel Görüntüsü Anonim (2015)

Latince Adı: *Thymus sipyleus*

Yapı: Yarı Çalı

Çiçek rengi: Beyaz renkli, bazen pembe

Toprak özelliği: Geçirgen ve nemli toprak

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Kayalık, taşlı, çakıllı kurak yamaç

Çiçeklenme zamanı: Mayıs-Ağustos

Rakım: 400-2700m

Endemik: Endemik değil

(Şekil 13).





Şekil 14. *Salvia suffruticosa* Bitkisi (Anonim, 2012)

Latince Adı: *Salvia suffruticosa*

Yapı: ot

Çiçek rengi: Sarı veya leylak

Toprak özelliği: Kireççe zengin kumlu-tınlı ve tınlı-kumlu

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: bozkırdaki kıyıları, nadas tarlaları, bağlar Çiçeklenme zamanı:

Nisan-Haziran

Rakım: 300-2000m

Endemik: Endemik değil

(Şekil 14).



Şekil 15. *Salvia sclarea* Bitkisi (Anonim, Tarihsiz)

Latince Adı: *Salvia sclarea*

Yapı: Ot

Çiçek rengi: Lila- pembe, açık mor

Toprak özelliği: Geçirgen ve nemli toprak

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: Kayalık volkanik yamaçlara, karışık iğne yapraklı ve yaprak döken korular şist kıyıları Çiçeklenme zamanı:

Mayıs-Ağustos

Rakım: 0-2000m

Endemik: Endemik değil

(Şekil 15).



Şekil 16. *Salvia candidissima* Bitkisi (Anonim, 1986)

Latince Adı: *Salvia candidissima*

Yapı: Ot

Çiçek rengi: beyaz Toprak özelliği: Kumlu-çakıllı

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: yol ve tarla kenarları

Çiçeklenme zamanı: Mayıs-Ağustos

Rakım: 700-2000m

Endemik: Endemik değil

(Şekil 16).





Şekil 17. *S. cyanescens* Bitkisi (Sağda)(Anonim, 2023)

Şekil 18. *Salvia cyanescens* Bitkisinin Çiçekleri (Anonim, 2022)

Latince Adı: *Salvia cyanescens*

Yapı: Ot

Çiçek rengi: Mavi-mor Toprak özelliği: Killi-tınlı

Koku durumu: Kokulu

Peyzajda Kullanım Alanı kireçtaşı ve volkanik yamaçlar, şist kıyıları, *Pinus nigra* ormanları, çakıllı nehir

Çiçeklenme zamanı: Haziran-Ağustos

Rakım: 2300m

Endemik: Endemik

(Şekil 17,18)



Şekil 19. *Salvia dichroantha* Bitkisi (Anonim, tarihsiz)

Latince Adı: *Salvia dichroantha**

Yapı: Ot

Çiçek rengi: Mor

Toprak özelliği: Geçirgen toprak

Koku durumu: Kokulu

Peyzajda Kullanım Alanı: bozkır ormanlardan ağaçsız yerler, nadas tarlaları, yol kenarları

Çiçeklenme zamanı: Temmuz-Eylül

Rakım: 810-1800m

Endemik: Endemik

(Şekil 19).

Çalışmada, lamiaceae familyasına ait adaçayı ve kekik türünden 15 bitki, peyzaj planlama ve tasarım çalışmalarında kullanımının uygun olduğu belirlenmiştir. Çiçek yapıları, çiçeklerin renkleri, ekolojik özellikleri ve kuraklığa dayanıklılık durumuna göre tespit edilen 15 türden 10 adetinin endemik olduğu belirlenmiştir. Endemik olmayan türler; *Origanum vulgare* alttür hirtum, *Thymus sipyleus*, *Salvia suffruticosa*, *Salvia sclarea* ve *Salvia candidissima*'dır.

Thymus sipyleus, *Salvia heldreichiana* ve *Salvia caespitosa* türlerinin yapılarının çalı formunda olduğu belirlenmiştir.

Değerlendirilen türler; kuraklığa dayanıklı ve tıbbi değerinin olması nedeniyle birçok yeşil alanda tercih edilebilir (Şekil 20).

Çoğunun otsu formda olması orta refüj veya kavşak düzenlemelerinde kullanılabilir. Boylarının kısa olması sürücünün görüş alanını etkilemeyecektir. Bu bitkiler, çiçeklenme döneminde arı çekeceği için çocuk oyun alanlarında veya oturma birimlerine yakın mekanlarda kullanılmaması gerekmektedir. Peyzaj tasarım çalışmalarında, bordür sınırlarında, kaya bahçelerinde, kavşak ve orta refüjlerde, otoyol kenarlarında, eğimli alanlarda yer örtücü olarak, doğal mekanlar oluşturmada, renklerinin çoğunun mavi ve mor olması nedeniyle vurgu etkisi oluşturmak amaçları ile kullanılabilir (Şekil 21).





Şekil 20. Seçilen Bitkilerin Yeşil Alanda Kullanımı



Şekil 21. Seçilen bitkilerin bordür Alanlarında (Solda), Kaya bahçesinde (Sağda) Kullanımları

Sonuçlar

Dünya genelinde kültüre alınmış Lamiaceae familyası bitkilerinin tür ve çeşitleri, Niğde kenti için önemli bir potansiyele sahiptir. Lamiaceae familyasından olan bu doğal türler, çeşitlerin korunması ve süreklilik açısından değerli bir kaynaktır ve bu cinsin süs bitkilerinin daha ileri tanım araştırması için temel oluşturmaktadır. Dünyada Lamiaceae familyasının süs bitkisi türlerinin ve çeşitlerinin kullanımı, Niğde Kenti'nin doğal florasındaki dağılımı ve Niğde Kenti'ndeki botanik bahçelerinin koleksiyon fonları üzerine yapılan bilimsel kaynakların analizi temelinde, süs bitkileri olarak tanıtılmasının ana yönleri belirlenmiştir.

Daha önce dekoratif amaçlar için kullanılmamış olan, Niğde Kenti'nin doğal florasından olan araştırma konusu olan bitkilerin ve formların tanıtılması ve araştırılması, çoğu endemik olan listede verilen bitkilerin nitelik ve nicelik özellikleri bakımından yüksek düzeyde çiçekçilikteki dünya trendlerini yansıtan modern çeşitlerin arasına girmeleri mümkün olacaktır.

Teşekkür

Makalemden seçmiş olduğum bitkilerin modellemesinde desteğini esirgemeyen Peyzaj Mimarı Sayın, Emirhan Duran'a sonsuz teşekkürlerimi sunarım.

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Improved Tomato Varieties and Farm Size: Major Determinants of Level of Output of Tomato Crop in Ondo State, Nigeria

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Abstract

The study aimed to evaluate the economic viability and profitability of cultivating improved tomato varieties in Akure North and Ifedore Local Government Areas of Ondo State, Nigeria. Primary data were collected through a well-structured questionnaire, with a sample size of 150 farmers selected using snowball sampling through a multi-stage procedure. Data analysis involved descriptive statistics, farm budgeting techniques, and multiple regression. Findings revealed that 36.7% of farmers were within their active working age. Most of the farmers (71.3%) were female, and 73.3% were married, with an average household size of seven. Around 40.7% of the farmers had higher education (HND/B.Sc.), and 68.7% were members of farming associations. Economic analysis indicated a total cost of N208,374.04 and a net income of N601,625.96, yielding a return on investment (ROI) of 3.89, meaning N2.89 profit for every N1 invested. The study also highlighted that farm size, farming experience, educational level, and agrochemical applications significantly influenced tomato production. Challenges identified included unfavourable climate, theft, price instability, poor seed supply, and inadequate capital. The study recommended government support in providing subsidies and resources for farm expansion and better extension services to ensure a steady supply of improved tomato varieties.

Keywords: *Economic performance, profitability, tomato farming, farm size, constraints, Nigeria*

Introduction

Tomatoes are a vital component of human nutrition due to their rich content of vitamins, minerals, and antioxidants. Their significance in addressing vitamin deficiencies, particularly in regions prone to malnutrition, is widely recognized (USDA Nutrient Database). In Nigeria, tomatoes are a staple food, especially in the preparation of soups and stews, making them essential for daily consumption in households across the country. However, despite their nutritional value, tomato production in many developing countries, including Nigeria, remains challenged by several factors that limit both output and quality (Abdulai et al., 2018; Bidzakin et al., 2018).

Globally, malnutrition remains a significant issue. Between 2010 and 2012, approximately 868 million people suffered from undernourishment, while nearly two billion experienced health issues due to micronutrient deficiencies (FAO, 2012b). In Nigeria, rural communities bear the brunt of these nutritional deficits, with tomatoes playing a pivotal role in combating these problems while simultaneously supporting the rural economy. The introduction of improved tomato varieties offers a promising solution to increase yields, minimize post-harvest losses, and stimulate the development of processing and export industries, thereby contributing to economic growth (Perez et al., 2017).

Adopting improved agricultural technologies, particularly modern seed varieties, has the potential to transform low-productivity, subsistence farming into more commercially viable enterprises, helping to alleviate malnutrition (Awideide et al., 2016). Anang (2019) emphasizes that such technological innovations are particularly vital in developing countries, where smallholder farmers face significant inefficiencies. However, over-reliance on rain-fed agricultural systems and the limited adoption of advanced inputs, such as fertilizers and modern seeds, continue to hamper tomato productivity (McMichael, 2013). Approximately 90% of African farmers still rely on local seed varieties, which are often of poor quality, limiting both yield and market value (Mohiuddin et al., 2007).

Improving tomato productivity in Nigeria will require institutional changes, such as reforms in land tenure systems and enhanced access to agricultural inputs and credit. It also depends on increasing farmers' adoption of improved technologies (Donkoh et al., 2013). Despite the potential economic benefits of improved tomato production, many farmers remain hesitant to invest in this area, particularly in southwestern Nigeria, where Hausa migrants, known locally as "Kanawa," dominate the off-season production (Ahmed & Anang, 2019).

This study, therefore, seeks to conduct an economic analysis of the production of improved tomato varieties in Akure North and Ifedore Local Government Areas of Ondo State. The specific objectives include examining the socio-economic characteristics of tomato farmers, determining the profitability of improved tomato production, analyzing the factors affecting production, and identifying the key constraints faced by farmers.



Methodology

This study was conducted in Akure North and Ifedore Local Government Areas (LGAs) of Ondo State, Nigeria, known as the "Sunshine State." Akure North LGA includes five key communities: Iju, Ita-Ogbolu, Oba-Ile, Igoba, and Ogbese. These communities are situated between latitudes 5°45' and 7°52'N, and longitudes 4°20' and 6°05'E, with a population of approximately 198,000. The area's vegetation is predominantly rainforest, characterized by dense trees and grasses. Major economic activities in Akure North include fishing and the cultivation of food and tree crops, such as cocoa, rubber, oil palm, and cashew. Farming and trading are the principal occupations of residents.

Ifedore LGA, one of the 18 LGAs in Ondo State, has its headquarters in Igbara-Oke and is bounded to the north and east by Akure South LGA, to the south by Osun State, and to the west by Ekiti State. The area lies within longitude 4.89°E and latitude 6.89°N, covering approximately 295 km². According to the 2006 census, Ifedore had a population of 176,327. The LGA includes major towns such as Igbara-Oke, Ijare, Ilara, Ipogun, Ibule, Isarun, Erigi, and Obo. The presence of Elizade University is also notable in the area.

Primary data were collected for this study using structured questionnaires. A multi-stage sampling technique was employed. In the first stage, Akure North and Ifedore LGAs were purposively selected due to the concentration of farmers growing improved tomato varieties. In the second stage, five communities were randomly selected from each of the two LGAs. In the third stage, 15 tomato farmers were randomly selected from each community using a snowball sampling method, resulting in a total sample size of 150 respondents.

Data were analyzed using descriptive statistics, farm budgeting, and multiple regression analysis. Descriptive statistics, including frequency and percentage, were used to summarize the socio-economic characteristics of respondents, such as age, gender, marital status, and household size, as well as to identify challenges faced by farmers. The budgeting technique was employed to assess the profitability of improved tomato varieties production.

Model Specification

Budgeting techniques involved the method of calculating gross margin, profit and Return on Investment (ROI) of improved varieties of tomato production in the study area. It is expressed as follows:

Net Revenue (NR)= TR - TC

Where:

NR = Net Revenue or Profit of Improved varieties of Tomatoes Enterprise

TR= Total Revenue of Improved varieties of Tomatoes production

TC= Total Cost income on Improved varieties of Tomatoes production

Return on Investment (ROI) = TR/TC

Total cost (TC) = Total Variable Cost (TVC) + Total Fixed Cost (TFC)

Total revenue (TR) = Output (Q) x Per Unit Price (P)

Profit = Total revenue - Total cost

Gross margin = Total revenue - Total variable cost

Return on Investment = Total revenue\ Total cost

The multiple regression analysis was used to identify the factors affecting improved tomatoes varieties production in the study area. The regression model in implicit form is given as:

$Y = F(X_1, X_2, X_3, X_4, X_5, \dots, U)$

Where Y = Output of Improved varieties of Tomatoes (naira)

X1= Farm Size (ha)

X2= Agro-Chemical (litre)

X3= Farming experience(years)

X4= Labour Cost (naira)

X5= Age of farmers (years)

X6= Level of education (years)

UI= Error term.

The following functional forms were estimated for the production function and the one that best satisfies the theoretical, statistical and econometric criteria for a production function was selected as lead equation. The functional forms that were estimated were: Linear, semi-log, double log and exponential.

Explicitly, the models were expressed as follows:



Linear function:

$$Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i$$

Semi-Log:

$$Y_i = b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6 + U_i$$

Exponentials:

$$\log Y_i = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + U_i$$

Double log

$$\log Y_i = b_0 + b_1\log X_1 + b_2\log X_2 + b_3\log X_3 + b_4\log X_4 + b_5\log X_5 + b_6\log X_6 + U_i$$

Results and Discussion

Socio-economic Characteristics of the Respondents

Gender plays a significant role in agricultural activities, with both men and women having specific responsibilities in farm labor. These roles vary by country and ecological zone. The findings show that 28.7% of the respondents were male, while 71.3% were female. This suggests that tomato production in the study area is largely female-dominated, likely because men are more involved in cash crop farming, which is generally more lucrative. This aligns with the findings of Karim (2012), who noted that some agricultural activities are more suited to one gender than the other, with tomato production being more commonly handled by women. The age distribution of the respondents indicated that the majority (36.7%) of farmers were between 31 and 40 years old, while 27.3% were aged 51 and above. This suggests that most farmers are within their productive years, which is expected to result in higher output. This finding is consistent with Ogunjimi et al. (2012), who reported that most Nigerian farmers fall within the productive age range. Table 1 reveals that 17.3% of the respondents were single, 73.3% were married, and 9.3% were widowed. The high proportion of married women actively engaged in tomato farming supports Ajayi's (2013) findings, which suggest that married women tend to focus more on their businesses to provide for their families. The study also showed that 34.7% of respondents had a household size of 1-5 members, while 55.3% had a household size of 6-10 members. A large household size may provide a labour advantage, as suggested by Afolami (2013), who found that larger households tend to achieve higher profits in tomato production, helping them meet basic family needs. The education level of the respondents showed that 40.7% had an HND or B.Sc. degree, while only 4% had no formal education. This indicates a relatively high level of literacy among farmers, which could facilitate the adoption of improved farming techniques and a better understanding of agricultural inputs such as fertilizers and chemicals. The majority (80.7%) of respondents cultivated tomatoes on small plots of land, ranging from 1-5 plots (648 square meters per plot). Only 18.7% had farms of 6-10 plots. This suggests that most farmers operate on small holdings due to limited financial resources, aligning with Samson's (2011) observation that farm size significantly affects the amount of farm produce. The farming experience of respondents indicated that 44.7% had been engaged in tomato farming for 1-5 years, 32.7% for 6-10 years, and 22.7% for over 11 years. Farmers with less experience are generally more open to adopting new technologies, which can enhance productivity and efficiency in tomato farming.

Improved Tomatoes Varieties in the Study Area

Table 2 showed that 12.7% of the respondents were into the production of cherry tomatoes, 3.3% are into beefsteak tomatoes production, 14.0% are into grape tomatoes production, 11.3% are into plum tomatoes production, 4.7% are into patio tomatoes production, .7% are into campari tomatoes production, 1.3% are into branfywine tomatoes production while 52.0% of the respondents are into UTC tomatoes production. This result shows that majority (52.0%) of the respondents are into UTC tomatoes production in the study area. This may be due to the high yield in production. Also, UTC tomatoes do not decay or get sour easily after harvest for long periods of time, and UTC tomatoes variety is good for tomatoes paste because it is a reddish fleshy tomato with stripes of yellow and low water content.

Costs and Returns

The incurred cost items for the improved tomato varieties production were fixed and variable costs. The fixed cost included expenditure on hoe, cutlass, knapsack, wheelbarrow and rent on land. The variable cost involved expenses on labour, transportation, herbicides, fertilizer and seed. The average income from improved tomato varieties production in Akure North and Ifedore Local Government Area of Ondo State was estimated as N625,446.43. while the total average variable cost was N184,533.57, given a total fixed cost of N23,820.47, in which straight line



method of depreciation schedule was used. The average total cost was N208,374.04, with net income of N601,625.96. The return on investment (ROI) of 3.89 suggests that every N1 invested in tomato production will yield an additional income of N3.80k. This clearly, indicated that tomato production enterprise is profitable in the study area.

Table1. Socio-economic Characteristics of the Respondents

Gender	Frequency	Percentage	Mean
Male	43	28.7	
Female	107	71.3	
Marital Status			
Single	26	17.3	
Married	110	73.3	
Widowed	14	9.3	
Age			
20-30	21	14.0	
31-40	55	36.7	
41-50	33	22.0	
51-60	41	27.3	
Educational Status			
No formal	6	4.0	
Primary	51	34.0	
Secondary	20	13.3	
HND/B.SC	61	40.7	
Postgraduate	12	8.0	
Household Size			
1-5	52	34.7	
6-10	83	55.3	
11-15	15	10.0	
Experience (years)			
1-5	67	44.7	
6-10	49	32.7	
11 years and above	34	22.7	
Farm Size (plots)			
1-5	121	80.7	
6-10	28	18.7	1.5
11-15	1	7	
Total	150	100.0	

Source: Field Survey,2023

Table 2. Popular Types of Improved Tomatoes Varieties in the Study Area

Tomatoes	Frequency	Percentage
Cherry Tomatoes	19	12.7
Beefsteak tomatoes	5	3.3
Grape tomatoes	21	14.0
Plum tomatoes	17	11.3
Patio tomatoes	7	4.7
Campari tomatoes	1	.7
Branfywine tomatoes	2	1.3
UTC	78	52.0
Total	150	100.0

Source: field survey 2023

Factors that Affect the Production of Improved Tomato Varieties in the Study Area

The table presents the results of a regression analysis on factors affecting the production of improved tomato varieties. The model's constant is statistically significant with a coefficient of 18.259 and a p-value of 0.009, indicating the baseline level of production when all other variables are held constant. Farm size is positively correlated with tomato production, with a coefficient of 0.391 and a p-value of 0.014, suggesting that larger farm sizes significantly contribute to higher production. Similarly, the use of agrochemicals has a strong positive effect on production, as indicated by a coefficient of 0.341 and a highly significant p-value of 0.005.



Farming experience also shows a positive impact on production, with a coefficient of 0.500 and a p-value of 0.040, implying that farmers with more years of experience tend to achieve better yields in tomato production. However, labour costs and the age of farmers do not significantly affect production, as reflected by their respective p-values of 0.239 and 0.647, showing no meaningful statistical relationship with production. Education level, however, plays a crucial role, with a coefficient of 0.287 and a p-value of 0.000, indicating that higher educational attainment significantly boosts tomato production, likely due to better understanding and adoption of improved farming techniques. The model's R-value of 0.949 suggests a very strong correlation between the independent variables and tomato production. The R-squared value of 0.949 means that 94.9% of the variation in tomato production is explained by the model, and the adjusted R-squared value of 0.867 confirms the model's high predictive power even when adjusted for the number of predictors.

Table 3. Cost Structure and Returns of Improve Tomatoes Varieties Production

Items	Average	Percentage
Fixed Cost	Value in (N)	
Land	13,333.33	11.5
Hoe	2,500	0.3
Cutlass	3,857.14	0.3
Knapsack	1,133.33	1.9
Wheelbarrow	2,146.67	2.0
Basket	850	0.3
Total Fixed Cost (TFC)	23,820.47	15.4
Labour		
Planting, Harvesting, Weeding	30,125	17.5
Variable Cost		
Transportation	75,000	24.5
Herbicides	16,071.43	10.5
Fertilizer	42,857.14	20.1
Seed	20,500	12.0
Total Variable Cost	184,553.57	84.6
Total cost TFC+TVC	208,374.04	100.0
Total Revenue= Qty*price	810,000	
Gross Margin=TR-TVC	625,446.43	
Net Farm Income NFI=(TR-TC)	601,625.96	
Return on investment=TR/TC	3.89	

Table 4: Results Showing the Factors Affecting the Production of Improved Tomato Varieties Production.

Variable	Coefficient	Standard error	p-value
Constant	18.259	3.015	.009
farm size	0.391**	0.015	.000
Agrochemicals	0.341***	0.092	.005
farming experience	0.500**	0.242	.040
labour cost	-0.500	0.432	.239
Age of farmers	-0.206	0.406	.647
level of education	0.287***	0.036	.000
R	.949a		
R square	0.9		
Adjusted R square	0.867		

Source: Data analysis, 2023

Constraint militating improved tomato varieties production in the study area

Table 5 shows that farmers in the study area were faced with a lot of challenges. These major challenges were highlighted and ranked. The result revealed that unfavourable climatic condition was the major constraint in the study area followed by the incidence of pilfering and theft. This implies that favourable climatic conditions will enhance the level of output of the crop in the study area. Instability of price ranked third while the poor supply of tomato seeds was ranked the fourth major constraint. The findings have revealed that the availability of improved tomato varieties is one of the major factors that determine the level of output of the crop. Therefore, improved tomato varieties seed should be supplied to tomato farmers at a subsidized rate to increase the level of output. Inadequate capital was ranked the fifth major challenge militating the tomato farmers in the study area, this is as a result of challenges faced in accessing credit. Inadequate market information and storage facilities with the incidence of pests and diseases were ranked sixth, seventh, eighth constraint respectively.



Table 5. Constraints militating improved varieties of tomatoes production

S/N	Constraint	Very serious		erious		ild		ot at all		Mean	Rank
		F	%	F	%	F	%	F	%		
1	Unfavorable climatic condition	57	38.0	53	35.3	27	18.0	13	8.7	1.97	1st
2	Incidence of pilfering and theft	61	40.7	49	32.0	26	17.3	14	9.3	1.95	2nd
3	Instability of price	62	41.3	53	35.3	25	16.7	10	6.7	1.89	3rd
4	Poor supply of tomatoes seeds	60	40.0	54	36.0	28	18.7	8	5.3	1.89	3rd
5	Inadequate capital	66	44	52	34.7	24	16.0	8	5.3	1.83	5th
6	Inadequate market information	71	47.3	48	32.0	21	14.0	10	6.7	1.80	6th
7	Storage facility	77	51.3	44	29.3	19	12.7	10	6.7	1.75	7th
8	Incidence of pest and disease	77	51.3	50	33.3	11	7.3	12	8.0	1.72	8th

Source: Computed from Field survey, 2023

Conclusion

Tomato production was found to be a profitable enterprise in the study area because it recorded a Net Farm Income of N601,625.96 and a return on investment of 3.89 which implies that for every one naira spent in tomato production a profit of N2.89 kobo is realized. This study has also revealed that farm size was significantly related to the level of tomato output. Farmers and younger people are encouraged to invest in tomato production as it is a profitable enterprise in the study area. Therefore, it is recommended among others, that government should assist farmers with loans and resources to expand farm size to boost the production of tomatoes. Extension services should be rendered to boost the supply of improved tomato varieties to the farmers.

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The Effect of Organic Acids Addition to the Diets on Fattening Performance of the Awassi

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Abstract

In this study, it was aimed to investigate the effect of formic acid and malic acid supplementation on performance of Awassi lambs fed with finishing diet. In the study, 36 heads male Awassi breed aged 3 months old. lambs were used. The animals were divided into 4 groups, one control and the other three experimental groups (each group consisted of 3 subgroups containing 3 animals and a total of 9 animals) considering their weight, so that there would be no statistically significant difference between the groups. No additives were added to the concentrate feed of the control group, and three experimental diets were prepared by adding 1.5g/kg formic acid, 4g/kg malic acid and 1.5g/kg formic acid + 4g/kg malic acid to the diets of the experimental groups, respectively. Animals were fattened for 56 days. During the trial, care was taken to ensure that the animals had constant access to clean drinking water and were fed adlibitum with concentrated feed and hay. Live weight of lambs during fattening period was determined by weighing on an empty stomach on the 0th, 14th, 28th, 42nd and 56th days of the experiment. While daily live weight gain and feed conversion was the highest in formic acid group ($p<0.05$), no significant difference was observed between the groups in terms of body weight and feed consumption ($p>0.05$). In conclusion, the addition of formic acid to the diet of lambs had a positive effects on performance of lambs. However, malic acid supplementation did not show any effect on performance on fattening performance.

Key Words: Awassi lamb, fattening performance, formic acid, malik acid, organic acid

İvesi Kuzularının Rasyonlarına İlave Edilen Organik Asitlerin Besi Performansı Üzerine Etkisi

Özet

Bu çalışmada, konsantre yemle beslenen İvesi kuzularda yeme formik asit ve malik asit ilavesinin performans üzerine etkisinin araştırılması amaçlanmıştır. Bu çalışmada 3 aylık yaşta sütten kesilmiş 36 baş İvesi kuzu kullanılmıştır. Hayvanların canlı ağırlıklarına bakılarak, gruplar arasında biri kontrol, diğer üç grup deneme olmak üzere 4 gruba ayrılmıştır. Deneme gruplarının rasyonlarına sırasıyla 1,5g/kg formik asit, 4g/kg malik asit ve 1,5g/kg formik asit + 4g/kg malik asit ilave edilmiş ve kontrol grubuna organik asit ilave edilmeyerek deneme yemleri hazırlanmıştır. Hayvanlar bir haftalık alıştırmaya dönemi sonrası 56 gün besiye alınmıştır. Deneme boyunca hayvanların önünde temiz içme suyu bulundurulmuş ve kuzular konsantre yem ile adlibitum olarak beslenmişlerdir. Deneme boyunca kuzuların canlı ağırlıkları denemenin 0, 14, 28, 42 ve 56. günlerinde sabah aç karnına yapılan tartımlarla saptanmıştır. Kuzulara verilen yemler her gün, kalan yemler ise ertesi gün sabah tartılmıştır. Günlük canlı ağırlık, yemden yararlanma oranı formik asit grubunda en yüksek bulunurken, canlı ağırlık ve yem tüketiminde gruplar arasında istatistik anlamda önemli bir fark gözlenmemiştir ($p>0,05$). Çalışmada sonuç olarak konsantre yeme formik asit ilavesi kuzu performansı üzerine olumlu etkileri önemli bulunmuştur. Malik asit ilavesi performans üzerine bir etki göstermediği tespit edilmiştir.

Anahtar kelimeler: Besi performansı, formik asit, ivesi kuzu, malik asit, organik asit





Genomic analysis, evolution, and functional profiling of GASA family genes revealed their conserved role in enhancing growth and development in cabbage

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Abstract

Gibberellic acid stimulated arabidopsis (GASA) gene family play an important role in plant growth and development. However, little information is available on these cysteine-rich short proteins in different plant species. This is the first comprehensive strategy to use available genomic data to explore the GASA gene family in *B.oleracea*. GASA proteins regulate several developmental processes, including organ growth, cell division, fruit ripening, bud dormancy, stem development, blooming time, and seed generation. The gene structure, promoter region, expression and phylogenetics of all BoGASAs were analyzed. This study reported fifteen different members of the BoGASA gene family, which were mapped onto five chromosomes. The phylogenetic and sequence composition analysis incorporating GASA members from Arabidopsis, sunflower, peanut, soybean and cabbage distributed the fifteen identified BoGASA genes into five well-conserved subgroups. A conserved GASA domain was found in all identified BoGASA genes and exhibited similar characteristics. The cis-acting element analysis implied that cabbage GASA genes contained many cis-elements associated with hormone, Light and growth response. To check the expression of BoGASA genes towards cuticular wax biosynthesis, the two types of *B.oleracea*: the wild type and the glossy mutant (nwgl) were comparatively analysed. Expression profile analysis derived from transcriptome data showed that the genes BoGASA1, BoGASA2, BoGASA12 were upregulated from the wild-type to mutant type, while the expression of other genes showed downregulation. The BoGASA2 showed maximum upregulation while BoGASA5 showed maximum downregulation from wild to mutant variety.

Keywords: GIBBERELIC-ACID STIMULATED ARABIDOPSIS (GASA); gene expression; genome wide; chromosomal mapping



Evaluating the efficacy of natural deep eutectic solvents in biocontrol of *Alternaria alternata*

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Abstract

The excessive and widespread use of synthetic fungicides has raised numerous environmental and health-related concerns. In response, there has been a growing global interest in the use of natural plant-derived products for plant protection. A promising area of research in this field is the development of natural deep eutectic solvents (NADES). These solvents, composed of natural compounds, offer a sustainable alternative for extracting bioactive compounds from plants, thereby enhancing the effectiveness of natural pesticides and antimicrobial agents. This study aimed to evaluate the efficacy (E%) of different NADES based on menthol, thymol, and camphor. Antifungal activity was tested against *Alternaria alternata*. Due to volatility of terpenoids, the experiment was conducted in the vapour phase in Petri plates. The incubation lasted seven days at 26 ± 1 degree Celsius, with the plates sealed and covered with parafilm. At the end of the experiment (7th day), the diameter of *A. alternata* mycelium was measured, and the inhibition percentage was calculated into E%. Among the menthol-based NADES, Menthol:Thymol stood out with an E% ranging from 58-100%, while for the thymol-based NADES, Thymol:Caprylic acid achieved an inhibition of 52-100%. However, the camphor-based NADES did not reach 100% efficacy. Such studies are crucial for selecting NADES that could be used for the biocontrol of *A. alternata*, offering a potentially sustainable alternative to synthetic fungicides.

Key Words: HDES, menthol, thymol, camphor



Investigation of Herd Management, Production and Socio-Economic Status of Dairy Cattle Farms Using Robotic Milking System and Traditional Milking System: Konya Province (Çumra, Ereğli and Karapınar districts)

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Abstract

The aim of this survey study was to evaluate the (i) herd management, (ii) production and (iii) socio-economic status of dairy cattle farms producing with robotic milking system (RMS) and conventional milking system (CMS) in Konya province (Çumra, Ereğli and Karapınar). In the study, survey data conducted with farm owners in dairy farms were used. No statistical comparison was performed in the available data, and mean and frequency values were given. It was determined that the livestock farming experience of RMS and CMS farm owners was 17.3 and 19.5 years, respectively. It was determined that concentrated feed was offered during milking in farms with RSS (4 kg/day), while no feeding was offered during milking in farms with CMS. In addition, the average number of milkings per day in farms with RMS and CMS were 4.25 and 2.75. In addition, it was determined that there was no use of labor in milking in farms with RMS. While 75% of RMS farm owners stated the acclimation period of primiparous cows to milking as 7 d, 100% of CMS farm owners stated this period as 2 d. While the mastitis cases observed in cows were determined by the robot based on the electrical conductivity parameter in farms with RSS, they were determined by the farmers' own observational assessments in farms with CMS. Before RSS, 50% of farmers stated that they used the rapid exit milking system. In addition, RMS farm owners stated that they have 1 or 2 robot units on their farms and that a single robot unit can milk approximately 66 cows. Farmers emphasized that the average cost of RSS in the first year of installation was approximately 242 500.00 €. As a result, all farmers using RMS emphasized that they were satisfied with the system because it reduced the labor force in some milking protocols. However, due to the high installation cost of the system, its economic efficiency should be carefully investigated.

Key Words: Dairy cattle, Robotic milking system, Traditional milking system, Management, Production

Robotik Sağım Sistemi ve Geleneksel Sağım Sistemi Kullanan Süt Sığırcı Çiftliklerinin Sürü Yönetimi, Üretim ve Sosyo-Ekonomik Durumlarının İncelenmesi: Konya İli (Çumra, Ereğli ve Karapınar ilçeleri)

Özet

Bu anket çalışmasında Konya ilindeki (Çumra, Ereğli ve Karapınar ilçeleri) robotik sağım sistemi (RSS) ve geleneksel sağım sistemi (GSS) ile üretim yapan süt sığırcı çiftliklerinin (i) sürü yönetimi, (ii) üretim ve (iii) sosyo-ekonomik durumlarının değerlendirilmesi amaçlanmıştır. Çalışmada, sığırcı çiftliklerindeki işletme sahipleri ile yüz yüze yapılan anket verisi kullanılmıştır. Mevcut veride herhangi bir istatistiki karşılaştırma yapılmamış olup, ortalama ve frekans değerleri verilmiştir. RSS ve GSS 'li çiftlik sahiplerinin hayvancılık tecrübelerinin sırasıyla 17.3 ve 19.5 yıl olduğu tespit edilmiştir. RSS'li çiftliklerde sağım sırasında kesif yem verilirken (4 kg/gün), GSS'li çiftliklerde sağım sırasında yemleme yapılmadığı belirlenmiştir. Ayrıca, RSS ve GSS li çiftliklerde günlük yapılan ortalama sağım sayısı 4.25 ve 2.75'tir. Ayrıca, RSS'li çiftliklerde sağımda iş gücü kullanımının olmadığı belirlenmiştir. İlk doğumunu yapan ineklerin sağıma alışma süresini RSS'li çiftlik sahiplerinin %75'i 7 gün olarak ifade ederken, GSS'li çiftlik sahiplerinin %100'ü bu süreyi 2 gün olarak belirtti. İneklerde gözlemlenen mastitis vakaları RSS'li çiftliklerde robot tarafından elektriksel iletkenlik parametresinin esas olarak tespit edilirken, GSS'li çiftliklerde çiftçilerin kendi gözlemsel değerlendirmeleri ile belirlenmektedir. RSS' den önce çiftçilerin %50'si hızlı çıkış sağım sistemini kullandığını ifade etti. Ayrıca, RSS'li çiftlik sahipleri çiftliğinde 1 veya 2 adet robot ünitesinin bulundurduğunu ve tek bir robot ünitesinin yaklaşık 66 baş ineğin sağımını gerçekleştirebildiğini belirtmiştir. Çiftçiler RSS'nin ilk kuruluş yılındaki ortalama maliyetinin ise yaklaşık 242 500,00 € olduğu vurgulamışlardır. Sonuç olarak, bazı sağım protokollerindeki iş gücünü azaltmasından dolayı, RSS kullanan çiftçilerin tamamı sistemden memnun olduğunu vurgulamışlardır. Ancak sistemin kurulum maliyetinin yüksek olmasından dolayı, ekonomik etkinliğinin dikkatle araştırılması gerekmektedir.

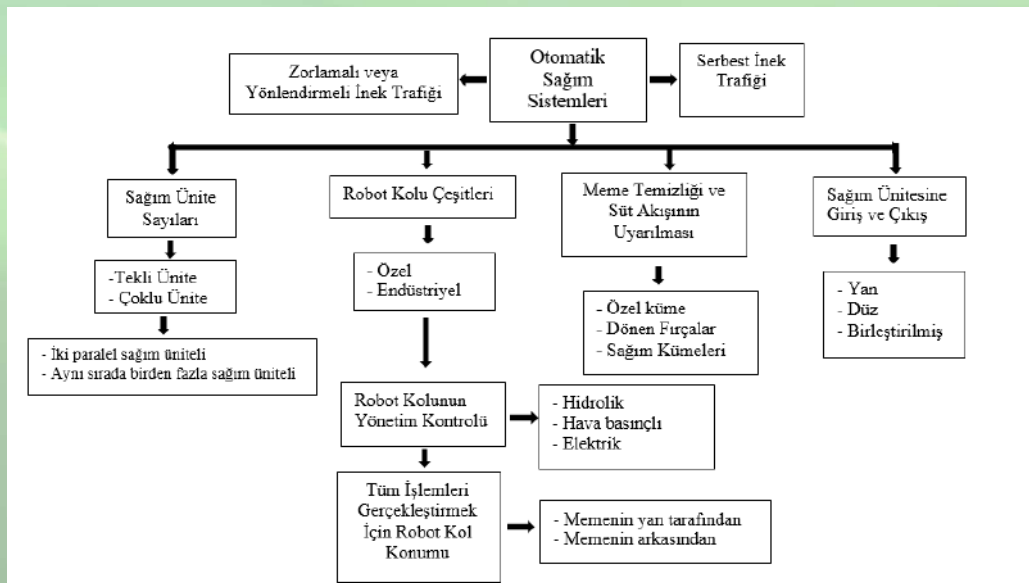
Anahtar Kelimeler: Süt sığırcı, Robotik sağım sistemi, Geleneksel Sağım sistemi, Yönetim, Üretim



Giriş

Süt çiftlikleri özellikle sürü yönetiminin önemli bir bileşeni olan sağım protokollerinin etkili şekilde yönetildiği bir standart çalışma modelini oluşturamaz ise meydana gelebilecek üretim kayıplarına bağlı olarak karlılık ve sürdürülebilirlik önemli düzeyde etkilenebilmektedir. Bu bakımdan, sağım odaları ve/veya üniteleri her süt çiftliklerinin genel olarak yönetim uygulamalarının merkezinde yer almaktadır. Süt endüstrisinde kullanılan sağım sistemleri, genellikle çiftliğin üretim modeline, sürü kapasitesi ve imkanlarına göre değişiklik göstermekte olup, portatif sağım makineleri, kilit arkası, balık kılıcı, paralel ve dönerli (rotary) gibi geleneksel sağım sistemleridir (GSS). Bununla birlikte, dünyada devam eden teknolojik gelişmelerin etkisiyle otomasyon ve/veya hassas hayvancılık teknolojilerinin kullanımı hızla artmış ve bir dizi araştırmaya çalışmalarının sonucunda otomatik sağım sağım sistemlerinin veya robotic sağım sistemlerinin (RSS) gelişmesine yol açmıştır. RSS'li sağım 1990 yılından önce ar – ge çalışmaları [bazı batı avrupa ülkelerindeki (Hollanda ve İngiltere) bazı kurumlarda] düzeyinde geliştirilmiş olup, bir dizi değişiklikler ve/veya iyileştirmelerden sonra nihai üretim uygulamaları 1992 yılında İngiltere'de çiftçilere sunulan sağım robotlarıyla gerçekleştirilmeye başlanmıştır (Sharipov ve ark., 2021; Kuraloğlu, 2022). Dünya genelinde RSS'nin tanıtımının yaygınlaşmasıyla birlikte, sistemin kullanım alanı her yıl büyümektedir. Dünyada 60 binden fazla bu türde system olduğu tahmin edilmektedir (Zagidullin ve ark., 2023). Bu sistemlerin hızla çiftçiler tarafından benimsenmesi i) entansifleşme sürecinin hızlanması, ii) sürü büyüklüklerinin artması, iii) iş gücündeki artan sorunlar ve iv) sağımla ilgili çiftlik personelinin hatalarını ve/veya ihmallerini de en aza indirmesinden dolayıdır (Cogato ve ark., 2021; İlhan ve ark., 2022). Ayrıca, süt çiftliklerinde RSS sistemlerinin sürü yönetim uygulamalarıyla birlikte entegre edilmesi sürü yönetimi, süt üretimi, sağım, yem dağıtımı, sağlık ve refah kriterlerinin değerlendirmesinin, yanı sıra çeşitli izleme ve kontrol uygulamalarının sürdürülebilirliğini de kolaylaştırmaktadır. Norveç'te süt sığırları üzerinde yapılan araştırmada, araştırmacılar, üreticilerin robotik sağım sistemini (RSS) kullanmalarının temel nedeninin, onlara daha esnek bir zaman sağlaması ve iş gücü kullanımını azaltması olduğunu vurgulamışlardır (Hansen, 2015). Benzer şekilde, yapılan diğer çalışmalarda da RSS'li sağımın üreticilere i) yüksek ortalama sağım sıklığının artışına bağlı süt üretimi, ii) optimum sürü sağlığı ve fertilité düzeyi, iii) bilgi toplama ve iyi sürü yönetimi potansiyeli, iv) daha az iş gücü ihtiyacı ve artan işgücü esnekliği ve v) çiftlik sahipleri için daha yüksek karlılık ve yaşam kalitesi sunduğu rapor edilmiştir (Tse ve ark., 2017; Tse ve ark., 2018).

RSS ineklerin sağım sürecini etkileyen tasarım özelliklerine ve temel ayırt edici özelliklere göre sınıflandırılmaktadır (Şekil 1). RSS' li sistemlerin çalışma prensibinde temel kural, ineklerin trafik yönünü gözlemlemektir. Bu sistemlerde ineklerin trafik yönü zorunlu (rehberli veya yönlendirmeli) ve serbest (gönüllü) olmak üzere iki yolu bulunmaktadır. İlk trafik yönün (rehberli veya yönlendirmeli trafik) kullanımında sistem barınağı yatma, sağım ve beslenme alanlarına ayıracak şekilde dizayn edilmiştir. İneğin dinlendiği veya yattığı yerden besleme bölümüne (yem yoluna) geçişi ancak sağım alanından geçtikten sonra yeme erişebilecekleri şekilde tasarlanmıştır. Bu sistem ineklere istedikleri zaman yeme erişim sağlamakta olup, son sağımdan bu yana ne kadar zaman geçtiğine bağlı olarak, sistem hayvanları belirli alana yönlendirir. Rehberli (yönlendirmeli) trafikten farklı olarak, serbest veya gönüllü trafikte sahip sistemde ise ineklerin sağım ünitesine varmasını kolaylaştırmak için besleme alanına erişim serbesttir.



Şekil 1. Otomatik sağım sistemlerinin sınıflandırılması (Sharipov ve ark., 2021).



RSS kullanımı tıpkı bazı Avrupa ülkelerinde (Hollanda, İngiltere, Almanya ve Fransa) hızla yaygınlaşırken, ülkemiz koşullarında bu sistemlerin kullanımının henüz sınırlı düzeyde olması, RSS'nin geleneksel sağım sistemlerine göre avantaj ve dezavantajlarının üreticiler tarafından tam olarak bilinmemesidir (Örs ve Oğuz, 2016; Örs ve Oğuz, 2018). Bu durum RSS'li sağım uygulamalarının yaygınlaşması ve benimsenmesini geciktirmektedir (Kuruloğlu, 2022). Ancak, ülkemiz koşullarındaki süt üreticilerinin de hayvanlarının genetik potansiyellerini sürü düzeyinden ziyade bireysel olarak her bir ineğin tüm potansiyelinin keşfedilmesi bakımından RSS'nin yaygınlaşması önem arz etmektedir.

Bildiğimiz kadarıyla ülkemiz koşullarında son bir kaç yıldır RSS kullanan çiftlik sayısında kısmen bir artış gözlenirse, halen GSS'li sağım yapan çiftlik sayısı oldukça yüksektir. Akar Çıkrıkcı (2019) ülkemiz koşullarında 2019 yılı itibarıyla 71 çiftliğin RSS'li sağım yaptığını ve bu çiftliklerin 13'ünün iç Anadolu bölgesinde olduğunu belirtmiştir. Ancak, bu çiftliklerin sürü yönetim uygulamaları, üretim ve ve sosyo-ekonomik durumları ile ilgili oldukça sınırlı düzeydedir. Bu bakımdan özellikle RSS'li sağım yapan çiftlikler ile ilgili çok sayıda detaylı çalışmalara ihtiyaç vardır. Bu çalışmada Konya ilinin Çumra, Ereğli ve Karapınar ilçelerindeki RSS ve GSS ile sağım yapan çiftliklerdeki (i) sürü yönetimi, (ii) üretim ve (iii) sosyo-ekonomik durumlarının değerlendirilmesi amaçlanmıştır.

Materyal ve Yöntem

Bu çalışma, Türkiye'nin yüz ölçümü bakımından en büyük ili olan Konya (38.873 km²)'da gerçekleştirilmiştir. Konya ili 36° 14' ve 39° 16' kuzey enlemleri ile 31° 14' ve 34° 26' doğu boylamları arasında yer almakta olup, bu ilimizin 31 ilçesi bulunmaktadır (Bağcı, 2020). Mevcut çalışma, Konya ilindeki Çumra, Ereğli ve Karapınar ilçelerini kapsamaktadır.

Çalışmayı kapsayan ilçelerdeki tüm RSS kullanan çiftliklerde (4 çiftlik) tam sayım yöntemine anket yapılmış olup, buna karşın 4 GSS kullanan çiftlik çalışmaya dahil edilmiştir. Çalışmada, sığırı çiftliklerindeki işletme sahipleri ile yüz yüze yapılan anket verisi kullanılmıştır. Mevcut veriler çiftçilerin beyanlarına bağlı olarak kaydedilmiştir. Elde edilen veride herhangi bir istatistiki karşılaştırma yapılmamış olup, ortalama ve frekans değerleri verilmiştir. Ortalama ve frekans değerleri SPSS paket programı ile belirlenmiştir.

Bulgular ve Tartışma

Mevcut çalışmada, RSS ve GSS kullanan çiftlikleri yaş ortalamaları sırasıyla, 50.3 ve 52 olarak belirlendi (Tablo 1). Lage, ve ark. (2024) RSS'li sistem kullanan çiftlik sahiplerinin %37'sinin <35 yaşında, %30'unun 36 ila 45 yaşları arasında, %22'sinin de 46 ila 56 yaşları arasında ve %7'sinin ise 56 yaş üstü olduğunu vurgulamıştır. Mevcut çalışmaya kıyasla, Lage ve ark. (2024) tarafından bulunan sonuçların daha düşük olduğu görülmektedir. Bu sonuçlar göre ülkemizde RSS'li çiftlik sahiplerinin yaş ortalamasının yüksek olduğunu göstermektedir.

RSS ve GSS'li çiftliklerin %75'inin lisans mezunu oladıkları tespit edilmiştir. Ayrıca, RSS'li sağım yapan süt üreticilerinin çiftçilikle uğraştıkları sürenin 13.3 yıl olduğu sonucuna varılmıştır. Buna karşın, GSS'li sağım yapan süt üreticilerinin çiftçilikle uğraştıkları sürenin 20 yıl olduğu belirlenmiştir. Bu çalışmada istatistiki olarak herhangi bir karşılaştırma yapılmamış olsa da, rakamsal olarak RSS kullanan süt üreticilerinin çiftçilikle uğraştıkları sürenin daha düşük olduğu gözlemlenmiştir (Tablo 1).

Bu çalışmada, RSS'li ve GSS'li çiftliklerde yeterli düzeyde Zooteknist ve Veteriner Hekim bulunmadığı gözlenmiştir. Ancak, hem RSS'li çiftliklerde (%75) hem de GSS'li çiftliklerde (%100) yoğun olarak yabancı işçi çalıştığı görülmektedir. Ayrıca, mevcut çalışmada iş gücü kullanımı ile ilgili RSS ve GSS'li çiftlikler arasında istatistiki olarak karşılaştırılma yapılmamış da GSS'li (8 iş gücü) sağımın uygulandığı çiftliklerdeki iş gücü kullanımının RSS'li çiftliklere (4 iş gücü) kıyasla daha yüksek olduğu gözlenmiştir (Tablo 2).

Tablo 1. Çiftlikleri sosya ekonomik yapısı

	RSS	GSS
Yaş	50.3	52
Ailedeki kişi sayısı	4.25	4
SG durumu	Bağ-kur	Bağ-kur
Eğitim Durumu		
İlkokul	%25	%0
Ortaokul	%0	%25
Lise	%0	%0
Lisans	%75	%75
Deneyim		
Hayvancılıkla Uğraşılan Süre (Yıl)	17.3	19.5
Çiftçilikle Uğraşılan Süre (Yıl)	13.3	20
Arazi Büyüklüğü (Dekar)	787.5	900

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi; SG: Sosyal güvenlik



ABD' nin büyük süt üreticileri ile ilgili yapılan bir başka çalışmada ise üreticiler RSS'ye geçiş yapmaya karar vermelerinin başlıca nedenini "iş gücü kullanımını azaltması" yönünde cevaplamışlardır (%81; Lage ve ark., 2024). Mevcut çalışmanın sonuçları ve Lage ve ark. (2024) tarafından elde edilen bulgular ile uyumlu olup, çalışma sonuçları RSS' li sağımın iş gücü kullanımını azalttığını işaret etmektedir. Benzer şekilde Coskun ve ark. (2023) RSS'li sağım yapan çiftliklerde iş gücü kullanımının %20 -30 daha az olduğu belirtilmiştir.

RSS ve GSS'li çiftlik sahiplerinin sırasıyla %50 ve %100'ünün bitkisel üretim faaliyetlerinin olduğunu belirtmişlerdir (Tablo3). Ayrıca, çiftliklerin genellikle Holstein ırkı ile süt üretimi faaliyetlerini gerçekleştirdikleri belirlenmiştir.

Mevcut çalışmada, RSS'li çiftliklerin %50 si kapalı barınaklarda üretim yaparken, GSS'lilerin % 50 si kapalı, %50'si yarı açık sistemlerde üretim yapmakadır (Tablo 4). Ayrıca, GSS'li çiftliklerde ortalama inek sayısı ve buzağı sayısı sırasıyla 154 ve 61 olup, RSS'li çiftliklerde bu değer 94 ve 44 olarak belirlenmiştir. Günlük ortalama süt verimlerinin ve süt satış fiyatlarının ise çiftliklerin benzer olduğu gözlenmiştir (Tablo 4). Hogenboom ve ark. (2019) ise RSS'nin ineklerinin süt verimini %5 ile %12 arasında artırabileceğini belirtmişlerdir. Ancak, yıllık satılan ve/veya sürüden ayıklanan inek sayılarının RSS ve GSS'li çiftlikler için sırasıyla 18 baş ve 27 baş olarak belirlenmiş olup, GSS'de daha yüksek olması dikkat çekici bir bulguydu. Mevut çalışmanın sonuçlarının aksine Oudshoorn ve ark. (2012) sürüden ayıklama düzeyini GSS ve RSS kullanan çiftliklerde sırasıyla % 32 ve % 38 olarak belirtmiştir. Benzer şekilde, Lage ve ark. (2024) çiftçilerin RSS'ye geçtikten sonra sürüden ayıklama oranında kısmen artış olduğunu ifade ettiklerini vurguladılar. Bazı araştırmacılar RSS'li sağımın bazı dezavantajlarının olabileceğini ve özellikle RSS'li sağımda başarısız sağım düzeyi ve ayıklama oranının GSS'den yüksek olduğunu belirtmektedirler (Coşkun ve ark., 2023). Araştırmacılar, bu durumu çiftlikteki meme yapısı bozuk olan ineklerden ve meme başı kirliliğine bağlamış ve sensörlerin meme başlarını tespit edememesiyle ilgili olabileceğini vurgulamışlardır (Coşkun ve ark., 2023; Lage ve ark., 2024).

Tablo 2. Çiftliklerdeki istihdam durumları

İstihdam Durumu	RSS		GSS	
	Evet	Hayır	Evet	Hayır
Personel durumu				
İşletmede Zootechnist istihdamı?	%0	%100	%0	%100
İşletmede Veteriner Hekim istihdamı?	%25	%75	%25	%75
İşletmede yabancı işçi istihdamı?	%75	%25	%100	%0
Personel sayısı				
İşletmede çalışan Veteriner Hekim sayısı	0.25		0.5	
İşletmede çalışan yabancı işçi sayısı	4		8	

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi

Tablo 3. Bitkisel üretim durumu ve çiftliklerdeki yetiştirilen sığır ırkları

Bitkisel Üretim Yapılıyor mu?			İrk
Sağım sistemi	Evet	Hayır	
RSS	%50	%50	Holstein, Avrupa kırmızısı
GSS	%100	%0	Holstein

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi

Tablo 4. Çiftliklerin kullandıkları barınak tipi, hayvan varlığı ve üretim durumları

	RSS	GSS
Barınak tipi		
Kapalı	%50	%50
Açık	%25	0
Yarı açık	%25	%50
Hayvan varlığı (baş)		
İnek	94	154
Buzağı	44	61
Dana, düve, tosun	192	278
Günlük ortalama süt verimi (kg)	31	32
Süt satış fiyatı (lira)	15.9	15.8
Satılan ve/veya ayıklanan hayvan (baş/yıl)		
İnek	18	27
Buzağı	11	8
Dana, Düve ve Tosun	33	58

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi



RSS'li çiftliklerde sağım robot tarafından gerçekleştirildiği için sağım için iş gücü kullanımı yoktur ancak GSS'li çiftliklerde bu değer ortalama 6.25 saattir (Tablo 5). Ayrıca, RSS ve GSS'li çiftliklerde ahır temizliğine ayrılan sürenin sırasıyla 2.7 ve 1.29 saat olduğu tespit edilmiştir. Yemleme için ayrılan süre ise RSS için 2.5 saat, GSS için ise 2.16 saat olarak belirlenmiştir. Özellikle RSS'li çiftliklerde sağım için ayrılan süre ve iş gücü kullanımını önemli düzeyde azalttığı görülmektedir.

RSS'li sağım yapan çiftlik sahipleri sağım süresinin 6 dk olduğunu belirtirken, GSS'li çiftliklerinin sahipleri bu süreyi 11.5 dk olarak belirtmişlerdir (Tablo 6). Günlük sağım sayısı verileri ise RSS için 4.25 GSS için 2.75 olarak belirlenmiştir. Benzer ifadelerle bir çok araştırmacı da mevcut bulguları desteklemekte olup, RSS'li sağımın sağım sıklığını arttırdığını ve böylelikle süt veriminde de kaydadeğer artışlar görüldüğü vurgulanmıştır (Hogenboom ve ark., 2019; Coşkun ve ark., 2023). RSS'li çiftliklerde sağım sırasında ineklere yem sunulurken, GSS'li çiftliklerde sağım sırasında yem sunulmamaktadır (Tablo 6).

Bu çalışmada, RSS'li sağımda günlük 4 kg yem sunulmakta olup, bu miktar bir günde sağım sayısına göre bölünerek her sağımda eşit miktarda verilir. Örneğin; günde 4 kez sağıma girmiş ise her sağımda 1 kg kesif yemlemesi yapılmaktadır. RSS'deki bu yemleme sağım ünitesini gün içerisinde ziyaret edip sağıma teşvik etmek amacıyla yapılan bir otomatik yemleme sistemidir. Bununla birlikte RSS'li sağım yapan çiftliklerde inekleri sağıma getirmek için ayrılan iş gücü kullanımı ve süre yoktur, ancak GSS'li sağım yapan çiftliklerde bu süre ortalama olarak 77.5 dakika olarak belirlendi.

Süt sığırcı çiftliklerinde sürüden ayıklama, bir dizi fizyolojik ve anatomik sorunlardan (sağlık sorunları, düşük süt verimi vb.) dolayı gerçekleşmektedir. Bu nedenle, sürüden ayıklama oranı ya da sürüden çıkarılan ineklerin ortalama laktasyon sırası çiftlikler için önemli bir karlılık göstergesidir (İlhan ve ark., 2022). Bu bakımdan RSS'li ve GSS'li çiftliklerdeki ineklerin sürüden çıkarıldığı ortalama laktasyon sırası önemli bir parametredir. Mevcut çalışmada RSS ve GSS'li çiftliklerdeki ineklerin sürüden çıkarıldıkları ortalama laktasyon sıraları sırasıyla 5 ve 4 olarak belirlenmiştir (Tablo 6).

Süt sığırcılığının en önemli yönetim uygulamalarından olan sağım işlemlerinin başarılı bir şekilde gerçekleşmesi her süt üreticisi için önem arz etmektedir. İneklerin dinlenme alanlarından gönüllü veya istekli olarak sağım ünitelerine gelerek, RSS'nin sağım protokollerini başarılı şekilde tamamlayabilmesi ineklerin hareketsiz kalmasına bağlıdır. Ancak, tanımadıkları ve deneyimlemedikleri bir olaya veya çevresel uyaranlara karşı hassas olan inekler sağım ünitesini ziyaret etmez ve sağım için girmezler. Bu bakımdan, özellikle birinci laktasyondaki ineklerin ve doğumu yaklaşan düvelerin RSS'ye alıştırılması ve adaptasyonu önemli bir konudur (Jago ve Kerrisk, 2011; Coşkun ve ark., 2023). Mevcut çalışmada, GSS'li çiftlik sahiplerinin tamamı birinci laktasyondaki ineklerin sağıma alışma süresinin 2 gün olduğunu belirtirken, RSS'li çiftlik sahiplerinin %75'i 7 günde ve diğer kalan %25'i de 14 günde alıştığını ifade etmişlerdir (Tablo 7).

Tablo 5. Sürü yönetim uygulamaları için harcanan süreler

	RSS	GSS
Sürü yönetim uygulamaları için harcanan süre		
Sağım için ayrılan süre (saat/gün)	0	6.25
Ahır temizliği için ayrılan süre (saat/gün)	2.7	1.29
Yemleme için ayrılan süre (saat/gün)	2.5	2.16

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi

Tablo 6. Sürü yönetim uygulamaları için harcanan süreler

	RSS	GSS
Hayvan başına ortalama sağım süresi (dk)	6	11.5
Sağım sayısı	4.25	2.75
Günlük üretilen süt miktarı (litre)	3075	5475
Sağım sırasında verilen kesif yem miktarı (kg/günlük)	4	0
Sağım sonrası sunulan TMR (kg/günlük)	38.75	32.5
İnekleri sağıma getirmek için ayrılan süre (dk)	0	77.5
İneklerin sürüden çıkarıldığı laktasyon sırası	5	4

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi

Tablo 7. Birinci laktasyondaki ineklerin sağıma alışma süresi

	RSS	Geleneksel
Alışma süresi (gün)		
2	%0	%100
7	%75	%0
14	%25	%0

RSS: Robotik sağım sistemi; GSS: Geleneksel sağım sistemi



Bu araştırmada çiftçilere süt sığırları çiftliklerinin önemli bir problemi olan mastitis vakaları ile ilgili sorular da soruldu (Tablo 8). RSS’li çiftlik sahiplerinin %75’i mastitis vakalarının “Nadiren” görüldüğünü belirtirken, GSS’li çiftlik sahiplerinin tamamı bu vakaların “Az” görüldüğünü ifade etmiştir. Ayrıca, RSS’li çiftliklerde mastitis vakaları robot (Elektriksel iletkenlik değişimine göre) tarafından tespit edilirken, GSS’li çiftliklerde bu tür vakalar sağımcıların gözlemsel değerlendirmeleri sonucunda belirlenmektedir (Tablo 8). Benzer bir çalışmada ise birçok çiftlik sahibinin RSS’ ye geçtikten sonra süt üretiminde artış (çiftçilerin %58’i), süt bileşenlerinde hafif değişiklikler (çiftçilerin %32’si) ve mastitisin önemli göstergesi kabul edilen somatik hücre ve bakteri sayımlarında değişmeyen seviyeler fark ettiği bildirilmiştir (Lage ve ark., 2024).

Antibiyotik tedavisi devam eden ineklerin sağımda sütleri sistemden nasıl ayrıldığı sorulduğunda ise RSS çiftlik sahipleri sistemin ayrıldığını belirtirken, GSS çiftlik sahipleri bu tür durumlarda sağım ünitesinden inekin ayrılarak ayrı sağıldığını ifade etmişlerdir (Tablo 8). “Ön sağım yapılıyor mu?” sorusuna ise RSS’li çiftlik sahipleri “Evet” cevabı verirken, GSS’li çiftlik sahipleri “Hayır” cevabı vermişlerdir.

Bu çalışmada, sağım sistemlerinin servis, yedek parça ve bakım-onarım işlemleri ile ilgili sorularda soruldu (Tablo 8). Her iki sağım sisteminde de çiftçilerin arıza durumunda servis ağının yanı sıra, yedek parça temininde de sorun yaşamadıklarını ifade etmişlerdir. Ayrıca, RSS ve GSS’li çiftliklerin sistem bakımı için ortalama 6 ayda bir sırasıyla 531.25 € ve 625 € ödediklerini belirtmişlerdir.

Bu çalışmada sadece RSS’li çiftliklere sorulan yenilikçi yaklaşım ile ilgili sorular vardı (Tablo 9). RSS’yi ilk 2015 yılında duyduklarını ifade eden çiftçilerin %75’i bu sistemi fuarlarda gördüğünü ve diğer %25’inin ise çiftlik ziyaretlerinde gördüklerini ifade etmişlerdir. Çiftçilerin tamamı RSS’li sağımdan memnun olduğunu bildirmişlerdir. Bu bulgulara göre çiftçilerin teknolojik gelişmeleri takip edebilmeleri ve bu sistemleri tanınması bakımından fuarları dikkatle takip etmesi önem arz etmektedir.

Çiftlik sahipleri RSS’nin kurulum maliyetinin ortalama 242 500,00 € olduğu belirtmişlerdir. Çok sayıda araştırmacı bir sürü için kurulan RSS’nin maliyetinin GSS’lere göre yaklaşık 2-3 kat daha pahalı olduğunu ifade etmektedir (Rotz ve ark., 2003; Coşkun ve ark., 2023). Bu sistem, çiftlik kurulum maliyeti bakımından çiftçiler için bir dezavantaj gibi görünmektedir.

RSS’li sisteme geçmeden önce, çiftliklerin %50’sinin “Hızlı çıkış” özelliğine sahip sağım ünitesi kullandığını belirtirken, %25’inin “Balık kılçığı” sağım ünitesini kullandığını ifade etmiştir. Çiftlik sahipleri bir veya iki sağım rabotu ünitesinin çiftliklerinde kurulu olduğunu ve bir sağım robotunun verimli olarak 66 inek sağımlı yapabildiğini ifade etmişlerdir (Tablo 9). Benzer şekilde Coşkun ve ark. (2023) bir sağım robotunun yaklaşık olarak 60 ile 70 arasında inek sağabileceğini ifade etmişlerdir. Sürü büyüklüğüne göre sağım sisteminin kapasitesinin optimum düzeyde olması bu teknolojik sistemden en etkin şekilde faydalanılması ve karlı üretim için önem arz etmektedir (Coşkun ve ark., 2023).

Tablo 8. Çiftlikteki sağım protokolleri ve meme hastalığı durumu, sistem bakım ve onarım bilgileri

	RSS	GSS
İneklerde gözlemlenen mastitis vakaları hangi sıklıktadır?		
Nadiren	%75	%0
Az	%25	%100
Çok	%0	%0
İneklerde gözlemlenen mastitis vakaları hangi yöntemle tespit ediliyor?		
RSS (Elektriksel iletkenlik değişimine göre tespit ediyor)	%100	%0
Somatik hücre sayısı (SHS)	%0	%0
California Mastitis Testi (CMT)	%0	%0
Gözlemsel değerlendirmeler	%0	%100
Sağım Protokolleri		
Antibiyotik tedavisi devam eden ineklerin sağımda sütleri sistemden nasıl ayrılıyor?	Sistem Ayrıyor	Ayrı sağımlı yapıyor
Sağımlı öncesi meme temizliği yapılıyor mu?	Evet	Evet
Ön sağımlı yapılıyor mu?	Evet	Hayır
Sağımlı sonrası dezenfektasyon işlemi uygulanıyor mu?	Evet	Evet
Bu protokoller için iş gücü harcanıyor mu?	Hayır	Evet
Sağımlı sistemi bakım onarım işlemleri		
Arıza durumunda servis ağında sorun yaşıyor musunuz?	Hayır	Hayır
Yedek parça temininde sorun yaşıyor musunuz?	Hayır	Hayır
Sağımlı sisteminin bakımı hangi sıklıkla yapılıyor?	6 ay	6 ay
Sağımlı sisteminin bakımı için kaç Euro ödeniyor?	531.25 €	625 €
İşletmede başka teknolojik yenilikler var mı?	Evet (%100)	

RSS: Robotik sağımlı sistemi; GSS: Geleneksel sağımlı sistemi



Tablo 9. Sadece RSS'li çiftliklere sorulan yenilikçi yaklaşım ile ilgili sorular

RSS'yi ilk ne zaman duydunuz?	2015
RSS'yi ilk nerede gördünüz?	Fuar (%75) - Çiftlikler (%25)
RSS'den memnun musunuz?	Evet (%100)
RSS'nin garanti süresi kaç yıl?	2 yıl
RSS'nin ilk kuruluş yılındaki ortalama maliyeti ne kadardır?	242 500,00 €
RSS'den önce hangi tip sağım sistemini kullanıyordunuz	
Hayvancılık yapmıyordum	%25
Balık kılçığı	%25
Paralel sistem	%0
Portatif makine	%0
Hızlı çıkış	%50
RSS'li çiftliklerde kaç robot bulunmaktadır?	1-2 adet
Sadece bir robot ünitesi ile ortalama kaç inek sağımı yapılabilir?	66 baş

Elde edilen sonuçlar RSS'nin önemli avantajlarının olduğunu işaret etmektedir. Özellikle, çiftliğin sürü düzeyinde yönetiminden ziyade bireysel düzeyde yönetilmesini kolaylaştırmaktadır. Ayrıca, ineğin sağım sürecinin hassas olarak takip edilmesi ve izlenmesinden dolayı, hem meme sağlığının hem de üretilen sütün miktarı ve kalitesinin takip edilerek pazara sunulan sütün kalitesinin iyileştirilemesine imkan sunmaktadır. Bir diğer önemli avantajı ise iş gücü kullanımını önemli düzeyde azaltmasıdır. Ancak, RSS'nin avantajlarının yanı sıra bazı dezavantajları da bulunmaktadır. Özellikle, kurulum maliyetinin yüksek olmasından dolayı, çiftçiler bu sistemin kurulumu maliyetini dikkate almalıdır. Bu bakımdan bu sistemin avantaj ve dezavantajlarının dikkatle ele alınması önemli bir husustur. Ülkemiz koşullarında da yaygınlaşmaya başlayan RSS'nin hem hayvan temelli (davranış, sağlık, üreme, sürü yönetimi ve refah durumu) hem de bu sistemin sürdürülebilirliği ve ekonomik etkinlik konularının ele alınacağı ileri çalışmalara ihtiyaç vardır.

Teşekkür

Konya ilinin Çumra, Ereğli ve Karapınar ilçelerindeki çiftçilere katkılarından dolayı teşekkür ederiz.

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Liposomal Coating Technology and Food Applications Ayşe Semra AKSOY¹, Fatma Sema AKSOY ÖZTÜRK²

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Abstract

The word "liposome" is derived from the combination of the words 'lipos' (fat) and 'soma' (structure or body). Liposomes are spherical structures composed of surfactants (mostly phospholipids) that can spontaneously form bilayers in aqueous solutions, with two molecular layers where non-polar groups face each other. The diameter of liposomes can vary between 20 nm and 20 µm. Liposome structures can consist of small and large unilamellar structures or multilamellar structures. In fact, some liposomes can be composed of spherical structures containing multiple multilayers. Liposomes can be produced by various methods. Traditional production methods include thin film rehydration, detergent removal, injection, heating, and sonication. Each of these methods comes with its own advantages and disadvantages. There are four common and important stages in the preparation of liposomes: drying of lipids dissolved in an organic solvent, exposing the lipid to an aqueous environment, purifying the formed liposome, and analyzing the final product. Liposomes are used in the food industry for the transport and controlled release of bioactive substances. This ensures that these components reach the targeted areas in the digestive system and increases their effectiveness. Encapsulation of functional components within liposomes enhances the stability of these substances, reduces their interaction with the environment, and preserves their effectiveness for longer in environments that could lead to degradation, thereby extending shelf life through natural components. Liposomes can mask unwanted tastes and odors in some foods, providing a more pleasant consumption experience. Additionally, liposome technology increases the bioavailability and storage performance of vitamins (C, D, E). Today, liposomal C and D vitamins are preferred as dietary supplements with a bioavailability rate of up to 80%.

Key Words: Liposome, Bioactive compounds, Phospholipid, Production methods, Vitamin bioavailability

Lipozomal Kaplama Teknolojisi ve Gıda Uygulamaları

Özet

Lipozom kelimesi, 'lipos' (yağ) ve 'soma' (yapı veya vücut) sözcüklerinin birleşiminden oluşmuştur. Lipozomlar, polar olmayan grupların birbirine dönük olduğu iki molekül katmanı oluşturan, sulu çözeltilerde kendiliğinden çift katmanlar meydana getirebilen yüzey aktif maddelerden (çoğunlukla fosfolipidler) oluşan küresel yapılardır. Lipozomların çapı, 20 nm ile 20 µm arasında değişiklik gösterebilir. Lipozom yapıları, küçük ve büyük tek katmanlı yapılardan oluşabileceği gibi, çok katmanlı yapılarda da bulunabilir. Hatta bazı lipozomlar, içinde birden fazla çok katman içeren küresel yapılardan oluşabilir. Lipozomlar, çeşitli yöntemlerle üretilebilir. Geleneksel üretim yöntemleri arasında ince film yeniden hidrasyon, deterjan giderme, enjeksiyon, ısıtma ve ultrasonikasyon (sonication) yer alır. Bu yöntemlerin her biri, kendi avantajları ve dezavantajlarıyla birlikte gelir. Lipozomların hazırlanmasında yer alan dört yaygın ve önemli aşama; organik çözücü içinde çözülmüş lipidlerin kurutulması, lipidin sulu ortama maruz bırakılması, oluşturulan lipozomun saflaştırılması ve nihai ürünün analizi aşamalarıdır. Lipozomlar, gıda sektöründe biyoaktif maddelerin taşınması ve kontrollü salınımı için kullanılır. Böylece bu bileşenlerin sindirim sisteminde hedeflenen bölgelere ulaşması ve etkinliği artmış olur. Lipozom içine fonksiyonel bileşenlerin hapsedilmesi, bu maddelerin stabilitesini artırır, çevre ile etkileşimini azaltır ve bozulmaya yol açabilecek ortamlarda daha uzun süre etkinliğini korur, raf ömrünün doğal bileşenler vasıtasıyla uzatılmasını sağlar. Lipozomlar, bazı gıdalarda istenmeyen tat ve kokuları maskeleyebilir, böylece daha hoş bir tüketim deneyimi sunar. Ayrıca, lipozom teknolojisi vitaminlerin (C, D, E) biyoyararlanımını ve depolama performansını artırır. Günümüzde lipozomal C ve D vitaminleri, %80'e varan biyoyararlanım oranıyla gıda takviyesi olarak tercih edilmektedir.

Anahtar Kelimeler: Lipozom, Biyoaktif maddeler, Fosfolipid, Üretim yöntemleri, Vitamin biyoyararlanımı



A Bibliometric Review on Food and Artificial Intelligence

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Abstract

The global population is increasing at a significant rate, both in our country and worldwide. Indeed, it is projected that the global population will reach ten billion by 2050, with the population of Türkiye reaching 105 million. In light of the aforementioned data, it is evident that the significance of food and its derivatives will continue to grow. In this context, it is imperative that existing food resources be utilized in the most efficient manner possible. The quality of food is of great consequence to the maintenance of adequate and balanced nutrition. A substantial body of evidence suggests that nutritional factors play a significant role in the aetiology of numerous diseases. Over the past decade, there have been significant advancements in technology. The use of developing technology in the field of food is increasing. Artificial intelligence (AI) is one such technological application, employed in numerous fields. The term "artificial intelligence" is defined as the imitation of human intelligence by a system or machine. In the field of food, artificial intelligence is employed for a variety of purposes, including the imitation of natural products, the adulteration of foodstuffs, the measurement of toxin levels, and the classification of food items. Furthermore, in this research, bibliometric analysis has been employed to evaluate the applications of food and artificial intelligence. The present review study compiles information on the potential applications of artificial intelligence in the field of food science and technology, as well as an overview of existing studies in the literature.

Keywords: Nutrition, Food, Artificial intelligence, Bibliometric analysis

Gıda ve Yapay Zeka üzerine Bibliyometrik Bir İnceleme

Özet

Küresel nüfus hem ülkemizde hem de dünya da önemli ölçüde artmaktadır. Nitekim 2050 yılında dünya nüfusunun on milyar kişiye ulaşacağı, Türkiye nüfusunun ise yüzbeş milyon olacağı tahmin edilmektedir. Bu veriler dikkate alındığında gıda ve ürünlerinin öneminin daha da artacağı aşikardır. Bu bağlamda mevcut gıda kaynakların en verimli şekilde değerlendirilmesi gerekmektedir. Yeterli ve dengeli beslenme için gıda kalitesi oldukça önemlidir. Yapılan çalışmalar birçok hastalığın oluşumunda beslenmenin önemli bir role sahip olduğunu belirtmektedir. Son on yıllık period boyunca teknoloji inanılmaz derecede gelişim göstermiştir. Gelişen teknolojinin gıda alanında kullanımı giderek artmaktadır. Özellikle bu teknolojik uygulamalardan biri olan yapay zekanın, birçok alanında kullanımı bulunmaktadır. Yapay zeka, insan zekasının bir sistem veya makine tarafından kopyalanması olarak tanımlanmaktadır. Gıda alanında yapay zeka taklit, tağşiş, toksin düzeyi, sınıflandırma gibi çeşitli amaçlar doğrultusunda kullanılmaktadır. Ayrıca gıda ve yapay zeka uygulamaları bibliyometrik analiz işleminde tabi tutulmuş ve değerlendirilmiştir. Bu inceleme çalışmasında yapay zekanın gıda üzerine kullanım olanakları ve literatürde yapılan çalışmalar üzerine bilgiler derlenmiştir.

Anahtar Kelimeler: Beslenme, Gıda, Yapay zeka, Bibliyometrik analiz,

Introduction

Food is the primary component of human nutrition and a fundamental require for maintaining optimal health and well-being. They are of great consequence to adequate and balanced nutrition, given the nutrients they contain (protein, carbohydrates, fat, minerals and vitamins). The current period has seen an intensification of the significance attributed to food, largely as a consequence of the emergence of



epidemics, earthquakes and other widespread phenomena in recent years. Indeed, the application of different processes to foods can result in a range of losses and the formation of various toxic substances (Oz et al., 2021; Savaş, 2024a; Savaş, 2024b; Demir and Gürses, 2022; Ekiz et al., 2023; Binici and Savaş, 2024). In order to minimise these losses, a variety of methods are currently in use. One of the technological methods employed is artificial intelligence.

The term "artificial intelligence" is defined as the replication of human intelligence by a system or machine. The objective of artificial intelligence is to construct a machine that is capable of exhibiting human-like cognitive processes and behaviours, including perception, reasoning, learning, planning and prediction (Nath et al., 2024). Indeed, it is asserted that this artificial intelligence application is capable of making decisions at all levels and contains information pertaining to a vast array of disciplines. (Jadhav et al., 2025). Figure 1 illustrates the various fields in which artificial intelligence is employed.



Figure 1. Areas of use of artificial intelligence in different fields

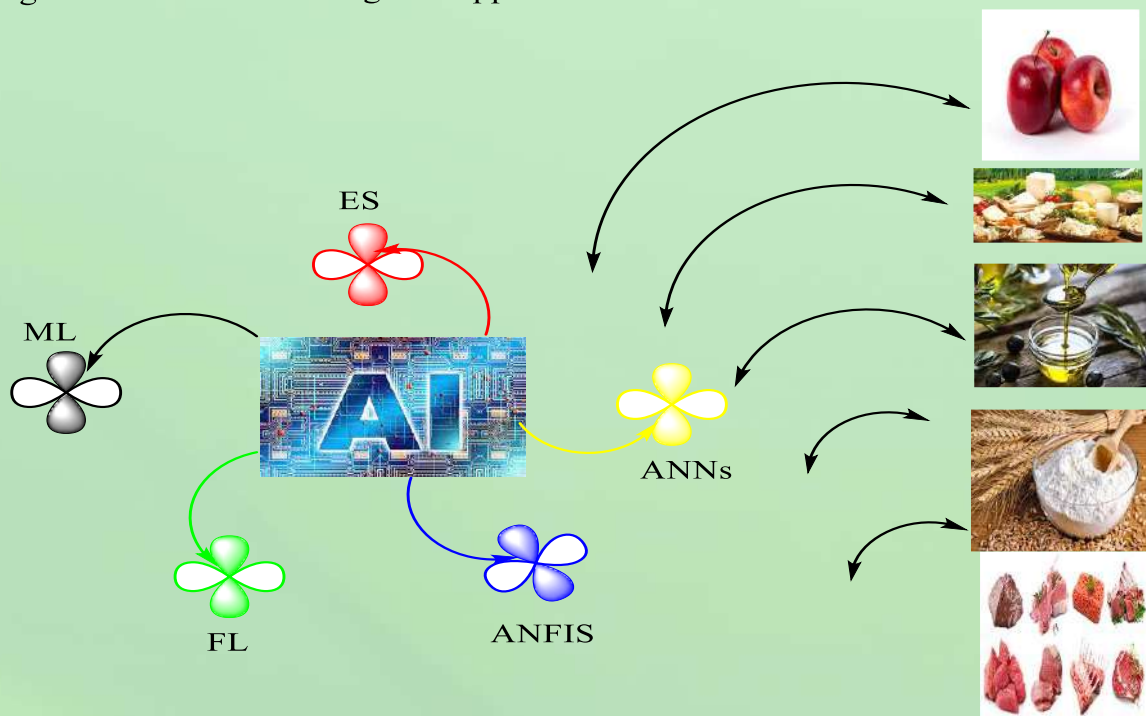
One of the key application areas of artificial intelligence is the agriculture and food processing sector. One of the most significant challenges of our time is to enhance the functionality of our food. It is imperative to ensure comprehensive oversight at pivotal stages of the supply chain, from the harvesting stage to the final product. As a result, rather than conducting this control on an individual basis, it can be accomplished with greater ease and economy through the application of artificial intelligence. In this context, it is hypothesised that the current quality losses of food can be prevented by increasing awareness and prevalence of artificial intelligence. The present review study compiles information about the areas of food application with artificial intelligence that have become quite popular recently.



The Relationship Between Food and Artificial Intelligence

Artificial intelligence, which is quite popular today, is an important information processing technique used in many areas such as food, medicine and cosmetics. Indeed, the most significant underlying rationale for its popularity is that it is capable of performing analytics by evaluating extensive data sets, evaluating them, and subsequently providing results (Manning et al., 2022; Jadhav et al., 2025). Furthermore, a variety of applications can be conducted with the aid of AI-supported systems, including the determination of food quality, the provision of control mechanisms, the categorisation of foods and the formulation of predictions. Additionally, sensors' freshness detection in the food industry, pathogen detection, counterfeiting detection and odour detection can also be carried out with the assistance of such systems (Thapa et al., 2023). It has been asserted that artificial intelligence applications and methodologies, including ES, ML, fuzzy logic (FL), ANNs, and adaptive neuro-fuzzy inference systems (ANFIS), are extensively employed in the food industry (Kakani et al., 2020; Thapa et al., 2023). Figure 2 shows the areas of use of artificial intelligence and food.

Figure 2. Artificial intelligence applications and its use on different foods



There is a literature on the use of artificial intelligence on different foods. These foods include meat and meat products, fruits and vegetables, dairy products, oils, nuts, etc. The purposes of using artificial intelligence applications include quality assessment, detection of imitation and adulteration, classification, and parameters such as the presence of toxins (Zhao et al., 2019; de santana et al., 2019; Gutiérrez et al., 2020; Fan et al., 2022; Jadhav et al., 2024).

Literature data of artificial intelligence and food research

Vosviewer software is a powerful visual analysis tool designed to explore the multidimensional, temporal, and dynamic aspects of scientific literature (Savaş, 2024). In this study, the Web of Science (WOS) database was used as the primary source of information. The Vosview analysis tool was used to determine the current status and identify the main points related to AI and food. Here, we used the Web of Science (WOS) database as the access platform and conducted a literature search using “AI” and “food” as keywords. The search was up-to-date, covering the year 2024. After the scanning process, a total of 361 articles on AI and food were obtained. The selected literature was exported and saved for



further analysis. The Vosviewer software was used to examine and cluster the authors and keywords. In this context, 28 different clusters emerged. In this context, the parameters of artificial intelligence most associated with food are shown in Figure 3.

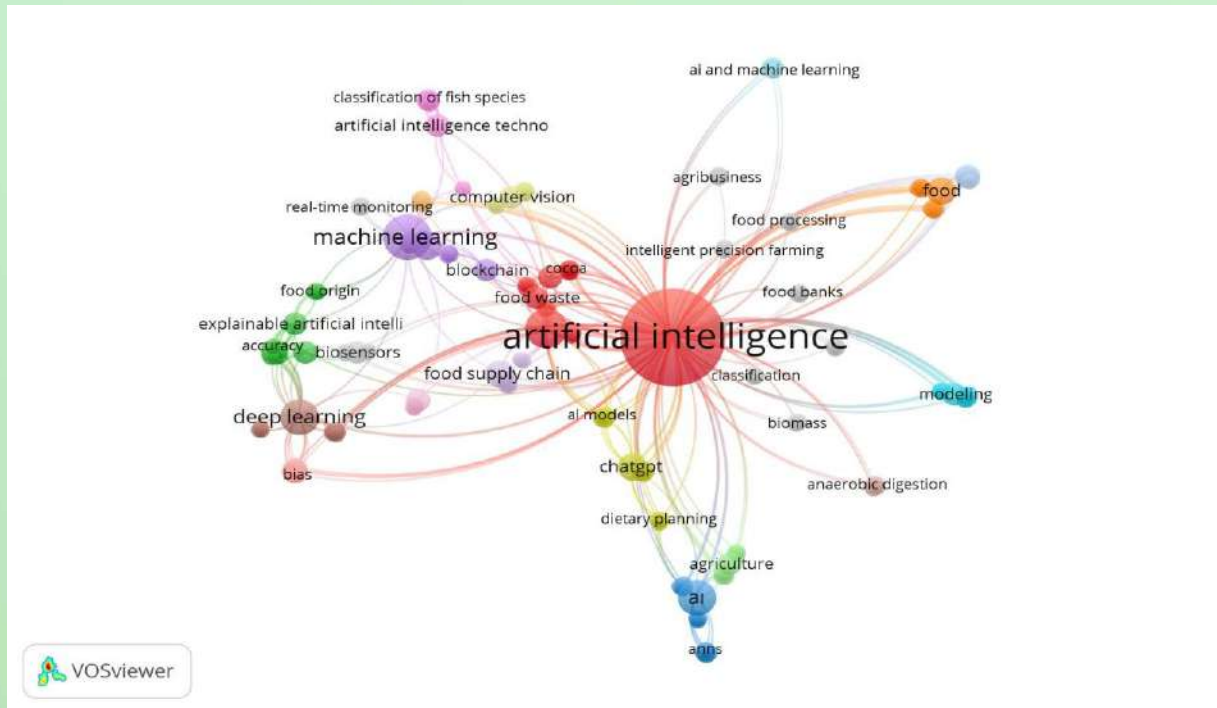


Figure 3. Parameters of AI most associated with food

Conclusion

The global population is increasing significantly. In fact, it is thought that the world population will reach ten billion people in 2050, and the population of Turkey will be one hundred and five million (Anoyomus, 2024). Therefore, the increase in the world population requires the food industry to increase its productivity and improve food safety. In short, with the developing technological conditions, the use of artificial intelligence in the food field should be increased even more. In this way, it is thought that food will be more controlled and nutritional losses will be minimized.

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Niğde Organized Industrial Zone Landscape Design Project

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Abstract

The importance of industry and industrialization in achieving our country's economic and social goals is immense. Industrial areas built within urban zones play a significant role in the development of a region. To achieve economic development and create qualified job opportunities, our country, which has a young population, is making significant progress in transitioning from industry to an innovation and design-centered model. However, we observe that the progress made is not sufficient in our rapidly evolving world. The purpose of this study is to bring together industrial facilities to ensure industrial efficiency and orderly urban settlement in cities, and to develop proposals that can minimize the negative environmental impacts of industrial enterprises. It is aimed to create green, spacious areas in specially planned regions that are also included in zoning plans, where employees can have more enjoyable and productive breaks. In the design, plant species that are resistant to air pollution, car exhaust emissions, noise pollution, etc., have been selected.

Key Words: Organized Industrial, Landscape Design, Green Space, Industry

Niğde Organize Sanayi Bölgesi Peyzaj Tasarım Projesi

Özet

Sanayinin ve sanayileşmenin ülkemizin ekonomik ve sosyal hedeflerine ulaşmasında önemi çok büyüktür. Kent alanında inşa edilen sanayi alanları, bölgenin gelişmesinde önemli paya sahiptir. Ekonomik kalkınmayı gerçekleştirebilmek ve nitelikli iş alanları için genç nüfusa sahip olan ülkemizin, sanayiden, inovasyon ve tasarım merkezli modele geçiş aşamasında önemli mesafeler almaktadır. Fakat gelişmekte ve değişmekte olan dünyamızda alınan mesafelerin yeterli olmadığını gözlemlemekteyiz. Çalışmanın amacı, kentlerde sanayi etkinliğini ve kentte düzenli yerleşmeyi sağlamak amacıyla, sanayi tesislerini bir araya toplamak, sanayi kuruluşlarının çevreye olumsuz etkilerini en aza indirebilecek öneriler geliştirmektir. Özel olarak planlanan ve imar planlarında da yer verilen bölgelerin yeşil, ferah ve çalışanların molalarda daha keyifli, verimli vakitlerin geçirebilecekleri yeşil alanların oluşturulması hedeflenmektedir. Tasarım kapsamında, hava kirliliğine, arabaların egzoz gazı salımına, ses kirliliğine vb. dayanıklı olan bitki türleri tercih edilmiştir.

Anahtar Kelimeler: Organize Sanayi, Peyzaj Tasarım, Yeşil alan, Endüstri

Giriş

Türkiye'de, sanayileşme çabaları Cumhuriyetle birlikte yoğunluk kazanmış ekonomik kalkınmanın ve yeni kazanılan siyasi bağımsızlığın temeli olarak görülmüştür. Sanayileşme Cumhuriyetin ilk yıllarında özel kesimin girişimlerine bırakılmış ancak gerek mali gücünün yetersizliği gerekse deneyim yoksunluğu nedeniyle özel kesim bu görevi beklenen şekilde yerine getirememiştir. İlk sanayileşme çabalarına müteakiben 1931 yılında uygulamaya konulan "I. Beş Yıllık Sanayi Planı" çerçevesinde sanayi alt yapısının oluşturulması çalışmalarına başlanmıştır. I. Sanayi Planı döneminde bütünüyle kamu girişimciliği ön planda tutulmuş Sümerbank, Etibank, Denizcilik Bankası gibi kuruluşlar faaliyete geçmiştir. 1960 yılında başlayan planlı kalkınma döneminde ise sanayinin "lokomotif" sektör olduğu açıklıkla belirtilmiş, ekonomik dengenin kurulması, ekonomik ve toplumsal kalkınmanın birlikte gerçekleştirilmesi, belli bir hızda büyüme ve sanayileşmeye önem verilmesi gibi uzun vadeli hedefler belirlenmiştir (Anonim, 2024). Belirlenen hedefler doğrultusunda ilk olarak 1961 yılında Bursa OSB'nin kurulmasıyla başlanmıştır. Organize sanayi bölgeleri düzenli çevre politikası oluşturulması ve güçlü sanayileşme politikalarının hayata geçirilmesi açısından önem arz etmektedir. Organize sanayi bölgeleri, firmalar arasında kolektif motivasyonun ve karşılıklı güvenin tesis edildiği yerlerdir. OSB'ler üretimde kalitenin artmasına yardımcı olduğu gibi kullanılan malzemelerde etkinliğin artırılmasını sağlamaktadır. İşletmelerin belirli bölgelerde toplanmasının sadece üretim artışı ya da sinerjinin oluşturulmasına katkısı yoktur. OSB'ler kurulmuş oldukları bölgelerin sadece ekonomik yapılarına olumlu katkı sunmazlar. Aynı zamanda sosyal yapının da gelişmesine katkı sunarlar. OSB'lerde istihdamın artırılması ve tamamlayıcı mesleki eğitimlerin daha düzenli bir biçimde



yapılmasına imkân olmaktadır. Organize Sanayi Bölgelerinin ülke, bölge, şehir ve küçük yerleşim yerlerine sağlamış olduğu çok çeşitli faydaları bulunmaktadır.

OSB'ler ülkelerin, bölgelerin ve şehirlerin ekonomik yapılarının gelişmesinde önemli görevler üstlenmektedir. Bunların başında sanayileşmenin yol açtığı olumsuz etkilerin üstesinden gelinmesi; çevreye duyarlı düzenli kentleşmenin sağlanması gelmektedir. OSB'lerinde, benzer faaliyetlerde bulunan firmaların aynı coğrafi yerleşke içinde bulunması birbirleri üzerinde olumlu etki yaratmaktadır. Kümelenme yaklaşımıyla açıklanacak bu etki sonucu firmalar gerek aynı sektördeki firmalar arasında gerekse farklı sektör firmaları arasındaki etkileşimlerin olmasından dolayı hem firmaların işlem maliyetlerini düşürücü hem de sinerji yaratarak bir arada bulunmanın vermiş olduğu avantajı verimliliğe çevirmeleri söz konusudur. İşletmelerin verimliliklerinin artması için ihtiyaç duydukları hammadde, elektrik, su, vb. ihtiyaçlarını kısa sürede halletmesi gerekir. Organize sanayi bölgeleri belirtilen ihtiyaçlara en iyi ve sağlıklı cevap veren yerlerdir (Yılmaz, 2021). Bu bölgelerde sunulan imkanları daha geniş ve alternatifli olması işletmelerin verimliliğine olumlu katkılar sunmaktadır. Türkiye'de 1962 yılında Bursa'da başlayan süreçte her geçen gün OSB sayısı artarak devam etmiştir. 1980'de 12, 2009'da 120 OSB sayısı 2011 yılı itibarıyla, faal olan OSB sayısı 131'e yükseltilmiştir. Bu doğrultuda 81 adet OSB'de yatırım programı kapsamına alınmıştır. Faal halde olan OSB'lerde toplam 37 bin işletme bulunmaktadır ve bu işletmelerde çalışan sayısı 1,8 milyondur (Anonim, 2024).

Bu çalışmanın amacı, OSB'lerinin, kapladığı alanlar ve çalışanlar göz önünde bulundurulduğunda, fiziksel yapının uygun tasarlanması gerekmektedir. Bu nedenle, OSB de peyzaj tasarımı uygulamaları vazgeçilmezdir. Peyzaj tasarımında ilk olarak göz önünde bulundurulması gereken OSB'de çalışanların veya yaşayanların için rekreasyon alan ihtiyacının karşılanabilmesidir. Oturma ve dinlenme olanaklarının yaratılmasıdır. Yapılacak estetik ve fonksiyonel bitkisel tasarımlar öncelikle bölgenin sosyal dokusuna ve halkın ihtiyaçlarına uygun olmalıdır. OSB'lerde gün boyu toplanma ve dinlenme işlevinin yerine getirilebilmesi ve estetik bir ortam yaratılabilmesi için ilgi çekici özelliklere sahip, yıl boyu farklı renk etkisinde, gölge yapabilecek ve bölge ekolojik şartlarına uyumlu bitkiler ile tasarımlar yapılmalıdır. Bu ilkeler göz önünde bulundurularak çalışma konusu olarak seçilen OSB'ler peyzaj tasarım açısından yeterli nitelikte olmadığından alanın yeniden tasarlanması amaçlanmıştır. Çalışmada, bu gerçeklikten yola çıkılarak peyzaj mimarlığı açısından fikir projesi üretilmiş ve kamu sektörünün gelecekte yararlanması hedeflenmiştir.

Niğde OSB'nin Kuruluş İşlemleri

Niğde Organize Sanayi Bölgesi. Niğde- Bor Karayolunun 7. Km'sindedir. Bakanlar Kurulu'nun 15.07.1976 gün ve 7/12207 sayılı kararı ile kurulmuştur. Bölgenin temeli 04.05.1986 tarihinde atılmıştır. Niğde OSB'nin altyapı çalışmaları Niğbaş A.Ş tarafından yapılmıştır. 1990 yılında enerji nakil hatları ve bölge içi elektrik şebekesi tamamlanmış, bölge içindeki yollar, içme ve kullanma suyu, kanalizasyon hatları ve şebekeleri vb. tesisler Niğde Belediyesi tarafından yapılan çalışmalarla 1994 yılında, İdare Binası, Kreş, Çırak Okulu, Çarşı Grubu, Sağlık Merkezi, Yemek Fabrikası- Kafeterya Tesisleri ve Isı Merkezi'nden oluşan Sosyal Tesisler 1995 yılından beri sanayicilere hizmete sunulmuştur. Düz bir arazi üzerinde kurulması, bölge içinde her parsel sınırında su, elektrik, doğalgaz, pis su hattı ve telefon ile destek hizmetlerinin bulunması bölgeyi yeni yatırımlar açısından tercih edilir kılmaktadır (Anonim, 2024).

Niğde Organize Sanayi Bölgesi'nde mevcut durumda üretim faaliyetini sürdüren 82 adet endüstriyel tesisler ve yapım aşamaları tamamlanmış ama faaliyete geçmeyen 9 adet endüstriyel tesis bulunmaktadır (Çizelge 1).

Çizelge 1. Sektördeki Dağılım (Anonim, 2023)

Tesislerin Faaliyet Gösterdiği Sektörler	Tesis Sayısı	Oran (%)
Tekstil	21	26
Gıda	12	15
Makine Tarım	10	12
Plastik	5	6
Mobilya	14	17
Diğer	20	24
Toplam	82	100

Niğde Organize Sanayi Bölgesi'nin arazisi 406 hektar olup yüzölçümleri 4.500 m² ile 164.000 m² arasında değişen 112 sanayi parseli mevcuttur. Bölge'nin ilave ve revizyon imar planı ve parsellasyon çalışmaları tamamlanmıştır. Tapu tescilleri yapılmıştır.

Çevre düzenlemesi ve temizlik çalışmaları hızla devam eden OSB de Kasım 2013 tarihi itibarı ile 75.000 fidan dikimi yapılmıştır.



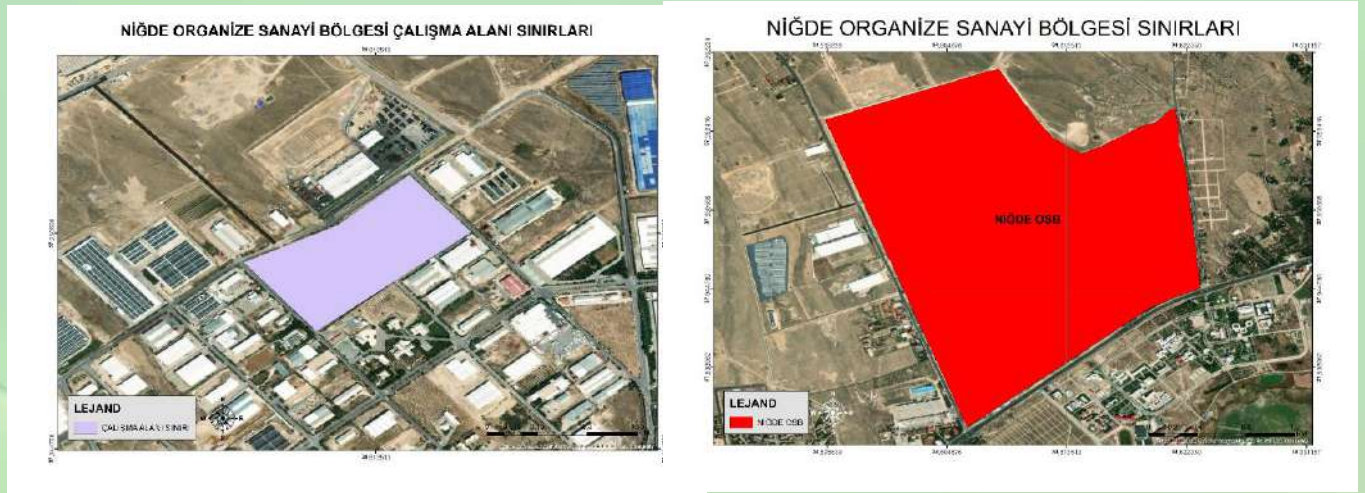
Materyal ve Yöntem

Niğde ili ülkemizin İç Anadolu Bölgesinin Güneydoğusundadır. Rakımı 1.229 m olan Niğde'nin nüfusu 346.667'dir. Çalışma konusu olan Niğde Organize Sanayi Bölgesi ise Niğde- Bor Karayolu'nun 7. km'sindedir. Niğde OSB'nin Google Earth de yer alan 04.11.2023 uydu görüntüsü verilerine göre 37°56'51"N Kuzey enlemi ile 34°36'57"E Doğu boylamı arasındadır (Şekil 1).



Şekil 1. Niğde İl Sınırı Haritası (Erduran ve Şahin, 2024)

Araştırma alanı Niğde ili sınırları içerisinde yer alan Niğde- Bor Karayolu'nun 7.km'sinde bulunan Niğde Organize Sanayi Alanıdır. Niğde Ömer Halisdemir Üniversitesi karşısında bulunan Niğde Organize Sanayi Bölgesindeki araştırma alanına ait sınırlar Şekil 2'de verilmiştir.



Şekil 2. Araştırma alanı

Alanın Mevcut Durumu

Niğde Organize Sanayi Bölgesi, 110.000 metrekarelik büyüklüğe sahiptir. Alanın mevcut durumundaki hali hazırda aktif ve sahip olduğu alanda peyzaj tasarım çalışması yapılması uygun ve çalışmakta olan 2 adet işletme vardır. Bunlar;

- Asrım Sağlık Tekstil Ür. İth. İhr. Ve Tic. Ltd. Şti
- Escom Enerji Santralleri Müh. Hiz. İnş. Taah. San. Ve Tic. Ltd. Şti



Yöntem

Alan üzerinde uygun açık yeşil alanlar, dinlenme alanları, kafe-restoran, yemekhane, revir vb. alanları tasarlanmıştır. Bu çalışmalar doğrultusunda alanın peyzaj tasarımı için “AutoCAD 2021”, 3 boyutlu çizim-modelleme programı olan “SketchUp 2023”, modellemenin bitkileri, malzeme materyallerinin modellemesi için “Lumion 10.5 Pro” kullanılmıştır.

Bulgular ve Tartışma

Alanda aktif olarak 82 işletme yer almaktadır. Bunlardan sadece Asrım Sağlık Tekstil Ür. İth. İhr. Ve Tic. Ltd. Şti ve Escom Enerji Santralleri Müh. Hiz. İnş. Taah. San. Ve Tic. Ltd. Şti’nin yeterince alanı bulunmakta ve peyzaj tasarımı çalışmasına uygun olduğu için adı geçen işletmeler seçilmiştir.

Bu işletmeler Sağlık ürünleri, enerji santralleri ve mühendislik hizmetleriyle uğraşmaktadır. Bu alanın sınırları içerisinde ve yol boyunca *Picea sp.* (Ladin Ağacı), *Prunus armeniaca* (Kayısı Ağacı), *Vitis vinifera* (Asma Ağacı) bitkileri yer almaktadır. Bu bitkilerin adetleri Çizelge 2’de verilmiştir.

Çizelge 2. Alanda Kullanılan Bitki Listesi

No	Bitkinin Latince Adı	Bitkinin Türkçe Adı	Adet
1	<i>Picea sp.</i>	Ladin Ağacı	280
2	<i>Prunus armeniaca</i>	Kayısı Ağacı	20
3	<i>Vitis vinifera</i>	Asma	2

Asrım Sağlık Tekstil Ür. İth. İhr. Ve Tic. Ltd. Şti.

Koordinatları 37°56'52.71"KN, 34°36'42.08" olan Asrım Sağlık Tekstil Ür. İth. İhr. ve Tic. Ltd. Şti de 8164 Metrekarelik alana sahip olan fabrika “Kolonoskopi şortu ve Pantolonu, Tek Kullanımlık Tulum, Cerrahi Örtü Setleri, Tek Kullanımlık Ziyaretçi Önlüğü, Tek Kullanımlık Boks Önlüğü vb.” sağlık ürünleri üretmektedir (Anonim, 2024).

Escom Enerji Santralleri Müh. Hiz. İnş. Taah. San. Ve Tic. Ltd. Şti.

37°56'49.96"KN , 34°36'45.78" olan Escom Enerji Santralleri Müh.Hiz.İnş.Taah. San. ve Tic.Ltd. Şti. olan Organize Sanayi Sitesi nde yer alan işletme, 2007’de kurulup 8413 metrekarelik alana sahip olan fabrika enerji santralleri ve mühendislik hizmetleriyle uğraşmaktadır. Kendi ekiplerince santral taşıma, yeniden montaj, kontrollük, devreye alma, işletme ve bakım projelerini yapabilmektedirler (Anonim, 2024).(Şekil3)



Şekil 3. Escom ve Asrım işletmelerine ait fotoğraflar



Alan üzerinde yapılan etüt çalışmaları sonucunda, peyzaj tasarım açısından eksiklikler belirlenmiş, alana uygun peyzaj tasarımı yapılmıştır. Alan içerisinde oturma alanları, su kullanımları ve bitkisel tasarım üzerinde yoğunlaşmıştır.

Çalışmaların dinlenme saatlerinde oturabilecekleri mekanlar tasarlanmıştır. Psikolojik olarak rahatlamalarını sağlayacak suyun ferahlık etkisinden yararlanılmıştır. Gölge mekanlar oluşturabilmek, yeşil alanlar tasarlamak için bitki türleri kullanılmıştır (Şekil 4).



Şekil 4 . Oturma alanları

Küresel ısınmanın etkisi ile dünyanın her yerinde sıcaklıklar normalden fazla olmaktadır. Niğde kenti'nde karasal iklim hakim olduğu için yaz dönemlerinde yakıcı bir sıcak hava yaşanmaktadır. Suyun serinletici etkisi için su kullanımına önem verilmiştir (Şekil 5).



Şekil 5. Tasarımda su yüzeyinin oluşturulması

Çalışanlara ve müşteriler ait olarak otopark tasarlanmıştır. İşçilere hizmet veren servisler için otopark alanında yer belirlenmiştir (Şekil 6).



Şekil 6. Otopark tasarımı

Araştırma alanında çalışanların mola saatlerinde gölge ve daha serin alanlarda dinlenmeleri için gölge yapan bitki türleri tasarımlarda düşünülmüştür (Şekil 7). Bu alanlar için seçilen bitki türleri Çizelge 3'de verilmiştir.





Şekil 7. Gölge mekanların oluşturulması

Peyzaj tasarımının temelini bitki türleri oluşturmaktadır. Kullanılacak bitkilerin özelliklerinin bölgeye uygun olması zorunludur. Türlerin ayrıca seçildiği alana göre estetik ve fonksiyonel olması gerekmektedir. Gölge mekanlar için geniş taçlı bitkiler, yönlendirme için dar mekanlarda daha piramit gelişen bitki türleri seçilmesi tasarımda uygun olacaktır. Bitkilerin özelliklerine göre tercih edilen türler Çizelge 3’de verilmiştir.

Çizelge 3: Alanda Kullanılacak Bitki Türleri

	Sıra No	Bitkinin Latince Adı	Bitkinin Türkçe Adı	Adet
Ağaçlar	1	<i>Acer platanoides</i>	Çınar Yapraklı Akçaağaç	57
	2	<i>Cupressus arizonica</i>	Mavi Servi	251
	3	<i>Platanus orientalis</i>	Çınar	3
	4	<i>Robinia hispida</i>	Pembe Çiçekli Akasya	78
	5	<i>Robinia pseudoacacia</i>	Beyaz Çiçekli Akasya	75
	6	<i>Buxus sempervirens</i>	Şimşir	532
Çalılar	7	<i>Euonymus japonica aurea</i>	Altuni Taflan	448
	8	<i>Photinia red robin</i>	Alev Çalısı	275

Araştırma alanında kullanılan türler, çalışanlar ya da müşterilerin ihtiyaç duydukları mekanlar düşünülerek tercih edilmiştir. Gölge alanlar için *Acer platanoides*, *Platanus orientalis*, *Robinia pseudoacacia*, *R.hispida* kullanılmıştır. Türlerin genel olarak kullanımı ve peyzaj tasarım projesi Şekil 8’de verilmiştir.



Şekil 8. Araştırma Alanına ait Peyzaj Projesi

Sonuç

T

ürkiye’de Sanayileşme sürecinde Organize Sanayi Bölgeleri ve Niğde İli OSB uygulaması adlı bu çalışmanın amacı, Türkiye’deki sanayileşme süreçlerini dönemler itibarıyla ele alarak, Organize Sanayi Bölgeleri hakkında bilgi vermek ve Organize Sanayi Bölgelerinin sanayileşmedeki rolünü vurgulayarak Niğde Organize Sanayi Bölgesinin karşılaştırmalı üstünlüklerini ve eksikliklerini tartışmaktır. Yapılan çalışma sonucunda Organize Sanayi Bölgelerinin sanayileşmesi, yerel ve ulusal kalkınmaya katkıda bulunmak ve ekonomik hedefleri gerçekleştirmek noktasında önemli görevlere ifa ettiği kanaatine varılmıştır (Arpa, 2014).

Niğde Organize Sanayi Bölgesi içerisinde bulunan 110.000 metrekarelik alanın günümüz anlayışına uygun olarak peyzaj tasarımı oluşturulmuştur. Bu peyzaj tasarımı oluşturulurken alan yerinde yapılan incelemeler dikkate alınmıştır. Alanın yerinde yapılan incelemelerine dayanılarak en önemli ihtiyacın oturma dinlenme, vakit geçirebilecekleri ve sohbet eşliğinde bir şeyler yiyip içilebilecek alanlar olduğu belirlenmiş olup, daha çok bu



yönde yapısal tasarımlar önerilmiştir. Bu yapısal tasarımlar önerilirken alanda yeşil alanın önemine dikkat edilip uygun bitki seçimi yapılmıştır. Alanın tüm çalışan veya çalışmayan insanların oturup vakit geçirebilmesi için dinlenme alanları çevresinde bitkiler ile süs havuzuyla estetik, güzel ve huzurlu bir ortam oluşturulmaya çalışılıp insanlara yeşil alanın ve doğanın ne kadar önemli olduğu ve korunması gerektiğini aşılamaaya çalışılmıştır. Alanın giriş ve çıkış noktaları geniş açıklık olarak bırakılmıştır. Yapılan tasarımların devamlılığı ve insanların alana çekiminin sağlanması başarılı bir yönetim ile sağlanabilecektir. Bu nedenle yerel yönetimlerin farklı meslek disiplinleri ve bilimsel çalışmalar eşliğinde hareket etmesi gereklidir.

Teşekkür

Niğde Organize Sanayi Bölgesi Peyzaj Tasarım Projesi konulu makale, Peyzaj Mimarı, Yakup Sadıklı'nın bitirme tezinden üretilmiştir.

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ID: 496

Eating Disorders: Symptoms, Causes, and Effective Treatment Methods

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Abstract

Eating habits are essential human needs influenced by both physiological and psychological processes. While food consumption is necessary for survival, modern life has altered these habits. Eating behaviors are not only influenced by physiological factors but also by social environment, family habits, and cultural norms. Eating disorders are especially prevalent among adolescents and can result in detrimental eating patterns. These disorders encompass anorexia nervosa, bulimia nervosa, and binge eating disorder. Anorexia nervosa is marked by severe restrictions on diet and exercise driven by an intense fear of gaining weight. Bulimia nervosa is characterized by periods of uncontrollable eating followed by purging or other compensatory actions to manage weight. Binge eating disorder is identified by episodes of overeating, accompanied by feelings of remorse. Addressing the symptoms, causes, and treatment of these disorders requires a comprehensive, multidisciplinary approach. Early identification and intervention are crucial in safeguarding both the physical and mental well-being of individuals with eating disorders. Without prompt recognition, these conditions can escalate into severe health issues and diminish quality of life. Hence, it is essential for healthcare providers, educators, and families to recognize the warning signs and take action early. A multidisciplinary approach is crucial in the treatment of eating disorders. Working together, dietitians, psychologists, psychiatrists, and other healthcare professionals help individuals achieve a healthy weight and restore psychological well-being. Treatment should address both physical and mental health needs, taking into account emotional states and life circumstances. This comprehensive care enhances the likelihood of successful outcomes. Raising awareness about eating disorders and developing effective treatment strategies is of great importance for public health. Research on the causes, symptoms, and treatment methods of eating disorders plays an essential role in improving individuals' quality of life. Therefore, efforts to prevent and treat eating disorders should be supported, and public health must be protected.

Key Words: Eating disorders, Anorexia nervosa, Bulimia nervosa, Binge eating disorder, Multidisciplinary approach

Yeme Bozuklukları: Belirtiler, Nedenler ve Etkili Tedavi Yöntemleri

Özet

Yeme alışkanlıkları, hem fizyolojik hem de psikolojik süreçlerden etkilenen temel insan ihtiyaçlarıdır. Gıda tüketimi hayatta kalmak için gerekli olsa da, modern yaşam bu alışkanlıkları değiştirmiştir. Yeme davranışları sadece fizyolojik faktörlerden değil, aynı zamanda sosyal çevreden, aile alışkanlıklarından ve kültürel normlardan da etkilenir. Yeme bozuklukları özellikle ergenler arasında yaygındır ve zararlı yeme biçimlerine yol açabilir. Bu bozukluklar anoreksiya nervoza, bulimiya nervoza ve aşırı yeme bozukluğunu içerir. Anoreksiya nervoza, aşırı diyet ve egzersiz ile kilo alma korkusunun bir sonucu olarak ortaya çıkar. Bulimiya nervoza, kontrolsüz yeme dönemleri ve ardından kilo kontrolü için kusturma veya diğer telafi edici davranışlarla karakterizedir. Aşırı yeme bozukluğu ise aşırı yeme dönemleri ve ardından pişmanlık duyguları ile tanımlanır. Bu bozuklukların belirtilerini, nedenlerini ve tedavisini ele almak kapsamlı ve çok disiplinli bir yaklaşım gerektirir. Erken tanı ve müdahale, yeme bozuklukları olan bireylerin hem fiziksel hem de zihinsel sağlığını korumada kritik öneme sahiptir. Bu durumlar hızlı bir şekilde tanınmazsa, ciddi sağlık sorunlarına yol açabilir ve yaşam kalitesini düşürebilir. Bu nedenle, sağlık hizmeti sağlayıcılarının, eğitimcilerin ve ailelerin uyarı işaretlerini tanıması ve erken müdahale etmesi önemlidir. Yeme bozukluklarının tedavisinde çok disiplinli bir yaklaşım kritik öneme sahiptir. Diyetisyenler, psikologlar, psikiyatristler ve diğer sağlık profesyonelleri birlikte çalışarak bireylerin sağlıklı bir kiloya ulaşmalarına ve psikolojik iyilik halleri sağlamalarına yardımcı olurlar. Tedavi, hem fiziksel hem de zihinsel sağlık ihtiyaçlarını göz önünde bulundurarak, duygusal durumlar ve yaşam koşullarını dikkate almalıdır. Bu kapsamlı bakım, başarılı sonuçların elde edilme olasılığını artırır. Yeme bozuklukları hakkında farkındalık yaratmak ve etkili tedavi stratejileri geliştirmek, halk sağlığı için büyük önem taşır. Yeme bozukluklarının nedenleri, belirtileri ve tedavi yöntemleri üzerine yapılan araştırmalar, bireylerin yaşam kalitesini artırmada temel bir rol oynar. Bu nedenle, yeme bozukluklarını önleme ve tedavi etme çabaları desteklenmeli ve halk sağlığı korunmalıdır.

Anahtar Kelimeler: Yeme bozuklukları, Anoreksiya nervoza, Bulimiya nervoza, Aşırı yeme bozukluğu, Disiplinlerarası yaklaşım





ID: 497

Patates Altın Kist Nematodu'nun Patates Klon Ve Çeşitlerinde Bitki Gelişimine Etkilerinin Araştırılması

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Özet

Kist Nematodları, dünya çapında patates (*S. tuberosum*) endüstrisinde büyük kayıplara neden olur. Patates Altın Kist Nematodu (*Globodera rostochiensis*) karantina kapsamında yer alan, kimyasal mücadelesi olmayan, bulaştığı topraktan uzun yıllar izole edilemeyen, verimin ciddi oranda azalmasına sebep olan bir zararlıdır. Bu çalışmada Patates Altın Kist Nematodu'nun tarla şartlarında Ünlene, Leventbey, Muratbey, PAE 13-08-07 klonu, Desiree ve Bettina çeşitlerinde bitki gelişimine etkileri araştırılmıştır. Tarla çalışması tesadüf blokları deneme deseninde kurulmuş olup 2021 ve 2022 yıllarında patates üretim sezonunda yürütülmüştür. Patates çeşitleri nematisit uygulanan ve uygulanmayan parsellere dikilmişlerdir. Araştırmada çeşitlerde % 50 çıkış gün sayısı, bitkide sap sayısı, % 50 çiçeklenme gün sayısı, bitki boyu, yumru olgunlaşma süresi, büyük-küçük yumru oranları ve dekara yumru verim özellikleri araştırılmıştır. İncelenen özellikler açısından nematisit uygulanan ve uygulanmayan koşullarda patates çeşitleri arasında istatistiksel olarak önemli farklar tespit edilmiş olup, nematisit uygulanmayan parsellerde çeşitlerde önemli düzeyde yumru verim kayıpları olduğu tespit edilmiştir.

Anahtar Kelimeler: *Globodera rostochiensis*, patates, çeşit, verim

Investigation of the Effects of Potato Golden Cyst Nematode on Plant Development in Potato Clones and Varieties

Abstract

Potato Cyst Nematodes cause major losses in the potato (*S. tuberosum*) industry worldwide. Potato Golden Cyst Nematode, *Globodera rostochiensis* is a pest that is quarantined, has no chemical control, cannot be isolated from the soil it is infected with for many years, and causes serious decreases in potato yield. In this study, the effects of Potato Golden Cyst Nematode on plant development in the Desiree and Bettina varieties were investigated in the materials belonging to Niğde Potato Research Institute (Ünlene, Leventbey, Muratbey, PAE 13-08-07) under field conditions. The field study was established in a randomized plot design and observations were taken during two years of potato production season. Potato varieties were planted in the same field in plots with and without nematicide application. While potato varieties were affected in certain proportions in terms of plant maturity time and plant height, the most affected were determined as yield loss per decare and decrease in the number of large tubers.

Key Words: *Globodera rostochiensis*, potato, yield





Antibacterial and Antifungal Properties of *Opuntia ficus-indica*

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Abstract

Phytotherapy, which offers natural remedies, is well-tolerated by the body and is currently experiencing significant growth in Western countries. This is largely due to concerns over the side effects associated with pharmaceutical drugs, prompting many to seek gentler, alternative forms of medicine. Our research focused on *Opuntia ficus-indica*, commonly known as the prickly pear, a plant widely used in phytotherapy. We aimed to investigate its potential antibacterial and antifungal properties. This species, a xerophyte from the cactus family, has been the subject of numerous studies worldwide, highlighting its various bioactive compounds with promising applications in several fields. In our study, we examined the antibacterial and antifungal activities of acetonetic crude extracts and essential oils extracted from the seeds of *Opuntia ficus-indica*. These tests were conducted against several pathogenic bacterial strains (including *Escherichia coli*, *Staphylococcus aureus*, *Bacillus cereus*, *Enterococcus faecalis*, and others) as well as pathogenic fungal strains (such as *Phytophthora infestans*, *Aspergillus parasiticus*, *Penicillium* sp., and two yeast species, *Candida albicans* and *Candida glabrata*), using the agar diffusion method. Our findings revealed that the acetonetic extract exhibited notable antibacterial effects against strains like *Bacillus cereus*, *Enterococcus faecalis*, and *Staphylococcus aureus*. The essential oil extracted from the seeds also demonstrated significant activity against *Micrococcus luteus* and *Pseudomonas aeruginosa*. Antifungal tests showed activity against most fungal strains, except for *Penicillium* sp. and *Phytophthora infestans*, likely due to the plant's high content of phytosterols, particularly beta-sitosterol, and secondary metabolites.

Key Words: *Opuntia ficus indica*, *Bacteria*, *fungy*



ID: 499

***In vitro* Antifungal Effects of Various Essential Oils against Aspergillus Crown Rot of Peanut**

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Abstract

Synthetic fungicides that combat plant pathogenic fungi can enhance crop yields, ensuring stable crop production and market quality. However, the increase in the use of fungicides has led to the development of fungicide-tolerant pathogen strains and the accumulation of fungicide residues in the food chain above safe limits. This underscores the need for improved fungal disease management through alternatives to synthetic fungicides. These alternatives include plant-derived compounds such as essential oils and extracts. Essential oils are known to be potent antifungal activity against both human and plant pathogens. *Aspergillus niger* is a toxin-producing fungal disease agent that causes *Aspergillus* crown rot in peanuts. In this study, the antifungal activities of nine different essential oils (EOs) from *Foeniculum vulgare*, *Lippia citriodora*, *Origanum majorana*, *Origanum minutiflorum*, *Origanum onites*, *Origanum syriacum*, *Origanum vulgare*, *Salvia aramiensis* and *Thymus syriacus* plants were evaluated against *Aspergillus niger* under *in vitro* conditions. These essential oils were assessed based on their impact on the mycelial growth of *A. niger*. The spore suspension of the fungus was spread on PDA medium, essential oils were absorbed into antimicrobial sensitivity test discs and their antifungal activities were determined. Among the nine essential oils tested, *O. vulgare* EO exhibited the highest antifungal activity with an inhibition zone diameter of 49.33 mm. The essential oils of *T. syriacus*, *O. onites*, *O. syriacum* and *O. minutiflorum*, however, expressed antifungal activity at the relatively lower diameter of inhibition zone (48.67, 47.00, 46.33 and 43.33 mm, respectively). The results of this study indicate that plant essential oils could be valuable in promoting research aimed at developing new agents for fungal disease management. However, further analyses are needed to optimize *in vivo* application conditions against *A. niger*.

Key Words: Antifungal, Essential oil, Peanut, *Aspergillus niger*

Yer Fıstığında Aspergillus Kök Boğazı Çürüklüğüne Karşı Çeşitli Uçucu Yağların *in vitro* Antifungal Etkileri

Özet

Bitki patojeni funguslarla mücadelede sentetik fungusitler, ürün verimini artırarak istikrarlı üretim ve pazar kalitesi sağlayabilir. Ancak fungusit kullanımındaki artış, fungusite toleranslı patojen türlerinin gelişmesine ve gıda zincirinde güvenli sınırların üzerinde fungusit kalıntılarının birikmesine yol açmıştır. Bu durum, sentetik fungusitlere alternatif olarak geliştirilen fungal hastalıklarla mücadele yöntemlerine olan ihtiyacı vurgulamaktadır. Bu alternatifler arasında, uçucu yağlar ve ekstraktlar gibi bitkisel kaynaklı bileşikler yer almaktadır. Uçucu yağların, hem insan hem de bitki patojenlerine karşı güçlü antifungal etkiye sahip olduğu bilinmektedir. *Aspergillus niger*, yer fıstığında *Aspergillus* kök boğazı çürüklüğüne neden olan, toksin üreten bir fungal hastalık etmenidir. Bu çalışmada, *Foeniculum vulgare*, *Lippia citriodora*, *Origanum majorana*, *Origanum minutiflorum*, *Origanum onites*, *Origanum syriacum*, *Origanum vulgare*, *Salvia aramiensis* ve *Thymus syriacus* bitkilerinden elde edilen dokuz farklı uçucu yağın (EO) *in vitro* koşullar altında *A. niger*'e karşı antifungal etkileri değerlendirilmiştir. Bu uçucu yağlar, *A. niger*'in misel gelişimi üzerindeki etkilerine göre incelenmiştir. Fungusun spor süspansiyonu PDA ortamına yayılmış, uçucu yağlar antimikrobiyal duyarlılık test disklerine emdirilmiş ve antifungal etkileri belirlenmiştir. Test edilen dokuz uçucu yağ arasında, *O. vulgare* uçucu yağı, 49,33 mm'lik inhibisyon zon çapı ile en yüksek antifungal etkiyi göstermiştir. Bununla birlikte, *T. syriacus*, *O. onites*, *O. syriacum* ve *O. minutiflorum* uçucu yağları sırasıyla 48,67, 47,00, 46,33 ve 43,33 mm'lik inhibisyon bölgesi çapları ile nispeten daha düşük antifungal etkinlik göstermiştir. Bu çalışmanın sonuçları, bitki uçucu yağlarının fungal hastalıkların mücadelesinde yeni ajanlar geliştirmeye yönelik araştırmaları teşvik etmede değerli olabileceğini ortaya koymaktadır. Ancak, *A. niger*'e karşı *in vivo* uygulama koşullarını optimize etmek için daha fazla analiz gerekmektedir.

Anahtar Kelimeler: Antifungal, Uçucu yağ, Yer fıstığı, *Aspergillus niger*



ID: 502

The Success Rate of Frozen Jersey Embryos in Rwanda: A case Study of Songa RAB Cattle Farm in Huye District

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Abstract

Milk and animal products are in high demand as the population grows and the economy prospers. Embryo technology is one of the technologies recommended for expanding access to improved dairy cattle. Challenges of the Rwanda dairy industry include low-producing cattle genetics, which results in the need to import live animals, semen, and embryos. This study investigated the embryo success rate at the Songa RAB farm between March and August 2024. Out of 62 potential recipients, 41 met experimental study parameters, including cycling, body condition score, body weight, reproductive history, and age. The cows and heifers that met selection criteria were treated with hormones to induce oestrus heat and only 17 animals had a suitable corpus luteum size to receive embryos. The pregnancy rate was determined at 90 days after implantation using ultrasonography. The collected data were analyzed via SPSS. 23. The study's findings revealed that only 29.4% of embryo transfers resulted in pregnancy. In the present study, size of the corpus luteum, recipient age, and frequency of observed heat signs were strongly correlated with a higher success rate. Despite its relevance in lowering the cost of importing live cows, minimizing animal disease transmission, and providing other economic benefits, ET technology is not commonly used, particularly in developing countries. Even though embryo technology has financial and technical barriers, it can still be recommended as an alternative method of integrating pure breeds into Rwanda's dairy development strategies.

Introduction

Embryo transfer is a process of transferring an embryo collected from a donor cow to another female (recipient) to complete the gestation period. This technique was first tested on rabbits and then on cattle, where it proved successful, particularly in developed countries (Kugonza et al., 2013). This technology is critical in the dairy sector because it accelerates the dissemination of high genetic merit cattle by maximizing the reproduction potential of the donor cow, and saves money over purchasing a live animal that may struggle to adapt to a new environment. Despite its importance, embryo transfer is expanding slowly, with little adoption in developing countries. This could be due to low technical expertise, economic constraints, poor success rate, and other reasons. The embryo transfer technology is proposed to be a tool to intensify livestock to keep high-performing dairy cattle and to obtain pure breeds with good performance in terms of milk production and other productive performance purposes. In Rwanda, ET was tested since 2010.

With the journey for improving milk production, the Rwandan government has implemented various initiatives, including bovine artificial insemination to improve local cattle breeds, imported exotic dairy cows, and the introduction of embryo transfer technology, in response to increasing milk yield and meeting the growing market for domestic and export dairy products. However, despite the significant increase in milk production in Rwanda from 503,130 MT in 2013 to 1,061,301 MT in 2023, the demand for milk still exceeds the current milk supply (MINAGRI, 2022). The Jersey cattle breed originated from Jersey Island and is reared all over the world for milk production. In Africa, the Jersey cattle breed was introduced around 1880 in South Africa and gradually spread to other countries through crossbreeding with native cattle breeds. Jersey cattle were first introduced to Rwanda in the 1950s at the Station of INEAC (Institut National pour l'Etude Agronomique du Congo-Belge et Ruanda-Urundi) in Nyamiyaga, Nyanza, in the Southern province of the country. The herd later formed the base population of the Songa Research farm operated by RAB (Rwanda Agriculture and Animal Resources Development Board) (Rutinywa and Van Pee, 2016). The introduction of Jersey genetics via ET in Rwanda is intended to reduce the cost of importing live bulls for semen production and live dams from abroad that cannot adapt well to new environments. The Jersey cow is indicated as the ideal dairy genetics cattle for smallholder production and commercial dairy enterprises to increase milk production in Rwanda's environment (Opoola et al., 2024). The Jersey breed is characterized by its small size, low feed consumption, excellent milk production, quality milk with



high nutritional content, disease resistance, heat tolerance, and effective productive performances (Opoola *et al.*, 2024). Therefore, the current study attempted to assess the success rate of frozen Jersey embryos at Songa RAB research station in Rwanda.

Materials and Methods

Study area

This study was conducted between March 2024 and August 2024 at the Songa RAB research station in Huye district, Southern province of Rwanda. Songa is located in the country's mid-altitude zone of 1500-1600 meters, with an average annual temperature of 22 to 29 degrees celsius and 1087 mm of rainfall (Meteo Rwanda). Songa RAB station has around 392 hectares and accommodates approximately 400 cattle, including cows, heifers, and male and female calves. The rainfall pattern varies, with a short rainfall season from September to December, and a longer rainy period from March to May. The dry season extends from June until the end of August, with significant rainfall in April and May. Throughout the year, January and February have moderate weather (Kugonza, *et al.*, 2013). In terms of farm management, cows graze on natural pasture by method of free access. Calves are suckled and weaned at 6 months of age, while female and male calves are kept in independent herd management groups.

Recipient animals

The study's target population included cows aged below 5 years old and 60 to 150 days postpartum and heifers aged 18 months to 24 months with body condition scores ranging from three to 3.5. Out of 62 animals, 41 met the experimental investigation criteria, including 28 heifers and 13 cows. The study used different cattle breed genetics available at the station, including Ankole x Sahiwal (AS) cross, Ankole x Jersey (AJ) cross, Ankole x Frisian (AF) cross, and Ankole x Brown Swiss (AB) cross. The recipients' genital organs of the recipients were examined using manual palpation and an ultrasonographic machine to confirm ovary status. Potential recipients with a corpus luteum in the ovary and without any abnormalities in the uterus were selected and treated with oestrus induction hormones. At the time of ET, the candidates were examined for corpus luteum condition; only 17 individuals were found to be eligible for ET and were then implanted. Some cows did not respond to synchronization, while others did not develop CL to maintain gestation and therefore were disqualified. In the present research, 7-day-old frozen Jersey embryos from the United Kingdom were implanted into recipient cows. The implantation of embryos was carried out by an expert with 40 years of experience in embryo collection and implementation from the United Kingdom with the support of a local team.

Synchronization of recipient

The current study used the Prid Delta technique to synchronize recipients' estrus. During this treatment, the recipients' cows received a series of hormone treatments to synchronize their estrous cycles. This method employs the Prid Delta device as a source of progesterone, prostaglandin (PG), and gonadotropin-releasing hormone (GnRH) to better control and synchronize the estrous cycle. The synchronization protocol was as follows: day 0: Administer GnRH (Gonadotropin-Releasing Hormone) and implant the Prid delta. Day 6: Administer PG (Prostaglandin). Day 7: Remove the Prid. Day 8-11: Monitor for estrus and heat signs. Day 16: implanting embryo.

Statistical analysis

The collected data were recorded and cleaned using Microsoft Excel spreadsheet. The cleaned data were imported and analyzed using SPSS, 23. The difference was considered as being statistically significant when the p-value was less or equal to 0.05 ($p \leq 0.05$).

Results and discussions

The success rate of frozen Jersey embryos in this study was 29.4%. This study's findings differ from the observation made by (Kugonza, *et al.*, 2013) who reported a pregnancy rate of 41% in Rwanda. the current findings are also in contrast with results observed in Netherlands by which reported 56.1% in frozen embryos and 58.4% in different locations in United States of America by (Lamb, 2011). The variation of the ET pregnancy rate might be different from one production system to another. The highest pregnancy rate is likely in intensive commercial dairy farming and less in extensive management systems. Cows in good management; transferring high-quality fresh embryos to suitable recipients might result in pregnancy rates of approximately 80% (Hasler, 2004). Reproductively healthy cows, easy calving, mothering abilities, proper feeding, disease management, and a good selection of recipients are key contributing factors to ET's success rate (Schmidt, 2010). The study findings showed the pregnancy rate was scanty compared to other studies that used frozen and fresh embryos (Hasler, 2004). This might be due to poor management of cows on the farm where cows depend on grazing without any supplementation and management input. To enhance success rate of embryos at Songa Research Center, proper



management of cows that are pretended to be recipients is critical in terms of feeding, and further selection of cattle with good mothering ability history will lead to recipient suitability for ET.

The present study revealed the impact of heat sign frequency on bovine embryo transfer in the study area. The highest success rate of 100% was observed on cows that showed clear mucus and mounted by others, and 50% for cows showed mounting others, mounted by others, and clear mucus respectively (Table1). The lowest conception rate was observed on cows that expressed one heat sign. This might be linked to previous studies that showed the contribution of more estrus signs on the pregnancy rate of bovine artificial insemination, which may contribute to a success rate of ET (Twagiramungu *et al.*, 1995). The more heat signs, the more hormones for maintaining pregnancy. The cows that showed more than two signs of heat expressed a good corpus luteum (CL) during implantation. This might be linked to an increase in hormones like luteinizing hormone (LH) that influence the heat signs intensity (Twagiramungu *et al.*, 1995).

ET pregnancy rate in the study area was proportional to corpus luteum size. The size of the corpus luteum (CL) can affect significantly the pregnancy rates of embryos. According to current findings, larger corpus luteal is associated with higher pregnancy rates. The corpus luteum plays an important role in early pregnancy as it produces progesterone, which helps maintain an appropriate atmosphere in the uterus for the developing embryo. The highest conception rate of 50% was observed in cows that showed big CL during implantation and the lowest pregnancy rate of 11.1% was observed in cows that developed medium CL. The findings of this study are similar to the observation made in Nashville United States of America by (Lamb, 2011) which reported the impact of increasing luteal tissue volume on increasing progesterone concentration level needed to maintain pregnancy.

Age is another factor that contributes to ET pregnancy rate. Pregnancy outcomes are generally better for younger recipients than older recipients. This study showed a high conception rate of 50% in cows under two years, and a reduced success rate of 22.2% in cows aged two to four years (Table 1). The higher the age, the lower the success rate, and vice versa. The study results are comparable to the findings reported by Biruh, 2020, who demonstrated that the pregnancy rate would reduce as age increased and increase when the recipient's age decreased. It is hypothesized that puberty heifers dominate cows in terms of the success rates of embryos. According to (Hasler, J. 2004 & Wilson, 2000), the success rate via ET was 73.05% in virgin heifers and 73% in mature heifers. This could be because mature heifers are more likely to maximize their hormone reproduction capacity following heat induction, but premature heifers are still too late for them to produce enough hormones to maintain pregnancy. Heifers are also less susceptible to reproductive complications that could arise during breeding and calving.

The breed of the recipient is another contributing factor that influenced the success rate significantly. A poor success rate was observed in local breeds (AA). The highest success of 100% was reported in Ankole x Brown Swiss cross followed by 60% of Ankole and Sahiwal genetics (AS) and 20% Ankole Frisian (AF) genetics respectively.

Table 1. Parameters Associated with embryo transfer Success rate

	Variables	Frequency	Success rate (%)	P-Value
Breed	AJ	1	0	0.118
	AF	5	20	
	AS	5	60	
	AA	5	0	
	AB	1	100	
Parity	Heifer	12	25	0.536
	Cows	5	40	
Age	Under 2 Years	6	50	0.319
	2 to 4 Years	9	22.2	
	Above 4 Years	2	0	
CL Site	Right CL	7	28.6	0.949
	Left CL	10	30	
BCS	3	10	20	0.309
	3.5	7	42.9	
CL Status	Presence of medium CL	9	11.1	0.079
	Presence of big with CL	8	50	
Observed heat signs of recipient	Mounting others	5	0	0.062
	Clear mucus	3	0	
	Mounted by others	3	33.3	
	Clear mucus and mounted by others	2	100	
	Mounting others, mounted by others and clear mucus	4	50	
Overall, Success rate			29.40%	



The study findings are similar to those published by Hill (2024), who found 35% in Holstein and Jersey crossbreed and 20% in Holstein. In this study, crossbred cows were more likely to perform than indigenous cattle breeds. This report differs from the findings reported by (Mebratu, 2020), who predicted a higher success rate in Boran (indigenous breed). The low success rate of indigenous breeds could be linked to observations from AI practitioners in Rwanda, who claim poor response via induction heat for indigenous cows compared to crossbred genetics.

Conclusion

The study was designed to determine the success rate of frozen Jersey embryos in Rwanda. The study found that the recipients' age, breed, and responsiveness during synchronization impact the ET success rate. Although embryo transfer is expensive in developing countries, such as Rwanda, it is now more profitable than importing live animals. The current study found that ET technology is feasible and has the potential to make a significant contribution and accelerate dairy cow improvement. Improving herd management and community awareness about embryo technology would result in genetic improvement at minimal expense. In addition, through further research, good partnerships between dairy industry companies, governments, and institutions might be a way to equip local teams to perform well embryo transfer.

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ID: 503

Farklı Gelişme Dönemlerinde Hasat Edilen Yonca (*Medicago sativa* L.) Çeşitlerinin Ot Verimleri ve Bazı Kalite Özelliklerinin Belirlenmesi

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Özet

Bu araştırmada beş farklı yonca (*Medicago sativa* L.) çeşidinin (Nimet, Elçi, L-7-2, Magna-601 ve Magnum-5) üç farklı gelişme döneminde (vejetatif, çiçeklenme başlangıcı ve tam çiçeklenme) hasat edilmesi sonucu elde edilen yaş ot, kuru ot verimleri ile bazı ot kalite özellikleri (% ham protein, % ADF ve %NDF) tespit edilmiştir. Araştırma da tarla çalışmaları Doğu Akdeniz Tarımsal Araştırma Enstitüsü Müdürlüğü'nün araştırma sahasında yürütülmüştür. Tesadüf Bloklarında Bölünmüş Parseller Deneme Desenine göre 4 tekrarlı olarak planlanan çalışmada çeşitler ana parselleri, hasat dönemleri ise alt parselleri oluşturmuştur. Araştırma sonuçları, incelenen özellikler açısından çeşitler, biçim dönemleri ve kalite değerleri arasında istatistiksel olarak çok önemli farklılıklar bulunduğunu ortaya koymuştur. Farklı dormansi oranlarına sahip çeşitlerin dört yıl sürdürülen tarla çalışmalarında kuru ot verimleri yıllara, biçim dönemlerine göre oldukça farklı bulunmuş ve aktif (Non-dormant) sınıfta yer alan Nimet, Elçi ve L-7-2 nolu çeşitlerinin kuru ot verimleri, yarı-dormant olan Magna-601 ve dormant olan Magnum-5 çeşidine göre daha yüksek bulunurken, kalite özellikleri açısından Magnum-5 çeşidi daha üstün değerlere sahip olmuştur. Aktif özellikte (Non-dormant) çeşitlerin özellikle sonbahar döneminde dormant ve yarı dormant çeşitlere göre önemli derecede yüksek ot verimi sağladıkları tespit edilmiştir.

Anahtar kelimeler: Yonca, çeşit, hasat dönemi, kalite



ID: 504

Investigation of Thermal Tourism Areas in Terms of Design Criteria for Healing Gardens: The Case of Eynal Thermal Tourism Centre (Simav-Kütahya)

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Abstract

Tourism is a concept that has different branches and subjects within itself. Health tourism is one of these subjects. Within health tourism, thermal tourism is an important component of this branch of tourism. Thermal tourism has a wide range of users in every season of the year. Therefore, landscape design and planning should be made in accordance with the design criteria of healing gardens based on health. For this purpose, Eynal Thermal Tourism Centre, which has important geothermal resources in Simav district of Kütahya province, was selected as a sample area. As a result of the literature review, the design criteria of healing gardens were determined. Afterwards, the sample thermal tourism area was examined and observed on-site within these criteria. Compliance with the criteria was evaluated in many basic qualities such as the use of plant material, spatial and landscape area diversity, pedestrian circulation network, walking paths, sports areas. Although there are many positive uses in the area, many negative effects and uses such as lack of sensible walking surface and monotony were also observed. After determining the deficiencies and correction needs in the area, suggestions for the area were listed and suggestions were made for the design criteria of improvement gardens for thermal tourism areas.

Key Words: Health tourism, Healing gardens, Design criteria, Eynal Thermal Tourism Centre, Simav

Termal Turizm Alanlarının İyileştirme Bahçeleri Tasarım Kriterleri Açısından İncelenmesi: Eynal Termal Turizm Merkezi (Simav-Kütahya) Örneği

Özet

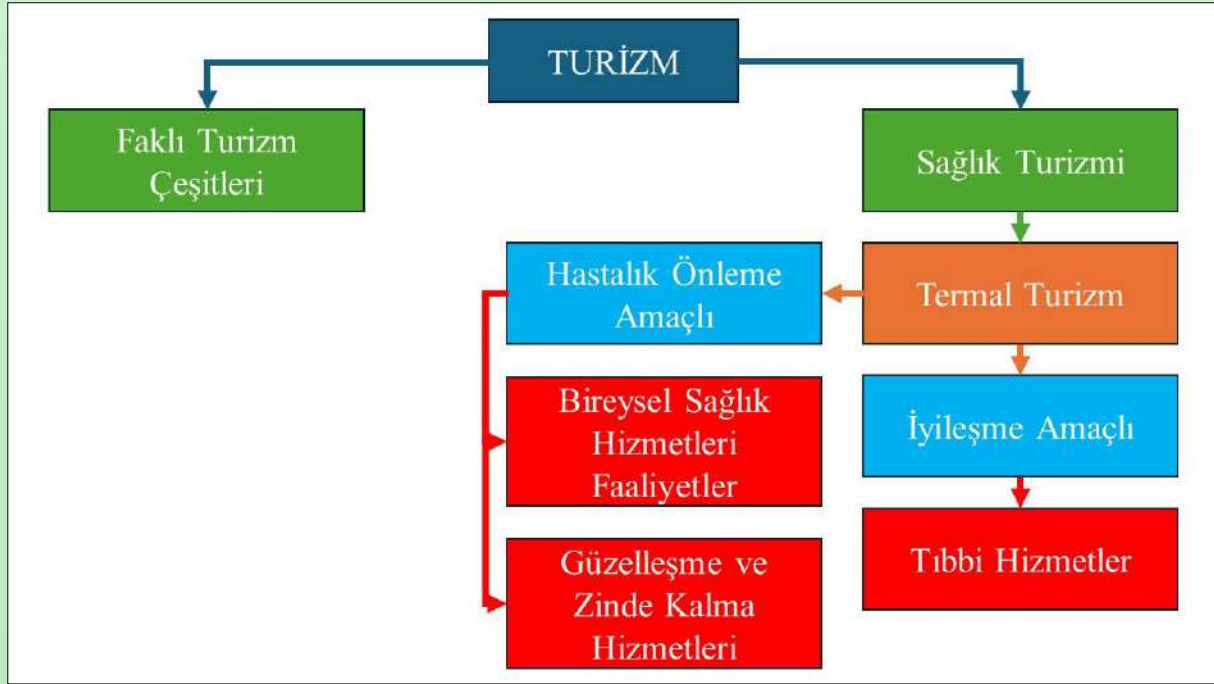
Turizm kendi içerisinde farklı kollar ve konulara sahip bir kavramdır. Sağlık turizmi de bu konulardan birisidir. Sağlık turizmi içerisinde termal turizm bu turizm kolunun önemli bir bileşenidir. Termal turizm yılın her mevsiminde çok çeşitli kullanıcı kitlesine sahiptir. Dolayısıyla benzer tasarım ve planlamalarının sağlık temelinde iyileştirme bahçeleri tasarım kriterlerine uygun olarak yapılması gerekmektedir. Bu amaç kapsamında Kütahya ilinin Simav ilçesine bağlı önemli jeotermal kaynaklarına sahip Eynal Termal Turizm Merkezi örnek alan olarak seçilmiştir. Literatür taramaları sonucunda iyileştirme bahçeleri tasarım kriterleri belirlenmiştir. Daha sonra örnek termal turizm alanı bu kriterler dahilinde yerinde incelenerek gözlemlenmiştir. Bitki materyali kullanımı, mekânsal ve peyzaj alanı çeşitliliği, yaya sirkülasyon ağı, yürüme yolları, spor alanları gibi birçok temel nitelikte kriterlere uyumluluk değerlendirilmiştir. Alanda yapılan incelemelerde birçok olumlu kullanımlar olduğu belirlense de hissedilebilir yürüme yüzeyi eksikliği ve monotonluk gibi birçok olumsuz etki ve kullanımlar da gözlemlenmiştir. Alandaki eksiklikler ve düzeltme ihtiyaçları belirlendikten sonra alan için önermeler sıralanmış, termal turizm alanları için de iyileştirme bahçeleri tasarım kriterleri adına önerilerde bulunulmuştur.

Anahtar Kelimeler: Sağlık turizmi, İyileştirme bahçeleri, Tasarım kriterleri, Eynal Termal Turizm Merkezi, Simav

Giriş

Turizm, çok farklı kollar ve konularda olguların çatı kavramı olduğu için çeşitli tanımları olan bir kavramdır. Fakat çeşitli tanımlamalara rağmen genel bir açıdan turizmin tanımı yapılabilir. Bu açıdan bakılacak olursa; insanların rutin hayatları ve uğraşları dışında kalan zamanlarını değerlendirmek veya rekreasyon amaçlı olarak seyahat etmeleri, geçici konaklamaları ve geçirdiği aktivitelerin bütünü turizm olarak tanımlanabilir (Çelik, 2018; Öztürk, 2018). Yaz, kış, eğitim, kültür, inanç gibi çeşitli amaçlar ile turizm farklı kolları ayrılmaktadır. Sağlık turizmi de bu kolların birisidir. Sağlık turizminin temelini yoğun ve stresli yaşamdan ya da çeşitli rahatsızlıklardan dolayı sağlık sorunları yaşayan veya sağlıklarını korumak isteyen insanlar oluşturur. Bu nedenle sağlık turizmi; insanların sağlıklarını iyileştirmek, korumak veya refahlarını arttırmak için gerçekleştirdiği seyahatler bütünü denilebilir (Aydın, 2012). Termal turizm sağlık turizminin yapısını oluşturan parçalardan birisidir. Termal turizm; ılıca, kaplıca, içmeler gibi hidroterapi ve talasoterapi merkezlerinde belirli sıcaklıklardaki şifalı olan maden sularının içme, yıkanma ve çamur banyosu gibi çeşitli şekillerde kullanıldığı turizm türüdür (Şekil 1) (Çiçek ve Avderen, 2013).





Şekil 1. Termal turizmin yapısı (Bucak ve Özkaya, 2013:10)

Termal turizm cinsiyet, yaş ve fiziki durum fark etmeksizin geniş yelpazede kullanıcıya her mevsim hitap edebilmektedir. Bu durum termal turizm alanlarını yıl içerisinde sürekli bir sirkülasyon içerisinde kalmasını sağlamaktadır (Avşar, 2023). Geniş yelpazede kullanıcı kitlesine ve her mevsimde sirkülasyonun olmasından dolayı termal turizm alanlarının ve peyzajın yakından ilişkili olduğu söylenebilir (Jiménez-García vd., 2020; Vasilyeva vd., 2023). Bu sebeple termal turizm alanlarının peyzaj planlama ve tasarımlarının alanın amacına hizmet edebilecek nitelikte uyumlu olmalıdır. Sağlık amaçlı kullanılan termal turizm alanlarının peyzaj tasarım ve planlamalarında iyileşme bahçeleri tasarım ilkelerine göre uygulanması bu alanların sağlık turizmi açısından en üst düzeye ulaşmasını sağlayacaktır (Keçecioglu, 2014). Çünkü literatürdeki çalışmalar doğa-insan birlikteliğinin psikoloji üzerinde oldukça olumlu etkilerinin olduğunu ve bu durumun sağlık açısından önemli etkilere sebep olduğunu göstermiştir (Lau ve Yang, 2009; Pouya vd., 2015). İyileşme bahçeleri; şifa bahçeleri, restoratif bahçeler, sağlık bahçeleri, rehabilitasyon bahçeleri gibi kavramların içeren yaygın bir tanımdır. Bu peyzaj tasarım yaklaşımını, iyileşmeyi teşvik etmek için kullanıcıların doğa içinde bir bahçede duyularını harekete geçiren veya rahatlatan bir sağlık tesisi olarak tanımlayabiliriz (Cooper Marcus, 2016). İyileşme bahçeleri birçok yönden faydaları olan bir peyzaj tasarım yaklaşımıdır. Bunlar arasından bazıları;

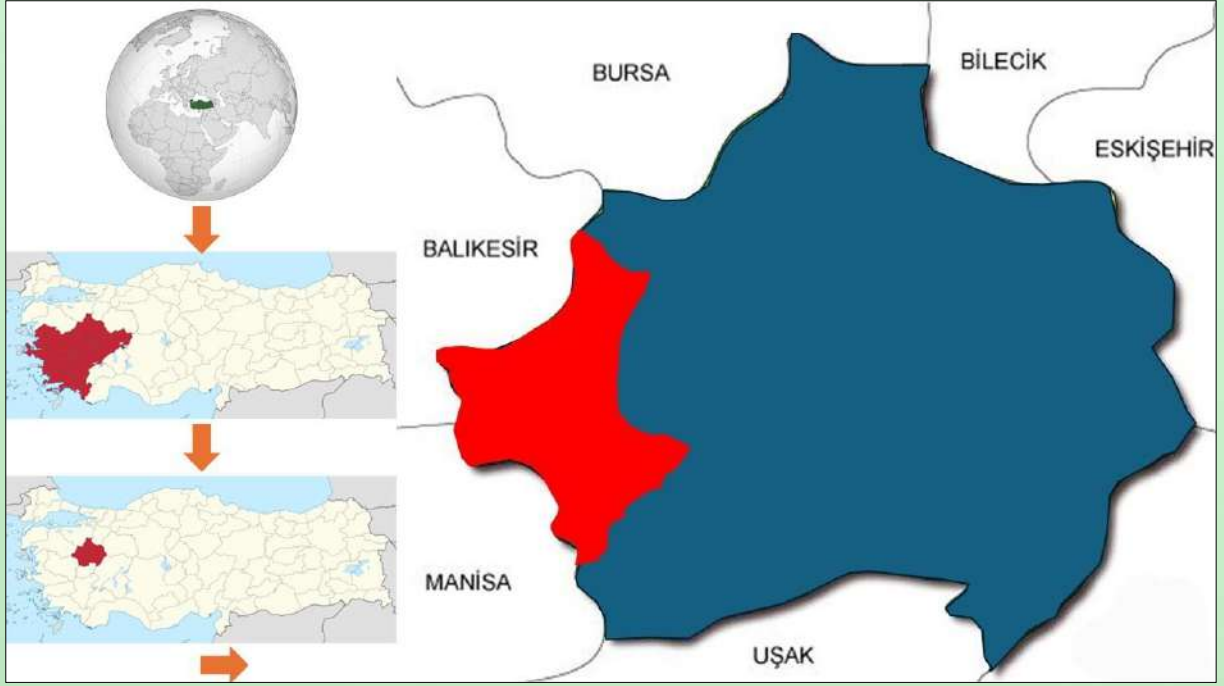
- İyileştirici etkilerinin bulunması,
- Stres ve baskıyı azaltıcı etkisinin olması,
- Kullanıcıları sadece psikolojik olarak değil, fiziksel aktiviteye teşvik eder bu açıdan da önemli etkilerinin olması,
- Motivasyon artırıcı etkiler yaratması olarak sıralanabilir (Din vd., 2023).

Bu çalışma sağlık turizminin bir parçası olan termal turizm alanlarının iyileştirme bahçeleri tasarım kriterleri açısından değerlendirilmesi amacıyla yapılmıştır. Amaca yönelik olarak jeotermal kaynak ve termal turizm açısından zengin bir yer olan Kütahya'nın Simav ilçesindeki Eynal Termal Turizm Merkezi örnek alan olarak seçilmiş ve iyileştirme bahçesi tasarım kriterleri açısından incelenmiştir.

Materyal ve Yöntem

Bu çalışmanın ana materyalini, ülkemiz önemli jeotermal kaynakları ve termal turizm alanlarına sahip Simav ilçesinde bulunan Eynal Termal Turizm Merkezi oluşturmaktadır (Tuncel ve Doğaner, 1992; Çardak vd., 2019). Simav, Ege Bölgesi'nin İç Batı Anadolu Bölümü'nde yer alan Kütahya ilinin bir ilçesidir (Şekil 2). İlçenin deniz seviyesinden yüksekliği 819 m'dir ve 2023 yılı Adrese Bağlı Nüfus Sistemi'ne göre nüfusu 61346 kişidir (Arslan, 2006; TÜİK, 2024).





Şekil 2. Simav (Vikipedi, 2024a; Vikipedi, 2024b; Vikipedi, 2024c; Vikipedi, 2024d'den değiştirilerek)

Simav, 163 °C rezervuar su sıcaklığı ile jeotermal kaynak açısından oldukça zengin bir sahadır ve Eynal bu jeotermal sahası içerisinde yer almaktadır (Gemici ve Tarcan, 2002; Kardaş, 2014). Sahip olduğu jeotermal kaynaklar sayesinde Eynal önemli bir termal turizm alanıdır (Akbulut, 2010). Çalışmada incelenen Eynal Termal Turizm Merkezi'nin Simav ilçe merkezine uzaklığı 5.3 km'dir (Gür ve Kahraman, 2022). İncelenen termal turizm merkezinin Simav ilçe merkezine göre konumu Şekil 3'te belirtilmiştir.



Şekil 3. Termal turizm alanının ilçe merkezine göre konumu. A) Eynal Termal Turizm Merkezi, B) Simav İlçe Merkezi (Google Earth Pro'dan değiştirilerek, 2024)

Çalışmada kaplıca alanlarının iyileştirme bahçeleri tasarım kriterleri açısından incelenmesi 3 aşamada gerçekleştirilmiştir;

- 1. Aşama: İyileştirme bahçelerinin tasarım kriterleri literatür taramaları ile belirlenmiş ve listelenmiştir.
- 2. Aşama: Kaplıca alanlarının her biri tasarım kriterleri dahilinde yerinde ziyaret edilerek incelenmiş, fotoğraflanmış ve değerlendirilmiştir.
- 3. Aşama: Değerlendirmeler sonucunda alanların kriterler dahilinde olumlu yönleri ve eksik yönleri belirlenmiş ve eksik yönlerin giderilmesi için önerilerde bulunulmuştur.



Bulgular ve Tartışma

Çalışma yönteminin ilk aşamasına göre iyileşme bahçelerinin tasarım ilkelerini belirlemek amacıyla literatür taraması yapılmıştır. Bu taramalar sonucunda belirlenen iyileşme bahçeleri tasarım ilkeleri şu şekildedir;

1. Peyzaj tasarım alanlarında çeşitlilik: Tasarım yapılan rekreasyon alanlarının tek veya grup halinde kullanıma elverişli olması gerekmektedir. Aynı zamanda bu alanlar farklı hedef kullanıcıların da ihtiyaçlarını karşılayabilecek düzeyde niteliklere sahip olmalıdırlar. Tasarım alanlarındaki artırılan seçenekler rekreasyon alan kullanıcılarının stresini azaltmaya yardımcı olmalıdır.
2. Bitkisel materyalin ve yeşil tonun egemen olması: Alanlarda bitkisel materyal yoğunluğunun fazla olması ve baskın olması insan-doğa ilişkisini kuvvetlendirir. Böylelikle psikolojik iyi olma hali desteklenebilir.
3. Egzersize teşvik etme: Tasarım alanlarındaki birimleri birbirine bağlayan sirkülasyon kullanıcıları yürüyüş vb. aktivitelere teşvik etmeli ve egzersiz yapabilmelerini sağlamalıdır. Sirkülasyon ağı belirli bir düzende olmalı, sınırları belirli olmalı, farklı kullanışlarda çeşitlendirilmeli ve farklı kullanışlara paralel olarak zemin malzemeleri de buna göre ayarlanmalıdır. Kullanılacak bitkisel materyallerin kullanıcıları rahatsız edecek seviyede dallanmamasına ve yüksekliklerine dikkat edilmelidir. Aynı zamanda bitkisel materyal sirkülasyon ağlarında sınırlandırma ve yönlendirme amaçlı da kullanılabilir.
4. Dikkat çekici nitelikte uyarıcıların bulunması: Bitkiler, su elemanları ya da tek renk düzeninde cansız materyallerin işitsel veya görsel etkileri kullanarak insanlar üzerinde sakinlik hissi yaratılabilir ve stresin azaltılmasına yardımcı olunabilir. Ek olarak bu materyaller kullanılarak pozitif duyguların harekete geçmesi de sağlanabilir. Bitkilerin, renk, doku, form ve koku gibi özellikleri ile kullanıcıların dikkatleri ve odak noktaları yönlendirilebilir, monotonluğun önüne geçilebilir. Aynı şekilde cansız materyallerde de sıcak renklerin kullanımları ile canlılık sağlanabilir, dikkat ve odak noktası yönlendirilebilir.
5. Çevresel uyarıcıların minimize edilmesi: Tasarım alanlarının kullanıcılarda dikkat dağılmasına sebep olabilecek gürültü, toz ve görüntü gibi dış etmenlere kapalı olması gerekmektedir. Bu alanlarda mahremiyete özen gösterilmelidir (Eckerling, 1996; Rivasseau-Jonveaux vd., 2012; Erbino vd., 2015; Chun ve Lee, 2016; Wang ve Tzortzi, 2023).

Peyzaj Alanlarında Çeşitlilik:

Açık ve kapalı alanlar dahil olmak üzere 245885 m² alana sahip Eynal Termal Turizm Merkezi'ndeki (Google Earth Pro, 2024) farklı mekân ve peyzaj alanı kullanımları yerinde tespit edilmiştir. Buna göre alanda bulunan farklı mekân ve peyzaj alanı kullanımları;

- 1 restoran,
- 2 Türk hamamı,
- 3 aile çay bahçesi,
- 1 butik otel,
- 1 açık su parkı,
- 1 yarı olimpiik yüzme havuzu,
- 1 ayak banyosu-terapi merkezi,
- 2 kafe,
- 192 konaklama amaçlı apart daire,
- 1 voleybol sahası,
- 1 basketbol sahası,
- 1 tenis kortu,
- 1 çim futbol sahası,
- 3 market,
- 5 çocuk oyun alanı,
- 2 piknik ve mesire alanı,
- 1 camii,
- 2 bisiklet ve yürüyüş yolu şeklindedir.

Örnek alanda 18 farklı mekân ve peyzaj alan kullanımının olması olumlu olarak gözlenmiştir. Fakat bu durum çeşitliliğin geliştirilebilir olmadığı anlamına gelmemektedir. Alanda su ögesi kullanımının olmaması çeşitlilik adına eklenebilecek ilk kullanım olarak akla gelmektedir. Sakıcı ve Var (2014) ve Yılmaz (2017) çalışmalarında peyzaj alanlarında su ögesi kullanımlarının stresli ve psikolojik rahatsızlıkları olan kişilerde rahatlatıcı ve iyileştirici etkilere sahip olduğunu belirtmişlerdir. Ayrıca farklı mekânsal kullanım olarak Kanat (2019)'un çalışmasında belirttiği üzere fiziksel ve ruhsal iyileşmede etkili olan aromaterapi ve fizik tedavi merkezi ile çeşitlendirilip alan zenginleştirilebilir.

Bitkisel Materyalin ve Yeşil Tonun Egemen Olması:

Termal turizm alanında yapılan incelemeler sonucunda alanda bulunan bitki türleri tespit edilmiştir. Tespit edilen bitki türleri ve familyaları Tablo 1'de belirtilmiştir.



Tablo 1. Eynal Termal Turizm Merkezi alanında tespit edilen bitki türleri

Bitki Türü	Familiya	Yaşam Formu
<i>Acer negundo</i> L.	Sapindaceae	Ağaç
<i>Acer negundo</i> var. <i>aureovariegatum</i> Wesm.	Sapindaceae	Ağaç
<i>Acer platanoides</i> L.	Sapindaceae	Ağaç
<i>Acer pseudoplatanus</i> L.	Sapindaceae	Ağaç
<i>Aesculus hippocastanum</i> L.	Sapindaceae	Ağaç
<i>Ailanthus altissima</i> (Mill.) Swingle	Simaroubaceae	Ağaç
<i>Berberis julianae</i> C.K.Schneid.	Berberidaceae	Çalı
<i>Berberis thunbergii</i> DC.	Berberidaceae	Çalı
<i>Betula pendula</i> Roth	Betulaceae	Ağaç
<i>Calendula officinalis</i> L.	Asteraceae	Çiçek
<i>Canna indica</i> L.	Cannaceae	Çiçek
<i>Catalpa bignonioides</i> Walter	Bignoniaceae	Ağaç
<i>Cedrus deodora</i> (Roxb. ex D.Don) G.Don	Pinaceae	Ağaç
<i>Cercis siliquastrum</i> L.	Fabaceae	Ağaç
<i>Cotinus coggygria</i> Scop.	Anacardiaceae	Çalı
<i>Cupressus arizonica</i> Greene	Cupressaceae	Ağaç
<i>Cupressus arizonica</i> var. <i>glabra</i> (Sudw.) Little	Cupressaceae	Ağaç
<i>Cupressus sempervirens</i> L.	Cupressaceae	Ağaç
<i>Elaeagnus angustifolia</i> L.	Elaeagnaceae	Ağaç
<i>Euonymus japonicus</i> Thunb.	Celastraceae	Çalı
<i>Ilex aquifolium</i> L.	Aquifoliaceae	Çalı
<i>Juglans regia</i> L.	Juglandaceae	Ağaç
<i>Juniperus sabina</i> L.	Cupressaceae	Çalı
<i>Koelreuteria paniculata</i> Laxm.	Sapindaceae	Ağaç
<i>Lavandula angustifolia</i> Mill.	Lamiaceae	Çalı
<i>Mahonia aquifolium</i> Pursh	Berberidaceae	Çalı
<i>Morus nigra</i> var. <i>pendula</i> L.	Moraceae	Çalı
<i>Nerium oleander</i> L.	Apocynaceae	Çalı
<i>Parthenocissus quinquefolia</i> (L.) Planch.	Vitaceae	Sarımsıkçı Tırmanıcı
<i>Philadelphus coronarius</i> L.	Hydrangeaceae	Çalı
<i>Photinia fraserii</i> Dress	Rosaceae	Çalı
<i>Picea pungens</i> Engelm.	Pinaceae	Ağaç
<i>Pinus brutia</i> Ten.	Pinaceae	Ağaç
<i>Platanus orientalis</i> L.	Platanaceae	Ağaç
<i>Platycladus orientalis</i> (L.) Franco	Cupressaceae	Çalı
<i>Populus alba</i> L.	Salicaceae	Ağaç
<i>Populus tremula</i> L.	Salicaceae	Ağaç
<i>Prunus cerasifera</i> Ehrh.	Rosaceae	Ağaç
<i>Prunus persica</i> (L.) Batsch	Rosaceae	Ağaç
<i>Robinia pseudoacacia</i> L.	Fabaceae	Ağaç
<i>Rosa sempervirens</i> L.	Rosaceae	Çalı
<i>Rosmarinus officinalis</i> L.	Lamiaceae	Çalı
<i>Salix babylonica</i> L.	Salicaceae	Ağaç
<i>Styphnolobium japonicum</i> (L.) Schott	Fabaceae	Ağaç
<i>Tagetes erecta</i> L.	Asteraceae	Çiçek



<i>Tamarix ramosissima</i> Ledeb.	<i>Tamaricaceae</i>	Çalı
<i>Tilia tomentosa</i> Moench	<i>Malvaceae</i>	Ağaç
<i>Viburnum lucidum</i> L.	<i>Adoxaceae</i>	Çalı
<i>Viburnum opulus</i> L.	<i>Adoxaceae</i>	Çalı
<i>Vitis vinifera</i> L.	<i>Vitaceae</i>	Sarılcı Tırmanıcı

Alanda 50 farklı bitki türü tespit edilmiştir. Tespit edilen bu bitkilerin genelinde yeşil yapraklı bitkiler hakimdir. Bu açıdan bakıldığında iyileştirme bahçeleri tasarım ilkeleri kapsamında alanın hem bitki çeşitliliği sağlaması hem de yeşil tonun hâkim olması olumlu bir etki olduğu görülmektedir.

Egzersize Teşvik Etme:

Alandaki yaya ve bisiklet yolları ve sirkülasyon ağı incelendiğinde egzersize teşvik edici olduğu, bitkiler veya pergoleler yardımı ile kısmen gölgelendirildiği belirlenmiştir. Bitki ve pergoleler yardımı ile yürüme yollarının gölgelendirilmesi egzersiz veya yürüme eylemlerinin iklimsel olaylar kaynaklı olarak kesintiye uğramaması konusunda kullanıcılara kolaylık sağladığı görülmüştür (Şekil 4).



Şekil 4. Pergole ve bitkiler yardımı ile yürüme yollarının kısmen gölgelendirilmesi (Orijinal, 2024)

Alanda farklı zemin malzemelerinin kullanılmaması yürüme yollarının ve sirkülasyon ağının düzenli şekilde devam etmesini sağlamaktadır. Ancak bu durum alanı kullanan bütün kullanıcılar için geçerli değildir. İncelemeler sonucunda alanın hiçbir yerinde hissedilebilir yürüme yüzeylerinin bulunmadığı görülmüştür. Alanda hissedilebilir yürüme yüzeylerinin olmaması görme engelli kullanıcılar için olumsuz bir durum olarak karşımıza çıkmaktadır. Bu yönüyle alan hem iyileştirme bahçeleri tasarım kriterlerine hem de engelsiz peyzaj tasarım yaklaşımlarına uymamaktadır (Gür ve Kahraman, 2024). Aynı zamanda yürüme yollarında ve sirkülasyon ağında egzersizi teşvik etme açısından karşılaşılan diğer bir olumsuzluk ise gölgelendirme amaçlı kullanılan bitkisel materyalin alt dal budamalarının yapılmamış olmasıdır. Bitkilerin alt dallarının budanmaması baş hizasında kullanıcılara zarar verebilir veya yürüyüş egzersizleri sırasında kullanıcılara rahatsızlık verebilir düzeyde olduğu tespit edilmiştir (Şekil 5).





Şekil 5. Yürüme yollarında bitki materyallerinin egzersizi engelleyici dal yapıları (Orijinal, 2024)

Yürüme ve bisiklet yolları, sirkülasyon ağı alan içerisinde yüksek bordür taşları ile ayrıldığı için alanda bitkiler yardımcı ile yapılmış herhangi bir yönlendirme veya sınırlama yapılmadığı görülmüştür. Bu durumun yürüyüş ve egzersiz esnasında kullanıcıların dar bir alanda kısıtlı kalma hissinin ortadan kalmasına ve daha geniş bir görüş açısı ile hareket etmelerini sağladığı düşünülmektedir.

Dikkat Çekici Nitelikte Uyarıcıların Bulunması:

Termal turizm merkezi alanında kafe, restoran ve aile çay bahçesi alanlarında gerek cansız materyaller gerekse bitkisel materyaller yardımıyla renk, doku, koku vb. etkiler kullanılarak yeşil renk hakimiyeti kaynaklı monotonluğun önüne geçildiği gözlemlenmiştir. Aksoy ve Demir (2022) çalışmalarında sıcak renklere sahip cansız materyallerin ya da sıcak renkli gövde, dal, yaprak, meyve, çiçek gibi organlara sahip bitki materyali kullanımlarının canlılık ve dinamizm kattığını belirtmişlerdir. Dolayısıyla spor alanlarının peyzaj düzenlemelerinde egzersize teşvik edici, sporun doğası gereği monotonluğun kırılması adına bu alanlarda sıcak renklere sahip cansız materyallerin kullanılması gerekmektedir. Termal turizm alanındaki spor alanları incelendiğinde cansız materyal veya bitkisel materyallerde sıcak renklerin kullanılmadığı ve bu alanlarda monotonluğun önüne geçilemediği bir olumsuzluk olarak gözlemlenmiştir (Şekil 6).



Şekil 6. Spor alanlarında sıcak renklerin kullanılmaması örneği (Orijinal, 2024)



Çevresel Uyarıcıların Minimize Edilmesi:

Eynal Termal Turizm Merkezi alanında araç sirkülasyonunun olduğu alanlar haricinde geriye kalan tüm kapalı ve açık alanlar gerek ağaç gerek ağaççık gerekse çalılar yardımı ile dış etmenlerden korumak ve mahremiyeti arttırmak amacıyla çevrelediği belirlenmiştir. Mesire ve piknik alanlarında mangal dumanları vb. kötü koku ve duman yayılımında hem kullanıcıların rahatsız olmasını engellemek hem de gölge oluşturması için ağaç türlerinin kullanıldığı gözlemlenmiştir (Şekil 7).



Şekil 7. Piknik ve mesire alanlarının ağaçlar ile perdelenmesi (Orijinal, 2024)

Alanda özellikle çevresel uyarıcıların minimize edilmesi gerektiği düşünülen konaklama amaçlı kullanılan apartların tamamının bitkisel materyaller yardımı ile çevrelediği ve mahremiyetin bu yolla sağlandığı belirlenmiştir (Şekil 8).



Şekil 8. Konaklama amaçlı apartların çalı ve ağaçlar kullanılarak mahremiyetinin oluşturulması (Orijinal, 2024)

Sonuç ve Öneriler:

Turizm kendi içerisinde birçok dala ayrılan bir kavramdır. Sağlık turizmi de turizmin bir dalıdır. Sağlık turizmi insanların sağlıklı yaşam, tedavi vb. ihtiyaçlarını giderdikleri seyahatler bütünüdür. Sağlık turizminin en önemli bileşenlerinden birisi de termal turizmdir. Termal turizm yılın her mevsimi yapılabilmesi ve yaş, cinsiyet vb. ayırım göstermeden tüm kitlelere hitap ettiği için termal turizm alanlarının peyzaj tasarımı ve planlamasının iyi yapılması



gerekmektedir. Buna bağlı olarak termal turizm alanlarının peyzaj tasarım ve planlamalarının termal turizmin temeline yani iyileştirme temeline yönelik olarak iyileştirme bahçeleri tasarım kriterlerine odaklanılarak yapılması gerekmektedir. Çalışmada Kütahya ilinin Simav ilçesinde yer alan ve önemli termal kaynaklara sahip olan Eynal Termal Turizm Merkezi örnek alan olarak seçilmiştir. Alan çalışmanın amacına yönelik olarak iyileştirme bahçeleri tasarım kriterleri altında incelenmiştir. Literatür taramaları sonucunda iyileştirme bahçeleri tasarım kriterleri belirlenmiştir. Örnek termal turizm alanı bu kriterler üzerinde yerinde incelenerek gözlemlenmiştir. İncelemeler sonucunda alanda kriterlere yönelik hem olumlu hem de olumsuz birçok nokta tespit edilmiştir. Bulgular ışığında Eynal Termal Turizm Merkezi örneği üzerinde görülen eksikliklere göre termal turizm alanlarında alınması gereken önlem ve öneriler şu şekilde sıralanabilir;

1. Termal turizm alanının mekânsal ve peyzaj alanı açısından çeşitliliğinin bulunması olumlu olarak gözlemlenmiştir. Fakat psikolojik açıdan olumlu etkilerinin olduğu bilinen peyzaj alanlarından su ögesi kullanımının alanda mevcut olmadığı görülmüştür. Alanda uygun yerlerde su ögesi kullanımı mekânsal ve peyzaj alanı çeşitliliğini zenginleştirdiği öngörülmüştür. Ayrıca fizik tedavi ve aroma terapi merkezleri gibi farklı mekânsal eklemelerle birlikte alanın çeşitlendirilmesi sağlanabilir.
 2. Alandaki bitki türlerinde yeşil yapraklı türlerin çoğunlukta olması iyileşme bahçeleri tasarım kriterleri açısından olumlu olsa da bitkilerin genelini yaşam formu olarak ağaç olması başka bir açıdan olumsuzluk olarak görülmüştür. Bu nedenle alanda bitkisel tasarımı çeşitlendirilebilmesi için yeşil yapraklı farklı türlerde çalı ve yer örtücü türlerin peyzaj tasarımına dahil edilmesi ve tür zenginliğinin artırılması gerekmektedir.
 3. Alandaki sirkülasyon ağı ve yürüme yollarının düzenli oluşu egzersize teşvik edici olsa da bu durumun tüm kullanıcılar için geçerli olmadığı tespit edilmiştir. Çünkü alanın hiçbir yerinde hissedilebilir yürüme yüzeyi zemin elemanı kullanımına rastlanmamıştır. Dolayısıyla sirkülasyon ağı, yürüme ve koşma yolları hem iyileştirme bahçeleri tasarım ilkelerini hem de engelsiz peyzaj tasarım yaklaşımlarına uymamaktadır. Alanda kullanılan tüm yaya sirkülasyonu ağı, yürüme ve koşma yollarına hissedilebilir yürüme yüzeyleri zemin elemanları dönmelidir. Ayrıca bu alanlardaki bitkisel kullanımlarda gerekli bakımların yapılması, alt dalların budanması ve kullanıcıların göz ve baş hizasında olası yaralanmaların önüne geçilmelidir.
 4. Alandaki spor alanlarının peyzaj düzenlemelerinde kullanılan gerek bitkisel materyal gerekse cansız materyallerin dikkat çekici nitelikte olmadığı ve monotonluğun önüne geçmedi gözlemlenmiştir. Bu durumda alanın zemin malzemeleri, oturma elemanları gibi cansız materyal kullanımlarında sıcak renkler kullanılmalıdır. Aynı zamanda bitkisel materyallerde çiçek, gövde, dal, yaprak gibi organları ile öne çıkan sıcak renklerin hakim olduğu türlerin tercih edilmesi ve monotonluğu önüne geçilmesi gerekmektedir.
- Çalışma sonucunda elde edilen bulgular ve önermeler ışığında termal turizm alanlarında iyileştirme bahçeleri tasarım kriterlerinin uygulanmasının sağlık turizmi açısından önemli katkılar sağlayacağı, kullanıcı konforu ve turist memnuniyetini daha üst seviyelere getireceği ortaya koyulmuştur. Kentsel açık-yeşil alanlardaki farklı kullanım statülerine sahip alanlarda incelemeler yapıp kriterler dahilinde alanların değerlendirilmesi daha sağlıklı kentler ve alanlar oluşturulması konusunda literatüre katkı sağlayacaktır.

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An Ethnobotanical Research on Woody Ornamental Plants Used in Landscaping of Recreation Areas in Çanakkale City

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Abstract

As one of the most important parts of urban open-green spaces, plant material has many aesthetic, functional and ecological advantages. From past to present, builders have utilized plants for many different purposes such as medicine, food, furniture making, etc. The concept of ethnobotany, which expresses the place of plants in the human-nature relationship, appears as an umbrella concept in economic, ecological and cultural terms. Many ornamental plants that we encounter in urban recreation have ethnobotanical use and the use of these plants may differ from region to region. For this purpose, existing woody ornamental plants in four recreation areas with different qualities in Çanakkale province, which has been an important settlement of many civilizations since ancient times, constitute the main material of the study. Within the scope of the study, 2 coastal landscaping areas, 1 city park and 1 university campus were determined as research areas and the ethnobotanical uses of woody ornamental plants in these areas were examined. As a result, it was determined that 97 ornamental plant taxa had ethnobotanical uses in the areas. The majority of these plants were found to have medicinal (34.56%) and food (26.74%) uses. Considering the high ethnobotanical use potential of plant material used in urban recreation areas, these plants should be promoted, and awareness should be created. As a final result of on-site observations and statistical evaluations in the study, suggestions were made for the ethnobotanical uses of ornamental plants in urban recreation areas.

Key Words: Woody Ornamental Plants, Urban Recreation, Ethnobotany, Plant Uses

Çanakkale Kenti Rekreasyon Alanları Peyzaj Düzenlemelerinde Kullanılan Odunsu Süs Bitkileri Üzerine Etnobotanik Bir Araştırma

Özet

Kentsel açık-yeşil alanların en önemli parçalarından biri olarak bitkisel materyalin estetik, işlevsel ve ekolojik birçok artısı bulunmaktadır. Geçmişten bugüne inşalar tıbbi, gıda, eşya yapımı vb. birçok farklı amaçlar için bitkilerden yararlanmışlardır. İnsan-doğa ilişkisi içinde bitkilerin yerini ifade eden etnobotanik kavramı; ekonomik, ekolojik ve kültürel açıdan bir çatı kavram olarak karşımıza çıkmaktadır. Kentsel rekreasyon içerisinde karşılaştığımız birçok süs bitkisi etnobotanik kullanıma sahip olup, bu bitkilerin kullanımı yöreden yöreye farklılık gösterebilir. Bu amaçla antik dönemlerden beri birçok medeniyetin önemli bir yerleşim yeri olan Çanakkale ilinde yer alan ve farklı niteliklere sahip dört rekreasyon alanındaki mevcut odunsu süs bitkileri çalışmanın ana materyalini oluşturmaktadır. Çalışma kapsamında 2 kıyı alanı peyzaj düzenlemesi, 1 kent parkı ve 1 üniversite kampüsü yerleşkesi araştırma alanı olarak belirlenmiş ve buradaki odunsu süs bitkilerinin etnobotanik kullanımları incelenmiştir. Sonuç olarak alanlarda 97 süs bitkisi taksonunun etnobotanik kullanımlarının olduğu belirlenmiştir. Bu bitkilerin çoğunluğunun tıbbi (% 34.56) ve gıda (% 26.74) amacıyla kullanımlara sahip olduğu görülmüştür. Kentsel rekreasyon alanlarında kullanılan bitkisel materyalin etnobotanik kullanım potansiyellerinin yüksek olduğu göz önüne alındığında, bu bitkilerin tanıtılması ve farkındalığının oluşturulması gerekmektedir. Çalışmada yerinde gözlem ve istatistiksel değerlendirmelerinin nihai sonucunda kentsel rekreasyon alanlarındaki süs bitkilerinin etnobotanik kullanımlarına yönelik önerilerde bulunulmuştur.

Anahtar Kelimeler: Odunsu Süs Bitkileri, Kentsel Rekreasyon, Etnobotanik, Bitki Kullanımları

Giriş

Kentsel açık-yeşil alanlar, kent yaşamının çok önemli bir elemanıdır. Kent içerisinde sosyal yaşamı destekleyerek estetik ve ekolojik öneme sahip etkileri ile birlikte kent gelişiminin sağlıklı olmasını sağlarlar. Kentsel açık-yeşil alanların ve kent ekosisteminin korunması ve sürdürülebilirliğinin sağlanması açısından süs bitkilerinin önemi yok sayılamaz. Kent yaşamına katılarak süs bitkileri insan-doğa ilişkisini güçlendirerek mental açıdan insanları rahatlatarak uyumlu alanlar yaratılmasına yardımcı olurlar (Erduran Nemutlu, 2013).



İnsanlar geçmiş zamanlardan beri bitkileri kullanarak şifa bulmak, beslenmek, korunmak, barınmak, avlanmak vb. ihtiyaçlarını karşılamışlardır. Bitkilerin bu şekilde kullanılmaları etnobotanik teriminin doğmasını sağlamıştır (Akan ve Bakır Sade, 2015). Etnobotanik geçmişten bu yana bitkilerin yerel halk tarafından kullanımı ya da kullanım biçimi olarak tanımlanabilir. Etnobotanikğin temel dayanağı, bitkilerin insanlar tarafından hangi amaçlarla ve nasıl kullanıldığı olmasının yanında insan-doğa ilişkisinin tarihi, coğrafi, kültürel vb. yönlerini de araştırmaktır (Demir vd., 2017). İnsan-doğa ilişkisinde bitkilerin rolünün ortaya konulmasında önemli bir etmen olan etnobotanik, dünyada bitkilerin şifa kaynağı olarak kullanılmasına büyük katkılar sağlar. Özellikle ülkemiz gibi zengin floraya sahip yerlerde insanlar günlük yaşamlarında bitkileri kozmetik, eşya yapımı gibi farklı durumlarda çok yoğun şekilde faydalanmaktadır (Korkmaz ve Alpaslan, 2015). Tüm bu farklı kullanımların yanında bu bitkilerin süs bitkisi olarak kent içerisinde rekreasyon alanlarında da kullanıldığı görülmektedir. Parklar, refüjler, kıyı alanları, kampüs yerleşkeleri vb. birçok farklı nitelikteki rekreasyon alanlarında kullanılan süs bitkilerinin etnobotanik kullanımlarının olması mümkündür. Etnobotanik bilgilerin ve kullanımlarının gelecek nesillere aktarılması ve farkındalığının oluşturulması açısından kentsel rekreasyon alanlarındaki süs bitkilerinin etnobotanik kullanımlarının belirlenmesi oldukça değerlidir (Fonseca ve Balick, 2018).

Bu çalışma farklı kullanım niteliklerine sahip kentsel rekreasyon alanlarında kullanılan odunsu süs bitkisi taksonlarının etnobotanik kullanımlarının belirlenmesi amacıyla yürütülmüştür. Amaca yönelik olarak Çanakkale kentindeki yoğun kullanıma sahip bazı rekreasyon alanları incelenmiş ve değerlendirilmiştir.

Materyal ve Yöntem

Bu çalışmanın ana materyalini Çanakkale ili merkezinde bulunan ve çok sayıda kullanıcıya hitap eden rekreasyon alanlarının peyzaj düzenlemelerinde kullanılan odunsu bitki taksonları oluşturmaktadır. Çanakkale ili Marmara Bölgesi'nde Marmara Denizi ve Ege Denizi'nin birbirine bağlandığı noktada yer almakta olup, 25° 35' – 27° 45' doğu boylamları ve 39° 30' - 40° 42' kuzey enlemleri arasında bulunmaktadır. İlin toplam yüzölçümü 9737 km²'dir (Çanakkale Belediyesi, 2024). Çanakkale ilinde Akdeniz ve Karadeniz iklimlerinin geçiş iklimi hakimdir ve yıllık ortalama yağış miktarı 600-1200 mm arasında değişmektedir (Karayel ve Akçura, 2016). Çalışmada Çanakkale kent merkezinde yoğun kullanıma sahip 2 ayrı kıyı alanı peyzaj düzenlemesi, 1 kent parkı ve 1 üniversite kampüs yerleşkesi gibi farklı niteliklere sahip 4 alanda incelemeler yapılmıştır. İnceleme yapılan alanlar; Eski Kordon ve Yeni Kordon kıyı alanları, Halk Bahçesi kent parkı ve Çanakkale Onsekiz Mart Üniversitesi Terzioğlu Yerleşkesi alanlarıdır (Şekil 1).



Şekil 1. Çalışmada incelenen alanlar. 1) Eski Kordon, 2) Halk Bahçesi, 3) Yeni Kordon, 4) Çanakkale Onsekiz Mart Üniversitesi Terzioğlu Yerleşkesi (Vikipedi, 2024a; Vikipedi, 2024b, Vikipedi, 2024c, Google Earth Pro, 2024'ten değiştirilerek)



- Eski Kordon; Çanakkale ilinin Cevat Paşa mahallesinde, Kayserili Ahmet Paşa Caddesi ve Çanakkale Boğazı boyunca uzanmaktadır. Aynı zamanda alan 67000 m² yüzey alanına sahip, Çanakkale feribot limanı ve Necip Paşa Camii arasında kalan bir kıyı alanıdır.
- Halk bahçesi; Çanakkale ilinin Cevat Paşa Mahallesi'nde, İnönü Caddesi, Kayserili Ahmet Paşa Caddesi, Zirveye Sokak ve Mehmetçik Bulvarı arasında bulunan ve 34188 m² yüzey alanına sahip bir kent parkıdır.
- Yeni Kordon alanı; Çanakkale ilinin Barbaros Mahallesi'nde, İğnelik Sokak ve Çanakkale Boğazı boyunca uzanmaktadır. Aynı zamanda alan 20480 m² yüzey alanına sahip, Anadolu Hamidiye Tabyaları ve Çanakkale Belediyesi Barış Kafe arasında kalan bir kıyı alanıdır.
- Çanakkale Onsekiz Mart Üniversitesi Terzioğlu Yerleşkesi alanı; Çanakkale ilinin Barbaros Mahallesi'nde, Çanakkale – İzmir asfaltı ve Prof. Dr. Sevim Buluç sokağının kesiştiği alanda başlayarak uzanan toplamda 319 ha yüzey alanına sahip bir üniversite yerleşke alanıdır.

Araştırmada yerinde gözlem ve literatür analizi yöntemi kullanılmıştır. Araştırma alanları yerinde incelenerek belirlenen alanların peyzaj düzenlemelerinde kullanılan odunsu süs bitkisi türleri tespit edilerek listelenmiştir. Daha sonra belirlenen bitki türleri içerisinde etnobotanik yönden kullanılan kısımları kullanım alanları literatür taramaları ile belirlenip yeni listeler oluşturulmuştur. Elde edilen veriler IBM SPSS 27 programı kullanılarak analiz edilmiştir. Analiz sonucunda; bitki türlerinin alanlara göre dağılımları, etnobotanik yönden kullanılan türlerin familyalara göre dağılımı, türlerin yaşam formlarına göre dağılımı, kullanılan kısımlarının oransal dağılımları belirlenmiştir.

Bulgular ve Tartışma

Çanakkale ilinde inceleme alanlarının peyzaj düzenlemelerinde tespit edilen 114 odunsu süs bitkisi taksonunun 97'sinin etnobotanik kullanımının olduğu belirlenmiştir. Alanlarda tespit edilen etnobotanik kullanıma sahip odunsu süs bitkileri Tablo 1'de belirtilmiştir. Tablo 1'de incelenen alanlardan Eski Kordon kıyı alanı peyzaj düzenlemesi "1", Halk bahçesi kent parkı alanı "2", Yeni Kordon kıyı alanı peyzaj düzenlemesi ise "3" ve Çanakkale Onsekiz Mart Üniversitesi Terzioğlu kampüs yerleşkesi alanı ise "4" ile kodlanmıştır.

Tablo 1. Çanakkale ili kıyı alanları peyzaj düzenlemelerinde etnobotanik kullanıma sahip odunsu süs bitkileri (Şenkardeş, 2014; Ballesteros vd., 2016; Uzun ve Kaya, 2016; Aslan, 2018; Mautone vd., 2019; Sabo ve Knezevic, 2019; Bellikci Koyu, 2020; Xiong vd., 2020; Ekren ve Çorbacı, 2021; Karakaya vd., 2022; Adaçay, 2023; Yang vd., 2023; İlbaş vd., 2024; Seyidoğlu Akdeniz ve Yener, 2024)

Bitki Taksonu	Familiya	Tespit Edildiği Alan	Etnobotanik Kullanımları	Kullanılan Kısımları
<i>Abelia × grandiflora</i> (Rovelli ex André) Rehder	Caprifoliaceae	2,4	Tıbbi	Tohum
<i>Abies nordmanniana</i> (Steven) Spach	Pinaceae	4	Tıbbi, Süs ve Eşya Yapımı	Yaprak, Reçine ve Kozalak
<i>Acer negundo</i> L.	Sapindaceae	2,3,4	Tıbbi, Gıda, Eşya Yapımı ve Yakacak	Odun ve Özsuğu
<i>Acer palmatum</i> Thunb.	Sapindaceae	4	Tıbbi, Gıda ve Yakacak	Odun, Gövde ve Özsuğu
<i>Acer platanoides</i> L.	Sapindaceae	4	Gıda ve Boya	Özsuğu ve Kabuk
<i>Acer pseudoplatanus</i> L.	Sapindaceae	2,3,4	Tıbbi ve Gıda	Özsuğu, Kabuk ve Sap
<i>Aesculus hippocastanum</i> L.	Sapindaceae	2,4	Tıbbi ve Gıda	Çiçek, Meyve ve Yaprak
<i>Albizia julibrissin</i> Durazz.	Fabaceae	2,4	Tıbbi ve Gıda	Çiçek ve Yaprak
<i>Berberis thunbergii</i> DC.	Berberidaceae	1,2,3,4	Tıbbi ve Gıda	Meyve, Yaprak ve Kök
<i>Betula alba</i> L.	Betulaceae	2,4	Tıbbi	Reçine
<i>Betula pendula</i> Roth	Betulaceae	4	Tıbbi, Gıda, Yakacak, Boya, Eşya Yapımı ve Böcek Kovucu	Odun, Yaprak, Kabuk, Dal ve Reçine
<i>Buxus sempervirens</i> L.	Buxaceae	3,4	Eşya Yapımı	Odun
<i>Castanea sativa</i> Mill.	Fagaceae	2	Gıda	Meyve
<i>Catalpa bignonioides</i> Walter	Bignoniaceae	1,2,4	Tıbbi	Meyve, Yaprak ve Kabuk





<i>Cedrus atlantica</i> (Endl.) Manetti ex Carrière	<i>Pinaceae</i>	4	Tıbbi ve Böcek Kovucu	Kabuk ve Esansiyel Yağ
<i>Cedrus deodara</i> (Roxb. ex D.Don) G.Don	<i>Pinaceae</i>	4	Tıbbi, Yakacak ve Eşya Yapımı	Odun, Yaprak ve Kabuk
<i>Cedrus libani</i> (L.) A.Rich.	<i>Pinaceae</i>	2,4	Tıbbi, Yakacak ve Eşya Yapımı	Odun, Yaprak, Gövde ve Kozalak
<i>Celtis australis</i> L.	<i>Cannabaceae</i>	2	Tıbbi, Gıda ve Boya	Meyve, Yaprak, Kabuk ve Tohum
<i>Cercis siliquastrum</i> L.	<i>Fabaceae</i>	1,2,4	Tıbbi, Gıda ve Eşya Yapımı	Odun, Çiçek ve Yaprak
<i>Chaenomeles speciosa</i> (Sweet) Nakai	<i>Rosaceae</i>	4	Gıda	Meyve
<i>Chamaecyparis lawsoniana</i> (A.Murray bis) Parl.	<i>Cupressaceae</i>	4	Tıbbi	Reçine
<i>Cornus alba</i> L.	<i>Cornaceae</i>	2,4	Gıda	Meyve
<i>Cotinus coggygia</i> Scop.	<i>Anacardiaceae</i>	4	Tıbbi ve Boya	Yaprak, Kabuk ve Genç Sürgün
<i>Crataegus monogyna</i> Jacq.	<i>Rosaceae</i>	4	Tıbbi ve Gıda	Çiçek, Meyve ve Yaprak
<i>Cryptomeria japonica</i> (Thunb. ex L.f.) D.Don	<i>Cupressaceae</i>	4	Tıbbi, Yakacak ve Eşya Yapımı	Odun ve Reçine
<i>Cupressus arizonica</i> (Greene) Bartel	<i>Cupressaceae</i>	2,3,4	Eşya Yapımı	Odun
<i>Cupressus macrocarpa</i> (Hartw.) Bartel	<i>Cupressaceae</i>	1,2,3,4	Eşya Yapımı	Odun
<i>Cupressus sempervirens</i> L.	<i>Cupressaceae</i>	2,3,4	Tıbbi, Gıda, Eşya Yapımı ve Böcek Kovucu	Odun, Reçine, Çiçek ve Kozalak
<i>Elaeagnus angustifolia</i> L.	<i>Elaeagnaceae</i>	2,3,4	Tıbbi, Gıda, Eşya Yapımı, Arıcılık ve Kozmetik	Çiçek, Meyve, Esansiyel Yağ ve Tohum
<i>Eriobotrya japonica</i> (Thunb.) Lindl.	<i>Rosaceae</i>	2,3,4	Tıbbi, Gıda	Çiçek, Meyve ve Yaprak
<i>Eucalyptus camaldulensis</i> Dehnh.	<i>Myrtaceae</i>	4	Tıbbi	Esansiyel Yağ
<i>Euonymus japonicus</i> Thunb.	<i>Celastraceae</i>	1,2,3,4	Tıbbi, Gıda ve Boya	Yaprak ve Kabuk
<i>Euryops pectinatus</i> Cass.	<i>Asteraceae</i>	1,3,4	Tıbbi	Çiçek
<i>Ficus carica</i> ex L.	<i>Moraceae</i>	2,4	Tıbbi ve Gıda	Meyve ve Yaprak
<i>Fraxinus excelsior</i> L.	<i>Oleaceae</i>	1,2,3,4	Tıbbi, Yakacak ve Eşya Yapımı	Odun, Gövde, Yaprak ve Kabuk
<i>Ginkgo biloba</i> L.	<i>Ginkgoaceae</i>	4	Tıbbi ve Gıda	Meyve, Yaprak ve Tohum
<i>Gleditsia triacanthos</i> L.	<i>Fabaceae</i>	2,4	Tıbbi ve Gıda	Meyve, Kabuk ve Tohum
<i>Hedera helix</i> L.	<i>Araliaceae</i>	2,4	Tıbbi ve Eşya Yapımı	Yaprak
<i>Hibiscus syriacus</i> L.	<i>Malvaceae</i>	2,4	Tıbbi, Gıda, Boya ve Kozmetik	Çiçek ve Yaprak
<i>Hydrangea macrophylla</i> (Thunb.) Ser.	<i>Hydrangeaceae</i>	4	Tıbbi ve Gıda	Yaprak
<i>Ilex aquifolium</i> L.	<i>Aquifoliaceae</i>	4	Tıbbi, Gıda ve Hayvan Yemi	Meyve ve Yaprak
<i>Juglans regia</i> L.	<i>Juglandaceae</i>	1,2,4	Tıbbi, Gıda, Boya, Eşya Yapımı ve Yakacak	Odun, Meyve, Yaprak ve Tohum
<i>Juniperus sabina</i> L.	<i>Cupressaceae</i>	2,4	Tıbbi, Böcek Kovucu ve Kozmetik	Yaprak ve Genç Sürgün
<i>Koelreuteria paniculata</i> Laxm.	<i>Sapindaceae</i>	4	Tıbbi ve Gıda	Çiçek, Meyve, Yaprak ve Sürgün
<i>Lagerstroemia indica</i> L.	<i>Lythraceae</i>	2,4	Tıbbi ve Gıda	Çiçek, Yaprak ve Kabuk
<i>Laurus nobilis</i> L.	<i>Lauraceae</i>	2,4	Tıbbi, Gıda, Yakacak ve Kozmetik	Odun, Meyve, Yaprak ve Tohum
<i>Lavandula angustifolia</i> Mill.	<i>Lamiaceae</i>	2,3,4	Tıbbi, Gıda, Kozmetik	Çiçek ve Esansiyel Yağ
<i>Ligustrum ovalifolium</i> Hassk.	<i>Oleaceae</i>	4	Tıbbi, Gıda ve Eşya Yapımı	Odun, Kabuk ve Kök



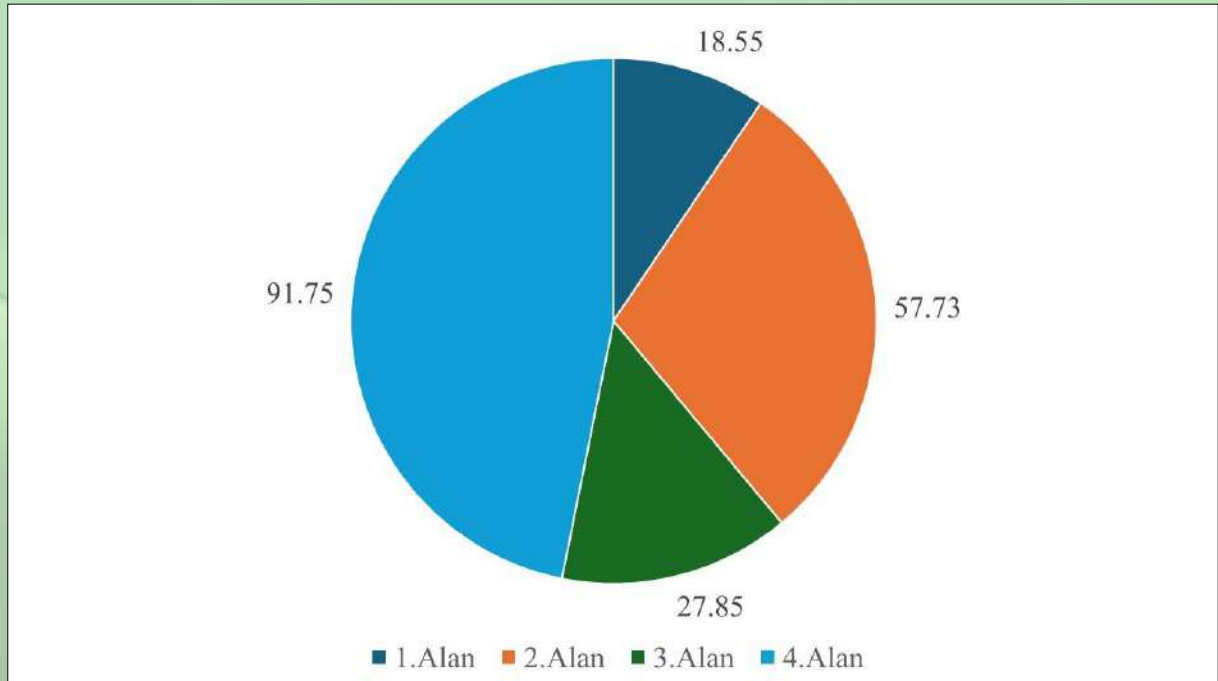


<i>Ligustrum vulgare</i> L.	<i>Oleaceae</i>	1,4	Tıbbi, Süs ve Boya	Meyve, Yaprak ve Dal
<i>Liquidambar styraciflua</i> L.	<i>Altingiaceae</i>	4	Tıbbi, Gıda, Yakacak, Eşya Yapımı ve Kozmetik	Odun ve Reçine
<i>Liriodendron tulipifera</i> L.	<i>Magnoliaceae</i>	4	Tıbbi, Gıda ve Eşya Yapımı	Odun, Kabuk ve Kök
<i>Lonicera japonica</i> Wall.	<i>Caprifoliaceae</i>	2	Tıbbi, Gıda ve Kozmetik	Çiçek, Meyve, Yaprak ve Tohum
<i>Magnolia grandiflora</i> L.	<i>Magnoliaceae</i>	1,3,4	Tıbbi, Gıda ve Eşya Yapımı	Odun ve Kabuk
<i>Mahonia aquifolium</i> (Pursh) Nutt.	<i>Berberidaceae</i>	4	Tıbbi, Gıda ve Boya	Meyve
<i>Malus × floribunda</i> Siebold ex Van Houtte	<i>Rosaceae</i>	4	Tıbbi, Gıda ve Yakacak	Odun ve Meyve
<i>Malus sylvestris</i> (L.) Mill.	<i>Rosaceae</i>	4	Tıbbi, Gıda ve Yakacak	Odun ve Meyve
<i>Melia azedarach</i> L.	<i>Meliaceae</i>	2,4	Tıbbi, Gıda ve Eşya Yapımı	Meyve ve Yaprak
<i>Morus alba</i> L.	<i>Moraceae</i>	2,3,4	Tıbbi ve Gıda	Meyve, Yaprak ve Kabuk
<i>Nandina domestica</i> Thunb.	<i>Berberidaceae</i>	3,4	Tıbbi	Kök
<i>Nerium oleander</i> L.	<i>Apocynaceae</i>	1,2,3,4	Tıbbi	Yaprak
<i>Olea europaea</i> L.	<i>Oleaceae</i>	2,3,4	Tıbbi, Gıda, Yakacak ve Eşya Yapımı	Odun, Meyve, Yaprak ve Yağ
<i>Paulownia tomentosa</i> (Thunb.) Steud.	<i>Paulowniaceae</i>	2,4	Yakacak, Eşya Yapımı	Odun, Kabuk ve Gövde
<i>Phoenix canariensis</i> H.Wildpret	<i>Arecaceae</i>	2,4	Gıda	Meyve
<i>Picea pungens</i> Engelm.	<i>Pinaceae</i>	2,4	Tıbbi ve Gıda	Tohum, Çiçek ve Genç Sürgün
<i>Pinus brutia</i> Ten.	<i>Pinaceae</i>	1,2,3,4	Tıbbi, Yakacak ve Eşya Yapımı	Odun, Kozalak
<i>Pinus mugo</i> Turra	<i>Pinaceae</i>	4	Tıbbi ve Kozmetik	Yaprak, Dal ve Sürgün
<i>Pinus pinea</i> L.	<i>Pinaceae</i>	2,4	Tıbbi, Gıda ve Yakacak	Odun, Yağ, Tohum ve Kozalak
<i>Platanus orientalis</i> L.	<i>Platanaceae</i>	1,2,3,4	Tıbbi, Gıda, Yakacak ve Eşya Yapımı	Odun, Meyve ve Yaprak
<i>Populus alba</i> L.	<i>Salicaceae</i>	2,4	Tıbbi, Gıda, Boya ve Eşya Yapımı	Gövde, İç Kabuk ve Kabuk
<i>Populus nigra</i> Mill.	<i>Salicaceae</i>	4	Tıbbi, Gıda, Yakacak, Eşya Yapımı ve Kerestecilik	Odun, Yaprak, Kabuk ve Dal
<i>Populus tremula</i> L.	<i>Salicaceae</i>	3,4	Tıbbi, Gıda ve Eşya Yapımı	Kabuk ve Odun
<i>Prunus armeniaca</i> L.	<i>Rosaceae</i>	2	Gıda	Meyve
<i>Prunus avium</i> (L.) L.	<i>Rosaceae</i>	4	Tıbbi, Gıda, Yakacak, Kozmetik ve Eşya Yapımı	Odun, Gövde, Çiçek, Yaprak ve Meyve
<i>Prunus cerasifera</i> Popov	<i>Rosaceae</i>	2,3,4	Gıda	Meyve
<i>Prunus dulcis</i> (Mill.) Rchb.	<i>Rosaceae</i>	4	Tıbbi, Gıda, Eşya Yapımı	Gövde, Odun, Meyve, Esansiyel Yağ
<i>Prunus persica</i> (L.) Batsch	<i>Rosaceae</i>	4	Tıbbi, Gıda ve Boya	Meyve ve Yaprak
<i>Punica granatum</i> L.	<i>Lythraceae</i>	1,2,4	Tıbbi, Gıda ve Kozmetik	Meyve ve Kabuk
<i>Pyracantha coccinea</i> M.Roem.	<i>Rosaceae</i>	2,4	Tıbbi ve Gıda	Meyve ve Kök
<i>Quercus coccifera</i> L.	<i>Fagaceae</i>	4	Tıbbi, Gıda ve Boya	Kabuk, Yaprak, Kabuk ve Tohum
<i>Quercus rubra</i> L.	<i>Fagaceae</i>	4	Tıbbi, Gıda, Yakacak ve Eşya Yapımı	Odun, Kabuk ve Tohum
<i>Robinia pseudoacacia</i> L.	<i>Fabaceae</i>	1,2,3,4	Tıbbi, Gıda, Yakacak ve Eşya Yapımı	Odun ve Çiçek
<i>Rosa semperflorens</i> Desf.	<i>Rosaceae</i>	2,4	Tıbbi ve Kozmetik	Çiçek
<i>Rosmarinus officinalis</i> L.	<i>Lamiaceae</i>	4	Tıbbi, Gıda ve Kozmetik	Yaprak ve Çiçek



<i>Salix babylonica</i> L.	<i>Salicaceae</i>	2,4	Tıbbi, Gıda, Eşya Yapımı ve Arıcılık	Odun, Yaprak ve Kabuk
<i>Syringa vulgaris</i> L.	<i>Oleaceae</i>	2	Tıbbi ve Kozmetik	Çiçek ve Kabuk
<i>Tamarix tetrandra</i> Pall. ex M.Bieb.	<i>Tamaricaceae</i>	4	Tıbbi ve Eşya Yapımı	Gövde, Kabuk ve Dal
<i>Taxus baccata</i> L.	<i>Taxaceae</i>	2,4	Tıbbi, Gıda ve Eşya Yapımı	Odun, Meyve ve Yaprak
<i>Thuja occidentalis</i> L.	<i>Cupressaceae</i>	2,4	Tıbbi ve Gıda	İç Kabuk, Yaprak, Dal, Reçine ve Tomurcuk
<i>Tilia tomentosa</i> Moench	<i>Malvaceae</i>	2,4	Tıbbi ve Gıda	Çiçek, Meyve ve Yaprak
<i>Trachycarpus fortunei</i> (Hook.) H.Wendl.	<i>Arecaceae</i>	1,3,4	Tıbbi ve Eşya Yapımı	Meyve, Kabuk ve Kök
<i>Ulmus minor</i> Miller	<i>Ulmaceae</i>	2,4	Tıbbi	Kök ve Kabuk
<i>Viburnum lucidum</i> Mill.	<i>Viburnaceae</i>	1,3	Tıbbi, Gıda ve Eşya Yapımı	Gövde, Meyve, Yaprak ve Dal
<i>Viburnum tinus</i> L.	<i>Viburnaceae</i>	1,2,3,4	Tıbbi	Meyve ve Yaprak
<i>Vitex agnus-castus</i> L.	<i>Lamiaceae</i>	2	Tıbbi	Tohum ve Esansiyel Yağ
<i>Washingtonia filifera</i> (T.Moore & Mast.) H.Wendl. ex de Bary	<i>Arecaceae</i>	4	Gıda ve Eşya Yapımı	Gövde, Meyve ve Yaprak
<i>Washingtonia robusta</i> H.Wendl.	<i>Arecaceae</i>	1,2,3	Gıda ve Eşya Yapımı	Gövde, Meyve ve Yaprak
<i>Yucca filamentosa</i> L.	<i>Asparagaceae</i>	4	Tıbbi ve Kozmetik	Kök

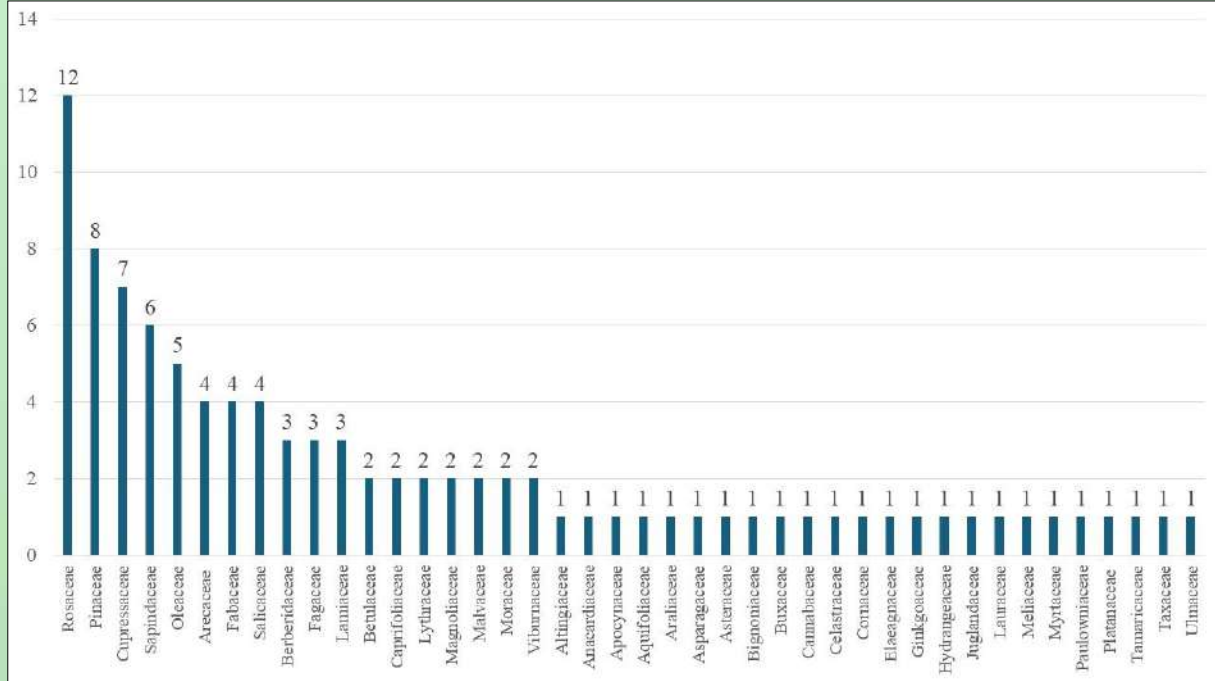
Tablo 1’de yer alan Çanakkale ili rekreasyon alanlarında kullanılan odunsu bitki türlerinin etnobotanik kullanıma sahip olanlarının alanlara göre dağılımı oransal olarak hesaplanmıştır. Buna göre, etnobotanik kullanıma sahip taksonlar bakımından en zengin alanın % 91.75’lik oranla Çanakkale Onsekiz Mart Üniversitesi Terzioğlu Yerleşkesi olduğu görülmektedir. Daha sonra dağılım sırasıyla; % 57.73 oranla Halk Bahçesi kent parkı, % 27.85 oranla Yeni Kordon alanı ve % 18.55 oranla Eski Kordon alanının olduğu belirlenmiştir (Şekil 2).



Şekil 2. Etnobotanik kullanıma sahip bitkilerin alanlara göre oransal (%) dağılımı

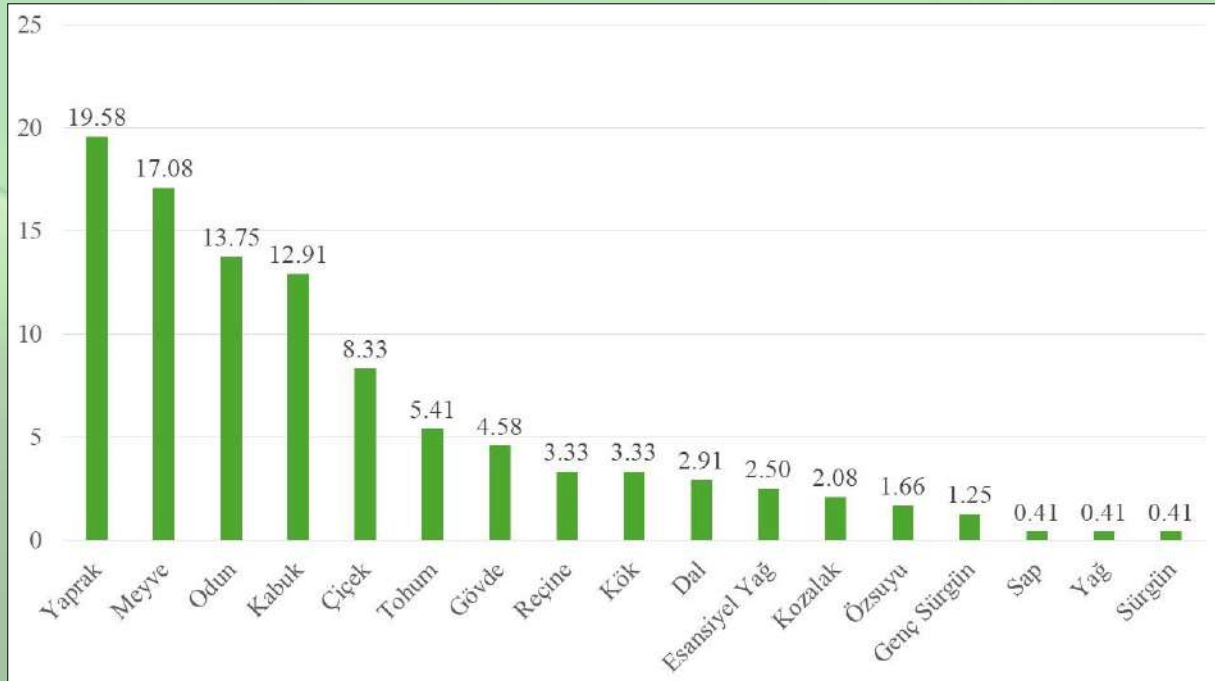


Çalışma alanlarında yer alan ve etnobotanik kullanıma sahip bitki taksonlarına ait oldukları familyalar bakımında değerlendirilmiştir. Tablo 1’de yer alan bitki taksonlarının familyalara göre dağılımı tespit edilmiştir. Buna göre en çok bitki taksonunun 12 takson ile *Rosaceae* familyasında yer aldığı belirlenmiştir. *Rosaceae* familyasının ardından en çok takson sayısına sahip ikinci familyanın ise 8 takson ile *Pinaceae* familyası olduğu tespit edilmiştir. Takson sayılarının familyalara göre dağılımı Şekil 3’te gösterilmiştir.



Şekil 3. Etnobotanik kullanıma sahip bitki taksonlarının familyalara göre dağılımı

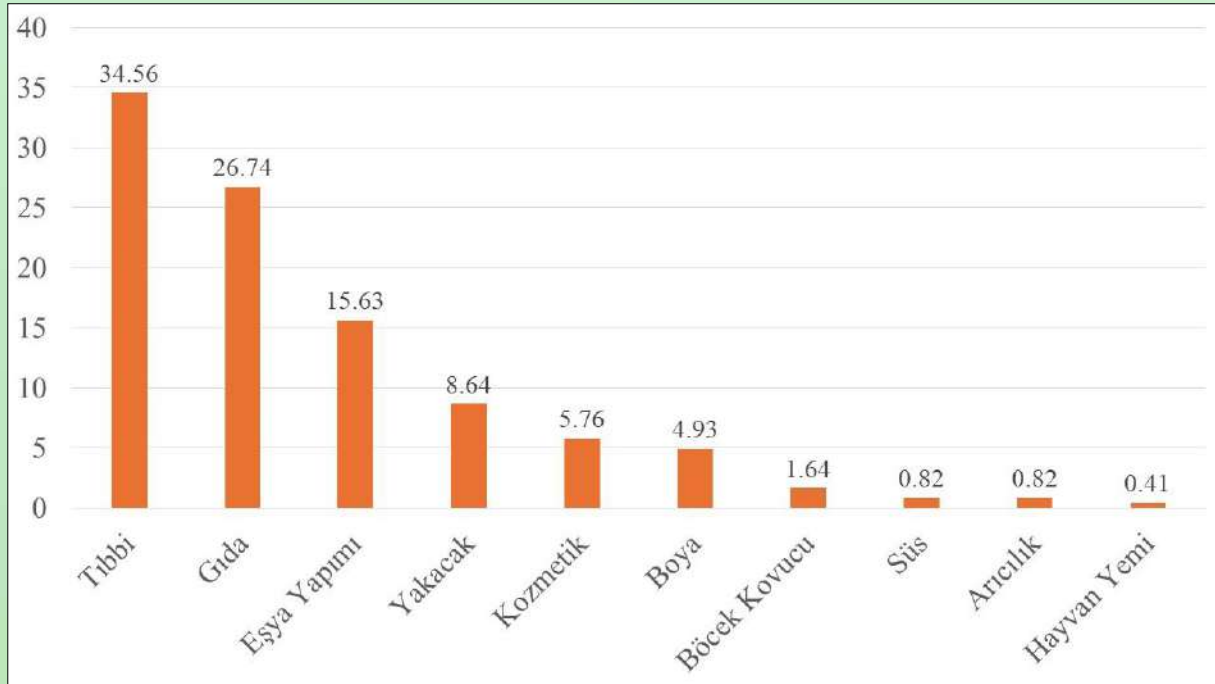
Alanlarda incelenen ve etnobotanik kullanıma sahip olduğu belirlenen bitki taksonlarının etnobotanik açıdan en çok kullanılan kısımları oransal olarak hesaplanmıştır. Bitkilerin kullanılan kısımlarının 17 farklı şekilde olduğu tespit edilmiştir. Kullanılan kısımların oransal dağılımları Şekil 4’te gösterilmiştir.



Şekil 4. Bitkilerin kullanılan kısımlarının oransal (%) dağılımı



Alanlarda incelenen ve Tablo 1’de belirtilen bitki taksonlarının etnobotanik kullanım alanları oransal olarak hesaplanmıştır. Bitki taksonlarının 10 farklı etnobotanik kullanım alanının olduğu tespit edilmiştir. Etnobotanik kullanım alanlarının oransal dağılımı Şekil 5’te gösterilmiştir.



Şekil 5. Bitki taksonlarının etnobotanik kullanım alanlarının oransal (%) dağılımı

Seyidoğlu Akdeniz ve Yener, (2024) çalışmalarında Bursa ili kent parklarının peyzaj düzenlemelerinde kullanılan odunsu süs bitkilerini etnobotanik inceleme yapmışlardır. Çalışmalarında bitki taksonlarının alanlara göre dağılımı, etnobotanik kullanılan kısımları ve kullanım alanlarının üzerinde istatistiksel analizler yapmışlardır. Buna göre elde ettikleri sonuçlarda etnobotanik kullanıma sahip olduğunu belirledikleri bitki taksonlarının en çok *Pinaceae* familyasında olduğunu tespit etmişlerdir. Bu çalışmada ise etnobotanik kullanıma sahip taksonların ise en çok *Rosaceae* familyasında olduğu belirlenmiştir. Aynı çalışmada bitkilerin etnobotanik kullanılan kısımlarının kısımlarının “yaprak”, en çok kullanıldığı alanın ise tıbbi olduğunu tespit etmişlerdir. Bu çalışmada da bitkilerin etnobotanik kullanılan kısımlarının kısımlarının “yaprak”, en çok kullanıldığı alanın ise tıbbi olduğu belirlenmiştir. Yöntem bakımından bu çalışma benzerlik gösterse de araştırma yapılan il ve araştırma alanlarının nitelikleri bakımından farklılık göstermektedir.

Sonuç

Kentsel rekreasyon alanlarında bitkisel materyaller estetik ve işlevsel özelliklerinin yanında insanlar tarafından tıp, gıda, yakacak, eşya yapımı vb. şekillerde de kullanılmışlardır. Etnobotanik kullanıma sahip bu bitki taksonları kent peyzajında kullanımlarının yanında sahip oldukları diğer özellikleri ile kent ekonomisine de katkı sağlamaktadır. Çanakkale ili yoğun kullanıma sahip rekreasyon alanları örneğinde gerçekleştirilen bu çalışmada Çanakkale ili merkezinde yer alan 2 adet kıyı alanı peyzaj düzenlemesi, 1 adet kent parkı ve 1 adet üniversite yerleşkesi alanlarındaki odunsu süs bitkisi taksonları incelenmiştir. Buna göre kentsel rekreasyon alanlarında tespit edilen 114 taksonun 97’sinin etnobotanik kullanıma (% 85.08) sahip olduğu görülmüştür. Araştırma alanlarında yer alan odunsu bitkilerden en çok etnobotanik kullanıma sahip olan bitki barındıran alan % 91.75 oranla Çanakkale Onsekiz Mart Üniversitesi Terzioğlu Yerleşkesi alanıdır. Familyalar açısından alanlarda tespit edilen bitkiler değerlendirildiğinde; en çok *Rosaceae* familyasından bitkilerin etnobotanik özelliklere sahip olduğu tespit edilmiştir.

Kentsel rekreasyon alanlarında kullanılan odunsu süs bitkilerinden etnobotanik kullanıma sahip olan taksonlar için farkındalık yaratılmalıdır. İnsan-doğa ilişkilerinin farklı bir yönden geliştirilmesi için rekreasyon alanlarındaki bitkiler üzerine bitkilerin etnobotanik açıdan kullanım amaçları ve kullanılan kısımları gibi özelliklerinin belirtildiği etiketler yapılabilir. Bu şekilde peyzaj alanlarında sıklıkla kullanılan bitkiler ile insan ilişkileri geliştirilerek gelecek nesillere de bu bilgiler aktarılabilir. Etnobotanik özelliklere sahip ve kent florasında doğal



olarak yer alan bitki taksonlarının rekreasyon alanlarında kullanım oranlarının arttırılması ile kentsel biyoçeşitlilik de korunarak arttırılabilir.

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ID: 506

Wheat crop yield forecast with climate change impacts using local and regional levels by crop simulation models in some case studies

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Abstract

As the world's population grows, food consumption is reaching a breaking point. Consequently, the importance of agricultural production has increased. But in addition to its significance now, a lot of environmental issues have surfaced. Climate change has the potential to significantly affect agricultural productivity by changing crop growth conditions and planting, harvesting, and storage dates. Unfortunately, there is no turning back from the current unfavorable climatic situation that the world is currently facing in terms of ecosystems and economics. Farmers must adjust to changing weather patterns as a result of the expanding effects of climate change on agricultural systems. For this reason, many scholars have tried a variety of approaches to gauge agricultural output at different levels of detail. Observing how extremely big agricultural areas are affected and assessing scientific predictions are two ways to gauge how much climate change affects agricultural production and to take action. In several nations, crop simulation models (CSMs) have been employed as a versatile instrument for a wide range of applications. Numerous scientific techniques are currently being researched for effective model yield simulations under heterogeneous climatic and soil conditions, as DSSAT conducts homogenous field-based simulations but CRAFT uses a cell-based simulation technique instead of a field-based simulation. DSSAT includes dynamic crop growth simulation models for more than 42 crops, including wheat crops. DSSAT has addressed numerous real-world concerns and broad agricultural problems, including genetic modeling, precision farming, on-farm management, regional evaluations of the effects of climate variability and change, economic and environmental sustainability, and food and nutrition security. DSSAT application for climate change in agriculture that enables variable input data for crop masks, weather, soil, and management at varying resolutions. In order to prepare diverse spatial local data sets, these tools may also require to make use of decision support systems like Geographic Information Systems (GIS), Remote Sensing (RS), and Machine Learning (ML) techniques.

Keywords:



ID: 585

The Power of Citrus Peel Waste: Natural Antioxidant Essential Oils Preventing Fish Oil Oxidation

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Abstract

In developing countries, food production and processing result in high costs and the generation of significant amounts of fruit waste, which harm the environment. These fruit wastes contain numerous beneficial components, including proteins, lipids, starch, micronutrients, bioactive compounds, and dietary fibers. Among these fruit wastes, citrus fruits play a vital role in providing various health benefits. Citrus species from the Rutaceae family are widely consumed as fresh fruits and juices worldwide. Citrus peel waste (CPW) constitutes approximately 60% of processed citrus fruits, making it a promising resource in the food production industry. CPW is rich in polyphenols and essential oils, holding importance in terms of nutritional value and pharmaceutical applications. It is known that essential oils derived from CPW (CPEo) prevent the oxidation of lipids, influenced by environmental conditions. With the harmful effects of synthetic antioxidants becoming more evident in recent years, the potential of CPEo as a natural alternative has gained attention. This study evaluates the results of research on the preservation of oxidation-sensitive fish oil using essential oils obtained from different citrus peels and their potential application areas. The volatile components playing a significant role in the antioxidant activity of CPEo include D-limonene, γ -terpinen, α -pinen, β -pinen, and linalool. D-limonene, the most abundant component in citrus oils, reduces oxidative stress by scavenging free radicals and protects cell membranes from lipid peroxidation. γ -terpinen is recognized for its effective free radical scavenging properties and its ability to inhibit lipid peroxidation, while α -pinen and β -pinen mitigate oxidative damage by neutralizing free radicals and reducing inflammation. Linalool stands out for its antioxidant and anti-inflammatory effects. The antioxidant activities of these volatile compounds contribute to cellular defense mechanisms through mechanisms such as free radical scavenging, inhibition of lipid peroxidation, and reduction of oxidative stress-related cellular damage, ultimately promoting overall health.

Key Words: Citrus Peels, Essential Oils, Antioxidant Activity, Fish Oil Oxidation, Natural Antioxidants

Turunçgil Kabuğu Atıklarından Gelen Güç: Balık Yağının Oksidasyonunu Önleyen Doğal Antioksidan Esansiyel Yağlar

Özet

Gelişmekte olan ülkelerde gıda üretimi ve işlenmesi, yüksek maliyetler ve çevreye zarar veren büyük miktarda meyve atığı üretimiyle sonuçlanmaktadır. Bu meyve atıkları; proteinler, lipitler, nişasta, mikro besinler, biyoaktif bileşikler ve diyet lifleri gibi birçok faydalı bileşen içerir. Meyve atıkları arasında turunçgiller, sağlık açısından çeşitli faydalar sağlayarak önemli bir rol oynar. Rutaceae familyasından gelen turunçgil türleri, dünya genelinde taze meyve ve meyve suyu olarak yaygın biçimde tüketilmektedir. Turunçgil kabuğu atıkları (CPW), işlenen turunçgil meyvelerinin yaklaşık %60'ını oluşturan ana yan ürünlerdir ve bu nedenle gıda üretim endüstrisinde umut verici bir potansiyele sahiptir. CPW, yüksek konsantrasyonlarda polifenoller ve uçucu yağlar içerir ve besin değeri ile farmasötik uygulamalar açısından önemlidir. CPW'den elde edilen esansiyel yağların (CPEo), çevresel koşullara bağlı olarak lipidlerin oksidasyonunu engellediği bilinmektedir. Sentetik antioksidanların zararlı etkilerinin ortaya konduğu son yıllarda, CPEo'nun doğal bir alternatif olarak kullanılma potansiyeli dikkat çekmektedir. Bu çalışmada, oksidasyona duyarlı olan balık yağının, farklı turunçgil kabuklarından elde edilen esansiyel yağlarla korunmasına yönelik araştırmaların sonuçları ve potansiyel uygulama alanları değerlendirilmiştir. İncelenen çalışmalarda, CPEo'nun antioksidan etkinliğinde önemli rol oynayan uçucu bileşenler arasında D-limonene, γ -terpinen, α -pinen, β -pinen ve linalool öne çıkmaktadır. D-limonene, turunçgil yağlarının en yaygın bileşeni olup, içeriği oluşturan diğer bileşenlerle oluşturduğu sinerjik etki serbest radikalleri süpürme kapasitesiyle oksidatif stresi azaltır ve hücre zarlarını lipid peroksidasyonuna karşı korur. γ -terpinen, güçlü serbest radikal temizleyici özellikleriyle lipid peroksidasyonunu engellerken, α -pinen ve β -pinen serbest radikalleri etkisiz hale getirerek oksidatif hasarı önler ve inflamasyonu azaltır. Linalool ise, antioksidan ve anti-enflamatuar etkileriyle öne çıkar. Bu uçucu bileşiklerin antioksidan etkinlikleri, serbest radikal süpürme, lipid peroksidasyonunun inhibisyonu ve oksidatif stresle ilişkili hücresel hasarları azaltma gibi mekanizmalarla hücresel savunma sistemine katkı sağlar ve genel sağlık üzerinde olumlu etkiler yaratır.

Anahtar Kelimeler: Turunçgil Kabukları, Esansiyel Yağlar, Antioksidan Aktivite, Balık Yağı Oksidasyonu, Doğal Antioksidanlar





ID: 585

Effect of Genotype and Storage Period on Hatchability results in Layer Parents

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Abstract

Breeder factors that affect hatchability include strain, health, nutrition, age of the flock, egg size, weight and quality, egg storage duration and conditions. Hatchability is of considerable economic importance for all hatcheries and therefore must be given appropriate attention in breeding programs for commercial layers. The variability between and within strains will tell us whether reproductive performance can be improved by selection within specific lines. Fertility and hatchability are the most important determinant for producing more chicks from given number of breeding stock within a stipulated period. Fertility and hatchability performance of eggs depend on the number of factors like genetic, physiological, social and environmental. The principal objectives of the commercial hatchery are to secure the maximum number of quality day-old chicks out of the eggs set for hatching. Several researchers reported that genotype of breeder hen had significant effect on hatchability of egg. Fertility and hatchability are 2 major parameters that highly influence the reproductive performance of chicken breeds. In commercial poultry production, storage of hatching eggs is an indispensable part of hatchery operation and long egg storage times are sometimes unavoidable due to flock logistic issues and market availability. It is well known that an increase in the storage duration increases incubation duration and decreases hatchability and chick quality.

Key Words: Breeder, hatchability, reproductive performance, physiological, Fertility





ID: 510

Importance of Weed-Tolerant Potato Cultivars

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Abstract

Potato plants are highly susceptible to weed interference, which can severely reduce crop productivity and quality. Efficient weed management is crucial for maintaining high yields, but current approaches have limitations. Mechanical and biological weed control methods often lack efficiency and are costly, while herbicide use poses environmental risks and contributes to herbicide-resistant weed species, thereby limiting herbicide options for potato producers. There is a growing need for alternative strategies, such as identifying potato cultivars that can naturally tolerate weed pressure while maintaining high yields. This study investigated the weed tolerance and yield stability of several potato cultivars when subjected to weed competition. Results revealed considerable variation in weed tolerance across the cultivars, with certain cultivars showing superior performance. The key traits associated with weed-tolerant potato cultivars included greater plant height, enhanced canopy coverage, and higher yield potential under competitive conditions. These traits enable certain cultivars to outcompete weeds and maintain productivity. Incorporating such weed-competitive potato cultivars into integrated weed management (IWM) systems could reduce the dependency on herbicides, thereby minimizing environmental impacts and lowering management costs. This approach represents a critical step toward more sustainable agricultural practices, offering an environmentally friendly and economically viable solution for potato producers facing weed management challenges.

Keywords: *Potato, weed competition, non-chemical weed control, competitive cultivars.*



Yiyecek ve İçecek Endüstrisinde Yapay Zeka Kullanımı

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Özet

Yapay zeka son yıllarda hayatın hemen hemen alanında kullanılmakta olup önemi giderek artmakta olan çoklu robotik veriye sahip bir teknolojidir. Yapay zeka hayatı kolaylaştırdığı gibi kendi içinde dezavantajları bulundurmaktadır. Yiyecek içecek endüstrisi de, tüketici beklentilerine paralel olarak gün geçtikçe yenilenmekte ve değişmektedir. Yapay zekanın insan zihnini taklit eder şekilde hareket etmesi, iş gücü yoğun sektörlerde yer edinmesini ve kullanılabilirliğini artırmaktadır. Restoran ve kafe sektöründe özellikle servis aşamasında iş gücü kullanımı kaçınılmazdır. Her ne kadar otomatlar uzun yıllar önce kullanılmaya başlanmış olsa da, self servis ve alakart servislerde insansız servis teknikleri bu sektörde henüz yenidir. Robot garsonlar, robot aşçılar, robot kasiyerler gibi insansız ve yapar zekanın bulunduğu hizmetler bu sektörde yerini almıştır. Bu uygulamaların yanı sıra ilerleyen yıllarda müşteri bazlı beslenme alışkanlıklarının tahmin edilerek yiyeceklerin hazırlanması, besinlerin uyumuna göre tabak tasarımlarının yapılması, gıdaların depolanması, hijyen kontrollerinin yapılması, gıdaların israf edilmesinin azaltılması ve atık yönetimi gibi süreçlerde yapay zekanın kullanımı beklenmektedir. Bu çalışmada, yiyecek ve içecek sektöründe yapay zekanın kullanımı, avantajları ve dezavantajları gibi hususlar detaylı olarak araştırılmış ve öneriler sunulmuştur.

Anahtar Kelimeler: *yapay zeka, yiyecek içecek, servis, robot*

Using Artificial Intelligence in the Food and Beverage Industry

Abstract

Artificial intelligence has been used in almost all areas of life in recent years and is a technology with multiple robotic data that is becoming increasingly important. While artificial intelligence makes life easier, it also has its own disadvantages. The food and beverage industry is also renewing and changing day by day in parallel with consumer expectations. The fact that artificial intelligence acts in a way that mimics the human mind increases its presence and usability in labor-intensive sectors. In the restaurant and café sector, the use of labor is inevitable, especially at the service stage. Although vending machines have been in 453s efor many years, unmanned service techniques in self-service and a la carte services are still new in this sector. Unmanned services such as robot waiters, robot cooks, robot cashiers and services with intelligence have taken their place in this sector. In addition to these applications, in the coming years, artificial intelligence is expected to be used in processes such as food preparation by predicting customer-based eating habits, plate designs according to the compatibility of nutrients, food storage, hygiene controls, reducing food waste and waste management. In this study, the use of artificial intelligence in the food and beverage industry, its advantages and disadvantages are investigated in detail and recommendations are presented.

Keywords: *artificial intelligence, food beverage, service, robot*

Giriş

Yiyecek ve içecek endüstrisi, yeni teknolojileri benimsemek, otomasyonu hızlandırmak, verimliliği artırmak ve üretim kesintilerini önlemek için önemli bir dönüşüm geçiriyor. Yapay zeka (AI) ve endüstriyel nesnelerin interneti (IIoT), endüstrilerin dijitalleşmesini sağlıyor. Bu çalışmada, gıda ve içecek sektöründeki en son AI teknolojilerine genel bir bakış sunulacak ve kalite optimizasyonu, analitik ve öngörücü bakım gibi alanlardaki mevcut AI gelişmeleri ele alınmıştır.

Yapay Zeka

Edward Fredkin bir televizyon programındaki röportajında tarihte üç büyük olay olduğunu belirtmiştir. Bu olaylardan birincisi evrenin başlangıcı, ikincisi yaşamın başlangıcı, üçüncüsü ise yapay zekanın



ortaya çıkmasıdır (Yücelbakan, 2019). Yapay zekanın erişim alanı, hayal gücünün çok ötesindedir. Yapay zekâ kavramı ilk kez 1956 Dortmund Konferansı'nda John McCarthy, Marvin L. Minsky, Nathaniel Rochester ve Claude E. Shannon tarafından sunulan bir tavsiye mektubunda dile getirilmiştir. Ancak kavramı ilk tanımlayan kişi John McCarthy'dir (Alpaydın, 2013). McCarthy (2004) yapay zekâyı, “insan benzeri zeki makineler özellikle de zeki bilgisayar programları yapma bilimi ve mühendisliği” olarak ifade etmiştir. Yapay zekâ ya da kısaca YZ, (İngilizce: Artificial intelligence ya da kısaca AI), insanlar da dahil olmak üzere hayvanlar tarafından, doğal zekânın aksine makineler tarafından görüntülenen zekâ çeşididir. Güçlü yapay zeka genellikle yapay genel zekâ (İngilizce: Artificial General Intelligence kelimelerinin kısaltılmışı olarak: AGI) olarak etiketlenirken, doğal zekâyı taklit etme girişimleri yapay biyolojik zekâ (İngilizce: Artificial Biological Intelligence: ABI) olarak adlandırılır.

Yiyecek Ve İçecek Endüstrisi

Yiyecek içecek endüstrisi, gıda maddelerinin üretimi, dağıtımı, işlenmesi, dönüştürülmesi, hazırlanması, muhafazası, nakliyesi, belgelendirilmesi ve paketlenmesine yönelik bir dizi endüstriyel faaliyeti kapsamaktadır. Bunun yanı insanların farklı nedenlerle ikamet ettikleri yerlerin dışına gerçekleştirdikleri seyahatlerde ya da geçici konaklamalarında yeme içme ihtiyaçlarını karşılamak amacıyla mal ve hizmet üreten işletmelerden oluşmaktadır.

Yiyecek içecek işletmeciliği, restoranlar, kafeler, barlar, oteller ve diğer yiyecek içecek hizmeti sunan işletmelerin yönetimi ve organizasyonu ile ilgilidir. Yiyecek içecek işletme türleri restoranlar, kafeler, barlar ve otellerdir. Restoranlar, farklı mutfak türleri sunan, genellikle masa servisi yapan yerlerdir. Kafeler ise daha hafif yiyecekler ve içecekler sunan, sosyal bir ortam sağlayan işletmelerdir. Barlar, alkol ve atıştırılmalıklar sunan, genellikle gece hayatına hitap eden mekanlardır. Oteller ise konaklama hizmeti sunan, aynı zamanda restoran ve kafe gibi yiyecek içecek hizmetleri de sunan işletmelerdir. Yiyecek içecek işletmelerinde menü geliştirme önemlidir. Bunun için yiyecek ve içecek seçenekleri müşteri taleplerine ve hedef kitleye uygun menü oluşturulması ve maliyet analizi yaparak uygun fiyatlandırma stratejileri geliştirmek gereklidir. Bu işletmelerde müşteri deneyimi önemli bir göstergedir.

Müşteri memnuniyetini artırmak için personelin eğitimi ve hizmet standartlarının belirlenmesi ile mekanın dekorasyonu, müzik ve genel atmosferinin müşteri deneyimini etkilemesi, müşteri deneyiminin önemli aşamalarıdır. İşletmede operasyon yönetimi ile pazarlama ve reklam da sürdürülebilirlik açısından gereklidir. Yiyecek ve içecek işletmelerinde malzeme alımı, depolama ve envanter kontrolü ile çalışanların işe alımı, eğitimi ve motivasyonu, bu süreçlerin parçasıdır. Yiyecek içecek işletmelerinde pazarlama ve reklam da diğer işletmeler gibi önemlidir. Bunun için hedef müşteri kitlesinin analizi ve ona uygun pazarlama stratejileri geliştirmek ve sosyal medya, web siteleri ve diğer dijital platformlar üzerinden tanıtım yapmak gereklidir. Ayrıca küçük, orta ve büyük tüm işletmelerin gelir ve giderlerin yönetimi, karlılık analizi, finansal durumun izlenmesi için düzenli raporlar hazırlanması gibi temel finansal yönetim mekanizmaların da işletilmesi önemlidir. Bu işletmelerde gıda güvenliği ve hijyen kurallarına uyulması, çevre dostu uygulamaların bulunması, gıda israfının azaltılması ve enerji tasarrufu işletmenin güvenliği ve sürdürülebilirliği açısından yasal zorunluluklar arasında yer almaktadır.

Yapay Zeka Ve Gıda Endüstrisi

Yapay zekânın yiyecek içecek sektöründe dolaylı etkisini beş başlık halinde toplamak mümkündür.

- Yiyecek ve içeceklerin sıralanmasına yardımcı olmak
- Tedarik zincirini yönetmek
- Çalışanların kişisel hijyen prosedürlerini takip etmelerini sağlamak
- Yeni ürünler geliştirmek
- Temizlik işlemi donanımlarını yönetmektir

Gıda ve İçecek Endüstrisinde AI Gelişmeleri

Gıdaların üretilmesinden tüketilmesine kadarki uzun süreçte yapay zeka veya yapay zeka benzeri uygulamalar son yıllarda hayatımıza girmiştir. Bu süreçte yaşanan temel gelişmeler;



- Verimlilik Artışı: Yapay zeka teknolojisinin entegrasyonu, gıda ve içecek endüstrisinde verimliliği dönüştürmüştür. Artan verimlilik, kesinti sürelerinde önemli azalmalar, onarım maliyetlerinde düşüş ve ek işgücü gereksinimlerinde azalma sağlamıştır.
- Otomatik Sıralama ve Temizleme: Gıda üretim tesisleri, meyve ve sebze gibi ürünleri otomatik olarak sıralamak, temizlemek ve imha etmek için yapay zeka kullanılmaktadır. Manuel işgücü, kameralar, sensörler ve aktüatörler kullanılarak otonom makinelerle otomatikleştirilmiştir.
- Kalite ve Güvenlik İzleme: Gıda kalitesi ve güvenliği, endüstriyel nesnelerin internetleri ve bunların cihazları, sensör dizileri, kablosuz cihazlar ve edge teknolojisi kullanılarak izlenmektedir. Yapay zeka tabanlı gıda güvenliği çözümleri, gıda ürünlerindeki riskleri belirlemeye yardımcı olmaktadır.

Yapay Zeka ve Endüstriyel Nesnelerin İnternetinin Gıda Üretimindeki Rolü

Yapay zeka ve endüstriyel nesnelerin interneti, gıda üretiminde veri yorumlama, anomali tespiti ve analitik içgörüler olarak etkileri sınıflandırılabilir. Çoğu yiyecek ve içecek uygulamasında, yapay zeka ve endüstriyel nesnelerin interneti sensörlerden gelen verileri yorumlar, kalıpları veya anormallikleri tespit eder ve ne zaman harekete geçilmesi gerektiğini belirler. Bu teknolojiler, bir varlığın arızalanabileceğini veya bakıma ihtiyaç duyabileceğini gösteren erken uyarı işaretleri gibi anomalileri tespit etmek için kullanılır. Yapay zeka teknolojisi, kalıpları ayırt etmek, bilgi tabanını genişletmek, neden-sonuç ilişkilerini tanımak ve olası sonuçlarla ilgili analitik içgörülerini kullanmak için kullanılır.

Yapay zeka, gıda endüstrisinde ön görücü bakım ve kalite analitiği sağlayabilir. Bu teknoloji işlemlerde oluşabilecek arızaların tespiti, hata sınıflarının yeniden tanımlanması, verimliliği etkileyen faktörlerin belirlenmesi sağlanabilmektedir.

Gıda ve içecek pazarında yapay zekanın değeri 2020'de 3,07 milyar USD iken, 2026'ya kadar %45,77'lik bir Compound Annual Growth Rate (CAGR, Bileşik Yıllık Büyüme Oranı) ile 29,94 milyar USD'ye ulaşması öngörülmektedir. Tüketici ihtiyaçlarındaki değişimler, hızlı, uygun fiyatlı ve kolay erişilebilir gıda seçeneklerinin tercih edilmesi, gıda ve içecek endüstrisinde bir dönüşüme yol açmıştır. Birçok şirket, operasyonları ölçeklendirmek ve dinamik bir pazar ortamında rekabetçi kalmak için yapay zeka, makine öğrenmesi, endüstriyel nesnelerin interneti ve robotik gibi gelişmiş teknolojilerden yararlanmaktadır.

Gıda endüstrisinde üretim optimizasyonu verimlilik açısından da önemlidir. Yapay zeka ve endüstriyel nesnelerin interneti teknolojileri, üretimi optimize etmek ve üretim tesislerinin en iyi çalışma noktalarını ortaya çıkarmak için en büyük potansiyele sahiptir. Aynı zamanda iklim değişikliğiyle ilgili tüm üretim sorunlarını daha titiz izleme sistemleri ve daha çevik üretim değişiklikleri ile ele almayı sağlayabilir. Endüstriyel nesnelerin interneti cihazları, yapay zeka algoritmaları ve aktüatörler, yapay zeka eğitilmiş modellerle birlikte üretimi otomatik olarak kalibre etmek için kullanılabilir, çıktı kalitesini ve hızını artırabilir.

Gıda endüstrisinde güvenlik sorunlarının tespiti, daha güvenli üretim hatları ve risk tanımlama açısından önemlidir. Yapay zeka tabanlı sistemler, endüstriyel nesnelerin interneti cihazlarının desteğiyle üretimde güvenlik ve kalite sorunlarını tespit etmek için performanslı çözümler sunmaktadır. Bu teknolojiler, insanlardan daha yüksek hız ve tutarlılıkla daha güvenli, daha doğru üretim hatları sağlayabilir. Fabrika zemininde AI tabanlı tespit, olası riskleri belirleyerek çalışanları ve ekipmanı daha güvende tutma potansiyeline sahiptir.

Yapay zeka teknolojileri, yiyecek ve içecek tesisleri için kritik öneme sahip olan hijyen ve temizlik görevlerini optimize etme potansiyeline sahiptir. Yapay zeka tabanlı çok sensörlü endüstriyel nesnelerin interneti sistemleri, ekipmandaki gıda kalıntılarını ve mikrobiyal kalıntıları tanıyarak optimal temizlik süresini belirleyen kendi kendini optimize eden temizlik sistemleri kullanılabilir. Bu sistemler, temizlik işlemlerinin verimliliğini artırırken, insan hatasını en aza indirir ve kaynakların daha etkili kullanılmasını sağlayabilmektedir.

Gıda endüstrisinde atık azaltma ve çevresel sürdürülebilirlik açısından değerlendirildiğinde, yapay zeka ile optimizasyon ve otomasyon temelli iyileştirmeler yapılabilmektedir. Yapay zeka ve endüstriyel nesnelerin interneti, optimizasyon için etkili bir şekilde kullanılmakta ve üretim girdisi ve çıktı malzemelerini ölçmek ve izlemek için yeni yaklaşımlar sağlayarak atık azaltma üzerinde önemli bir etki yaratmaktadır. Yapay zeka analitiği, endüstriyel nesnelerin interneti gerçek zamanlı izlemeyi kullanarak



her parti veya döngüyle ilgili olarak üretim çıktılarındaki anomalileri meydana gelir gelmez tanımlar ve üretim kalitesini kontrol edebilir. Bu sistemler, üretim sürecindeki verimsizlikleri hızla tespit ederek ve düzelterek, atık miktarını önemli ölçüde azaltır ve genel üretim verimliliğini artırmaktadır. Yiyecek ve içecek süreç optimizasyonunda yapay zeka ve endüstriyel nesnelerin interneti kullanımı, enerji ve su tüketimini optimize etmenin dolaylı bir yolunu sağlar, işletme maliyetleri ve marjlar için anında avantajlar yaratırken çevre üzerinde olumlu bir etki yaratabilmektedir. Yapay zeka tabanlı bilgisayarlı görü ve desen tanıma teknikleri, sensörler kullanılarak parametre ölçümleriyle birleştirilerek, varyasyonları kolayca tanıyabilir, tüm partileri israf etmeden kirleticileri çıkarabilir ve süreç gereksinimlerine göre su ve enerji kullanımını sürekli olarak ayarlayabilmektedir. Robotik ve endüstriyel nesnelerin interneti cihazları dahil olmak üzere 7/24 çalışan tüm süreç, üretim hattı boyunca yapay zeka tabanlı çözümler kullanılarak tamamen otomatikleştirilebilir.

Yapay zeka tabanlı paketleme sistemleri de gıda endüstrisinde kullanılmaya başlanmıştır. Yapay zeka destekli robotik, üç boyutlu kameralar ve endüstriyel nesnelerin interneti, hızlı ve verimli teslimat talepleri için paketleme ve toplama uygulamalarında hızla gelişen bir alandır. Gıda ve içecek endüstrisi süreçleri, karmaşıklığı azaltarak ve emek yoğun süreci otomatikleştirerek akıllı otomasyon için benzersiz potansiyel sunar. Bu teknolojiler, maliyeti düşürür, verimliliği ve doğruluğu artırır ve ölçekli çalışmayı sağlayacaktır.

Tedarik zinciri yönetimi gıda endüstrisinin önemli bir parçasıdır. Yapay zeka, lojistik, öngörücü analitik ve şeffaflık yoluyla tedarik zinciri yönetiminde kullanılır. Yapay zeka, tedarik zinciri verilerini analiz ederek ve tedarik zincirindeki değişkenleri daha iyi anlayarak gelecek senaryoları öngörür. Bu, pazara sunma süresini kısaltır ve belirsizlikleri öngören ve bunlarla başa çıkabilen çevik bir tedarik zinciri kurabilmektedir.

Gıda ve içecek sektöründe yapay zeka tabanlı çözümlerin büyük ölçekli uygulanmasının yüksek maliyeti pazar büyümesini kısıtlıyor. Trend, maliyet etkin, ölçeklenebilir ve enerji verimli yapay zeka ve endüstriyel nesnelerin interneti teknolojileri geliştirmek ve bunları gıda ve içecek tedarik zincirlerinin çeşitli katmanlarına uygulamaktır. Bu, küçük ve orta ölçekli işletmelerin de yapay zeka ve endüstriyel nesnelerin interneti teknolojilerinden yararlanmasını sağlayarak, sektörün genelinde dijital dönüşümü hızlandırır.

Gıda işleme endüstrisinde hammadde, yapay zeka ve endüstriyel nesnelerin interneti tabanlı otomatik çözümler kullanılarak yapılan sıralama yardımıyla gıda depolaması göz önüne alındığında giderek daha fazla homojen hale getirilebilir. Bu, işgücü maliyetini azaltabilir, hızı artırabilir ve verimliliği iyileştirebilir. yapay zeka ve endüstriyel nesnelerin interneti tabanlı görüntü işleme ve sensör teknolojileri, hammaddelerin kalitesini hızlı ve doğru bir şekilde değerlendirerek, üretim sürecinin başında kalite kontrolünü optimize eder.

Restoranlarda Yapay Zeka Kullanımının Önemi

Yapay zeka, restoranların operasyon yönetiminde de kullanılmaya başlanmıştır. Yapay zeka, müşterilerin ihtiyaçlarını daha iyi anlamak ve kişiselleştirilmiş hizmet sunmak için kullanılabilir. Yapay zeka, sipariş tahminleri yaparak, menü yönetimini ve stok kontrolünü iyileştirebilir. Yapay zeka, mutfak iş akışlarını optimize ederek ve israfı azaltarak verimlilik sağlayabilir. Restoranlarda, yapay zeka, müşteri tercihlerini analiz ederek özelleştirilmiş menü önerileri sunabilir. Yapay zeka destekli chatbotlar, müşterilerin kolaylıkla rezervasyon yapmasına ve sipariş vermesine yardımcı olabilir. Yapay zeka, müşteri yorumlarını anlık olarak analiz ederek gelişim fırsatlarını tespit edebilir.

Restoranlarda menü yönetimi ve sipariş tahmini için yapay zeka kullanılmaktadır. Yapay zeka, geçmiş satış verilerini inceleyerek müşteri talebini tahmin edebilir. Yapay zekaa, öngörülen talebe göre stok seviyelerini ayarlayarak israfı önleyebilir. Yapay zeka, en çok talep gören ürünleri belirleyerek menü tasarımını iyileştirebilir.

Mutfak verimliliği yiyecek içecek işletmelerinin yönetiminin önemli bir parçasıdır. İş akışı optimizasyonu, tahmin destekli tedarik, gıda israfını azaltma ve kalite kontrolün sağlanması mutfak verimliliğinin süreçleridir. Yapay zeka, en çok talep gören ürünleri belirleyerek menü tasarımını iyileştirebilir. Yapay zeka, ürün talebini öngörerek gerekli hammadde ve ürünlerin doğru miktarda tedarik edilmesini sağlar. Yapay zeka, stok takibi ve ürün ömrü analiziyle gıda israfını önemli ölçüde azaltabilir. Yapay zeka destekli sensörler, yemeklerin pişme durumunu ve sıcaklığını anlık olarak izleyebilir.



Diğer işletme türlerine benzer şekilde yiyecek içecek işletmelerinde de insan kaynakları yönetiminde de yapay zeka kullanılmaktadır. Yapay zeka, yoğunluk ve talep verilerini analiz ederek personel ihtiyacını öngörebilir. Yapay zeka, çalışan tercihlerini ve becerilerini dikkate alarak en uygun vardiya planını oluşturabilir. Yapay zeka, dinamik iş yükü ve çalışan yeteneklerini göz önünde bulundurarak görevleri etkin şekilde dağıtabilir.

Müşterilerin geri bildirimleri de yapay zeka tabanlı sistemlerle yapılabilmektedir. Restoranlarda yapay zeka, müşteri geri bildirimlerindeki duyguları analiz ederek memnuniyet seviyesini belirleyebilir. Yapay zeka, geri bildirimlerdeki temaları tespit ederek iyileştirme fırsatlarını ortaya çıkarabilir. Yapay zeka, müşteri memnuniyetindeki değişimleri anlık olarak izleyebilir.

Sonuç Ve Öneriler

Yiyecek ve içecek işletmelerinde yapay zeka ve endüstriyel nesnelerin internet tabanlı sistemlerin kullanımı gün geçtikçe artmaktadır. Bu sistemlerin kullanımı işletmeler tarafından kullanımı artıkça hem tedarikçi, hem müşteri, hem çalışan hem de işveren açısından önemli faydalar sağlanabilmektedir. Gelecekte yiyecek ve içecek işletmelerinde ve gıda endüstrisinde otomasyon, kişiselleşmiş deneyim, karar destek ve personel yönetimi süreçlerinde yapay zekanın daha çok yer alacağı düşünülmekte olup, Endüstriyel 4.0 ve Endüstri 5.0 sistemlerine geçiş bu sektörler açısından artık lüks değil bir ihtiyaç olmaktadır.



Sivas'ta Coğrafi Tescilli Yiyecek ve İçecekler ve Tescil Potansiyeli

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Özet

Coğrafi işaret, tüketiciler için ürünün kaynağını, karakteristik özelliklerini ve ürünün söz konusu karakteristik özellikleri ile coğrafi alan arasındaki bağlantıyı gösteren ve garanti eden kalite işaretidir. Coğrafi işaret tescili ile kalitesi, gelenekselliği, yöreden elde edilen hammadde ile yerel niteliklere bağlı olarak belli bir üne kavuşmuş ürünlerin korunması sağlanır. Belirgin bir niteliği, ünü veya diğer özellikleri bakımından kökenin bulunduğu yöre, alan, bölge veya ülke ile özdeşleşmiş ürünü gösteren işaretlerdir. Coğrafi işaretler, menşe adı ya da mahreç işareti olarak tescil edilir. Gıda, tarım, maden, el sanatları, sanayi ürünleri coğrafi işaret tesciline konu olabilir. Sivas, geçiminin büyük kısmını tarım ve hayvancılıktan sağlayan ve zengin bitki örtüsüne sahip önemli bir kenttir. Sivas'ta 21 adet coğrafi tescilli ürün bulunmakta olup, bunun 15 tanesi yiyecek ve içecek grubunda yer almaktadır. Yüzölçümünün büyüklüğü ve birçok medeniyete ev sahipliği yapmış olan Sivas'ta gastronomi ürün yelpazesi de son derece geniştir. Bu zamana kadar coğrafi tescil edilen yiyecek ve içeceklerin yanı sıra bu bölgeye ait çok önemli gastronomik unsurlar da bulunmaktadır. Sivas'ın sahip olduğu bu potansiyelin ortaya çıkarılmasında yerel halk ve yerel yönetimlerin işbirliği yapması gerekmektedir. Yapılan bu çalışmada Sivas'a ait coğrafi işaret tescil potansiyeli bulunan yiyecek ve içecekler derlenmiştir.

Anahtar Kelimeler: coğrafi işaret, Sivas, geleneksel ürün adı

Geographically Registered Food and Beverages in Sivas and Registration Potential

Abstract

A geographical indication is a quality mark that indicates and guarantees for consumers the origin of the product, its characteristic features and the connection between the said characteristic features of the product and the geographical area. With the registration of a geographical indication, the protection of products that have gained a certain reputation due to their quality, tradition, raw materials obtained from the region and local qualities is ensured. It is a sign indicating a product identified with the region, area, region or country of origin in terms of a distinctive quality, reputation or other characteristics. Geographical indications are registered as a designation of origin or a designation of origin. Food, agriculture, mining, handicrafts, industrial products can be subject to geographical indication registration. Sivas is an important city that provides most of its livelihood from agriculture and animal husbandry and has rich vegetation. There are 21 geographically registered products in Sivas, 15 of which are in the food and beverage group. The gastronomy product range in Sivas, which has a large surface area and has hosted many civilizations, is also extremely wide. In addition to the foods and beverages that have been geographically registered so far, there are also very important gastronomic elements belonging to this region. Local people and local administrations should cooperate in revealing this potential of Sivas. In this study, foods and beverages of Sivas that have the potential for geographical indication registration have been compiled.

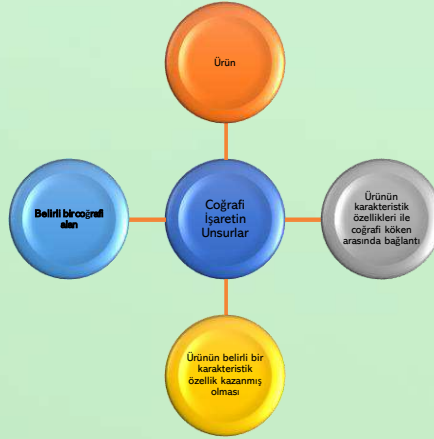
Keywords: geographical indication, Sivas, traditional product name

Giriş

Gastronomi turizmi açısından yiyecek ve içeceklerin korunması, tanıtılması ve pazarlanması önemlidir. Gastronomik unsurların gelecek nesillere aktarılmasında bu unsurların aslına uygun olarak korunması temel gerekliliktir. Coğrafi işaretli gıdalar hem bölgesel hem ulusal ve uluslararası gastronomi turizminin pazarlanması, kırsal kalkınmanın sağlanması ve diğer turizm unsurlarına dolaylı katkılarından dolayı son yıllarda önem düzeyi de artmıştır. Sivas birçok kültüre ev sahipliği yapmış olmasından kaynaklı zengin kültüre sahip Orta Anadolu'da bulunan bir ilimizdir. Farklı kültürlerden edinilen geçmiş sayesinde yiyecek ve içecek çeşitliliği de bir hayli fazladır. Her ne kadar Sivas'a ait ürünler coğrafi işaret tescili ile koruma altına alınmış olsa da ilin genelinde daha keşfedilmeyi bekleyen birçok ürün bulunmaktadır. Bu potansiyelin ortaya çıkarılması, üreticilerin bilgilendirilmesi, yerel yönetimler ve sivil toplum örgütlerinin işbirliği yapması ile bu ürünlerin coğrafi işaret tescilinin yapılması önemlidir.



Coğrafi İşaret Kavramı



Şekil 1. Coğrafi İşaretin Temel Unsurları

Coğrafi işaret, belirli bir coğrafi bölgeden gelen ve o bölgeye özgü özellikler veya ün kazanan ürünleri tanımlamak için kullanılan bir işarettir. Bu işaretler, ürünlerin kalitesini, itibarını ve özgünlüğünü korumak amacıyla tasarlanmıştır. Coğrafi işaretler, özellikle tarım ürünleri, gıda maddeleri, şaraplar ve el sanatları gibi alanlarda yaygın olarak kullanılmaktadır.

6769 Sayılı Sınai Mülkiyet Kanununun Coğrafi İşaretler kitabının hükümleri kapsamında koruma sağlanmaktadır: **MADDE 34- Coğrafi işaret; belirgin bir niteliği, ünü veya diğer özellikleri bakımından kökenin bulunduğu yöre, alan, bölge veya ülke ile özdeşleşmiş ürünü gösteren işarettir. Coğrafi işaretler, menşe adı ya da mahreç işareti olarak tescil edilir.**

Coğrafi İşaret Çeşitleri

Menşe adı: Coğrafi sınırları belirlenmiş bir yöre, bölge veya istisnai durumlarda ülkeden kaynaklanan, tüm veya esas özelliklerini bu coğrafi alana özgü doğal ve beşerî unsurlardan alan, üretimi, işlenmesi ve diğer işlemlerin tümü bu coğrafi alanın sınırları içinde gerçekleşen ürünleri tanımlayan adlar olarak tanımlanır.



Şekil 2. Türkiye'deki Coğrafi İşaret Türleri

Özellikler:

- Üretim sürecinin en az bir aşaması, coğrafi bölge içinde gerçekleşmelidir.
- Ürünün özellikleri, bölgenin iklimi, toprağı ve geleneksel üretim yöntemleri gibi faktörlerden etkilenir.

Örnekler:

- Ankara Tulum Peyniri: Ankara'nın Çamlıdere ilçesinde üretilen ve koyun sütünden yapılan bir peynir türüdür.
- Aydın İnciri: Aydın ilinde yetiştirilen, kendine özgü tat ve aromasıyla bilinen bir incir çeşididir.

Mahreç işareti: Coğrafi sınırları belirlenmiş bir yöre, bölge veya ülkeden kaynaklanan, belirgin bir niteliği, ünü veya diğer özellikleri bakımından bu coğrafi alan ile özdeşleşen, üretimi, işlenmesi ve diğer işlemlerinden en az biri belirlenmiş coğrafi alanın sınırları içinde yapılan ürünleri tanımlayan adlar

Özellikler:

- Ürünün tüm üretim aşamaları, belirli bir coğrafi alan içinde gerçekleştirilmelidir.
- Ürünün özellikleri, o bölgedeki doğal ve insan kaynaklı faktörlerle belirlenir.

Örnekler:

- Gaziantep Baklavası: Gaziantep mutfağının vazgeçilmez bir parçası olan baklava, özel tarifleri ve yapım yöntemleri ile tanınmaktadır.
- Çanakkale Domatesi: Çanakkale ilinde yetiştirilen ve kendine has lezzetiyle bilinen domates türüdür.

Geleneksel Ürün Adı: Belirli bir coğrafi bölgede üretilen ve geleneksel olarak bilinen ürünleri tanımlamak için kullanılır. Bu işaret, ürünün yerel kültür ve geleneklerle olan bağlantısını vurgular.

Özellikler:



- Ürünün geleneksel yöntemlerle üretilmesi ve bu yöntemlerin uzun bir süre boyunca devam etmesi gerekmektedir.
- Ürünün kalitesi ve özellikleri, yerel kültür ve geleneğe dayanır.
- Örnekler:
- İzmir Kordon Boyu Zeytini: İzmir bölgesinde geleneksel yöntemlerle üretilen bir zeytin çeşididir.
- Sakarya Pidesi: Sakarya iline özgü, özel tariflerle hazırlanan bir pide türüdür.

Coğrafi İşaretin Tarihi

Coğrafi işaretlerin tarihi, ürünlerin kökeni ve kalitesinin korunması amacıyla kullanılan bir sistem olarak oldukça eski zamanlara dayanmaktadır. İşte coğrafi işaretlerin tarihi hakkında bazı önemli noktalar:

Antik Dönem

- Eski Medeniyetler: Coğrafi işaretlerin ilk örnekleri, antik dönemlerde Mısır, Yunan ve Roma medeniyetlerinde görülmektedir. Bu dönemde, yerel ürünlerin kalitesi ve özellikleri üzerine yapılan tanımlamalar, ürünlerin kökenini belirtmek için kullanılmaktaydı.
- Şarap ve Zeytin: Antik Yunan'da, belirli bölgelerde üretilen şarap ve zeytin gibi ürünler, o bölgenin özellikleriyle ilişkilendirilerek tanımlanmıştır.

Orta Çağ

- Geleneksel Üretim: Orta Çağ boyunca, özellikle Avrupa'da, yerel ürünlerin üretim yöntemleri ve kaliteleri hakkında daha sistematik bir yaklaşım gelişti. Bu dönemde, belirli bölgelerde üretilen gıda maddeleri ve el sanatları, o bölgeye özgü olarak tanımlanmıştır.
- Lonca Sistemleri: Ticaretin ve zanaatın gelişmesiyle, lonca sistemleri aracılığıyla ürünlerin kalitesi ve kökeni korunmaya çalışılmıştır.

Modern Dönem

- 19. Yüzyıl: Coğrafi işaretlerin resmi olarak tanınması, 19. yüzyılda Avrupa'da başladı. Özellikle Fransa, coğrafi işaretlerin korunması konusunda öncü bir rol üstlenmiştir.
- Paris Konvansiyonu (1883): Sınai Mülkiyetin Korunması için Paris Konvansiyonu, coğrafi işaretlerin uluslararası düzeyde korunmasına yönelik ilk adımlardan birisidir.

20. Yüzyıl ve Sonrası

- Avrupa Birliği Düzenlemeleri: 1992 yılında Avrupa Birliği, coğrafi işaretlerin korunmasına yönelik düzenlemeler getirdi. "Korunan Menşe Adı" (PDO) ve "Korunan Coğrafi İşaret" (PGI) sistemleri bu dönemde oluşturulmuştur.
- Dünya Ticaret Örgütü (WTO): 1994'te imzalanan TRIPS Anlaşması (Ticaretile İlgili Fikri Mülkiyet Hakları Anlaşması), coğrafi işaretlerin korunmasını uluslararası düzeyde teşvik etmiştir.

Dünya'da ilk Fransa'da 1919 yılında Appellation d'origine contrôlée (Controlled designation of origin) aracılığıyla "Rokfor Peyniri" tescil edilmiştir. İspanya'da 1925 yılında Denominación de origen (Designation of origin) aracılığıyla "Rioja Şarabı" tescil edilmiştir.

Türkiye'de Coğrafi İşaret

Türkiye, Avrupa Birliği'ne uyum süreci ile birlikte coğrafi işaretlerin tescil edilmesine yönelik yasal düzenlemeleri 1995 yılında başlatmıştır. Türk Patent Enstitüsü'nün (TPE) yetkisinde çeşitli kriterler çerçevesinde coğrafi işaret tescil işlemleri yapılmaktadır. Ekim 2024 Türk Patent Enstitüsü verilerine göre 1646 adet ürünün coğrafi işaret tescil işlemi yapılmıştır. Bunların tanesi 1243 tanesi mahreç işareti, 393 tanesi menşei işareti ve 7 tanesi geleneksel ürün adı olarak tescil edilmiştir. Ayrıca 584 tane ürün adı da başvuru aşamasında olup değerlendirilmeleri devam etmektedir. Tescil edilen bu ürünlerin büyük bir çoğunluğu tarımsal ürünlerden ya da kaynağını tarımdan alan ürünlerden oluştuğu görülmektedir. Avrupa Birliği'nin coğrafi işaretlere bakış açısı bu noktada sadece tarımsal ürünlerle ilgilidir. Burada Avrupa Birliği, haksız rekabetin önüne geçmek, yüksek kalitede bir ürün standardı oluşturmak, tarımsal ürün desenini arttırmak ve ürünler hakkında tüketicileri bilgilendirmek gibi bir dizi amaçları içermektedir. Avrupa Birliği'nden farklı olarak ülkemizde tescil belgesi almış ürünlerin bir kısmı doğrudan tarımla ilgili değildir. Örneğin baston, halı, kilim, bazı hayvan türleri, tekstil, el işi vb. ürünler de tescil belgesine konu olmuş ürünlerdir. Bu ürünler Türkiye'ye özgü 'kültürel coğrafi işaret' olarak tanımlanabilir. Türk Patent ve Marka Kurumu, 2000'li yıllarda coğrafi işaret tescil süreçlerini hızlandırdı. Türkiye'de birçok yerel ürün, coğrafi işaret olarak tescil edilmiştir. Bu ürünler, yerel kültür ve geleneklerin korunmasına katkıda bulunmaktadır.

Avrupa Birliği'nde Ekim 2024 itibarıyla 27 ürünümüz coğrafi işaret tesciline sahiptir. Bunlar sırasıyla: Gaziantep Baklavası, Aydın İnciri, Malatya Kayısı, Aydın Kestanesi, Milas Zeytinyağı, Bayramiç Beyazı, Taşköprü Sarımsağı, Giresun Tombul Fındığı, Antakya Künefesi, Suruç Narı, Çağlayancerit Cevizi, Gemlik Zeytini, Edremit Zeytinyağı, Milas Yağlı Zeytini, Ayaş Domatesi, Maraş Tarhanası, Edremit Körfezi Yeşil Çizik Zeytini, Ezine Peyniri, Safranbolu Safranı, Aydın Memecik Zeytinyağı, Araban Sarımsağı, Osmaniye Yer Fıstığı, Bingöl Balı, Bursa Şeftalisi, Hüyük Çileği, Bursa Siyah İnciri / Bursa Siyahı, Söke Pamuğu.



Coğrafi işarete şu kişiler/kurumlar başvurabilir;

- Üretici grupları
- Ürün veya ürünün kaynaklandığı coğrafi alanla ilgili kamu kurum ve kuruluşları ile kamu kurumu niteliğindeki meslek kuruluşları
- Ürünle ilgili olarak kamu yararına çalışan veya üyelerinin ekonomik çıkarlarını korumaya yetkili dernekler, vakıflar ve kooperatifler.

• Ürünün tek bir üreticisi varsa, bu durumu ispat etmesi şartıyla ilgili üretici

Gıda, tarım, maden, el sanatları ürünleri ve sanayi ürünleri coğrafi tescil adı alabiliyorken, aşağıdaki adlar coğrafi tescil alamaz;

- Coğrafi İşaret tanımı kapsamına girmeyen adlar.
- Ürünlerin öz adı olmuş adlar (jenerik adlar)
- Ürünün gerçek kaynağı konusunda halkı yanıltabilecek olan bitki tür ve çeşitleri, hayvan ırkları veya benzeri adlar.
- Kamu düzenine veya genel ahlaka aykırı adlar.
- Başvuru hakkına sahip kişiler tarafından başvurusu yapılmış olmasına rağmen kendi ülkesinde korunmayan, koruması sona eren veya kullanılmayan adlar.
- Tescilli veya başvurusu yapılmış bir coğrafi işaret ile tamamen veya kısmen eş sesli olan ve tüketiciyi yanıltabilecek adlar.

6769 Sayılı Kanunun 49 uncu maddesi kapsamında denetim

- Coğrafi işaretlerin ve geleneksel ürün adlarının kullanımının denetimi; tescilli coğrafi işaretleri ve geleneksel ürün adlarını taşıyan ürünlerin üretimi, piyasaya arzı veya dağıtımı aşamalarında veya ürün piyasada iken kullanımının tescilde belirtilen özelliklere uygunluğunun denetimine ilişkin her türlü faaliyeti kapsar.

5996 Sayılı Veteriner Hizmetleri, Bitki Sağlığı, Gıda ve Yem Kanununun 23 üncü maddesi kapsamında denetim

- Tarım ve Orman Bakanlığı, tarım ve gıda ile ilgili coğrafi işaret veya geleneksel ürün adlarının kullanımının tescilde belirtilen özelliklere uygunluğunu denetler.

Coğrafi İşaretlerin Önemi

Coğrafi işaretler, üreticilere ve tüketicilere birçok avantaj sunar:

- Kalite Güvencesi: Coğrafi işaret, ürünün belirli bir standartta üretildiğini garanti eder.
- Tüketici Bilinci: Tüketicilerin, ürünlerin kökeni ve kalitesi hakkında bilgi sahibi olmasını sağlar.
- Yerel Ekonomiyi Destekleme: Coğrafi işaretler, yerel üreticilerin rekabet gücünü artırarak yerel ekonomiyi destekler.

Coğrafi tescil sürecinde çeşitli zorluklar yaşanabilmektedir. Bunlar bürokratik engeller, maliyetler, rekabet veya bilgi eksikliği olabilmektedir. Tescil başvurusu süreci uzun ve karmaşık olabilir. Gerekli belgelerin toplanması ve sunulması zorlu olabilir. Tescil süreci, başvuru ücretleri, danışmanlık hizmetleri gibi önemli maliyetler gerektirebilir. Bu maliyetler bazı üreticiler için engelleyici olabilir. Tescil başvurusunun onaylanması için, ürünün özgünlüğü ve coğrafi bağının güçlü olması gerekir. Bu, rekabetçi bir ortamda zorlu olabilir. Bazı üreticiler, tescil süreci ve faydaları hakkında yeterli bilgiye sahip olmayabilir. Bunlar, tescil başvurusunun gecikmesine veya reddedilmesine yol açabilir.

Sivas'ta Coğrafi Tescilli Ürünler

Sivas, Türkiye'nin tarihi ve kültürel zenginliğine sahip bir şehridir. Bu zenginlik, yiyecek ve içecek kültürüne de yansımıştır. Sivas'ta, coğrafi işaret tesciliyle korunan birçok lezzet bulunmaktadır. Sivas, Türkiye'nin Orta Anadolu Bölgesi'nde yer alır. Doğu Anadolu ve İç Anadolu Bölgeleri ile sınır komşusudur.

Sivas, İç Anadolu Bölgesi'nin yüksek ve engebeli bir coğrafi konumuna sahip olup, iklimi karasal iklimdir. Kışlar soğuk ve karlı, yazlar ise sıcak ve kuraktır. Sivas'ın toprakları, genellikle kuru ve yarı kurak özellikler gösterir. Bölgede geniş bozkır alanları bulunur. Sivas'ta dağlar ve vadiler de bulunur. Sivas'ın coğrafi konumu ve ekolojisi, çeşitli bitki örtüsü ve hayvan yaşamına ev sahipliği yapar.

Sivas'ın geleneksel ve köklü mutfak kültürü bulunmaktadır. Bu kültürün kaynağı zengin miras, doğal malzemeler, özel lezzetler ve misafirperver yapısıdır. Sivas mutfağı, yüzyıllardır süregelen gelenekler ve kültürel etkileşimlerle zenginleşmiştir. Sivas'ın coğrafi konumu ve ekolojisi, lezzetli ve sağlıklı ürünlere olanak tanır. Sivas'ın mutfak kültürü, coğrafi konumuna özgü lezzetleri, geleneksel tarifleri ve sunumlarıyla öne çıkar. Sivas'ın sıcak ve misafirperver kültürü, yemek kültürüne de yansır.



Bu coğrafyada, una (temeli buğday), süt (ağız, avuz vb.) ve süt ürünlerine (peynir, yoğurt vb.) ve kırmızı et, sakatat gibi besin ürünlerine dayalı yöresel yemekler ön plana çıkmaktadır. Sivas'ta sakatatlar içerisinde de en fazla kelle tüketilir. Sivas yöresel lezzetlerinde ön plana çıkan ürün grupları

- Buğday ve buğday unu ile yapılan yağlı hamur işleridir.
- Hayvansal ürünlerden yapılan hayvansal protein ağırlıklı yöresel yemeklerdir.
- Şekerpancarı içerikli yemekler

Sivas'ta Ekim 2024 itibarıyla 21 coğrafi tescilli ürün bulunmaktadır (Tablo 1). Bunlardan 14'ü yiyecek içecek ürün grubunda 7 tanesi diğer kategorisindedir. 21 ürünün, 16'sı menşei işareti, 5'i mahreç adı bulunmaktadır.

Tablo 1. Sivas'ta tescilli coğrafi işaretli ürünler (Ekim, 2024)

Coğrafi İşaretin Adı	Türü	Ürün grubu
Divriği Pilavı / Alatlı Pilavı	Mahreç İşareti	Yemekler ve çorbalar
Gemerek Gilaburusu	Menşei Adı	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Gürün Dut Pekmezi	Menşei Adı	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Kangal Balıklı Kaplıcası	Menşei Adı	Diğer ürünler
Kangal Koyunu	Menşei Adı	Diğer ürünler
Koyulhisar Domatesi	Menşei Adı	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Sivas Bıçağı	Mahreç İşareti	Halılar, kilimler ve dokumalar dışında kalan el sanatı ürünleri
Sivas El Halısı	Mahreç İşareti	Halılar ve kilimler
Sivas Katmeri	Mahreç İşareti	Fırıncılık ve pastacılık mamulleri, hamur işleri, tatlılar
Sivas Kemik Tarağı	Mahreç İşareti	Halılar, kilimler ve dokumalar dışında kalan el sanatı ürünleri
Sivas Köftesi	Mahreç İşareti	Yemekler ve çorbalar
Sivas Pastırması	Mahreç İşareti	İşlenmiş İşlenmemiş Et Ürünleri
Sivas Pezik Turşusu	Mahreç İşareti	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Suşehri Kuru Fasulyesi	Mahreç İşareti	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Tonus Köftesi	Mahreç İşareti	İşlenmiş İşlenmemiş Et Ürünleri
Ulaş Etli Pidesi	Mahreç İşareti	Fırıncılık ve pastacılık mamulleri, hamur işleri, tatlılar
Ulaş Yaprak Döneri	Mahreç İşareti	Yemekler ve çorbalar
Yenihan Bebekleri	Mahreç İşareti	Halılar, kilimler ve dokumalar dışında kalan el sanatı ürünleri
Zara Balı	Mahreç İşareti	Bal
Zara Sac Ekmeği	Mahreç İşareti	Fırıncılık ve pastacılık mamulleri, hamur işleri, tatlılar
Şarkışla Kilimi	Mahreç İşareti	Halılar ve kilimler

Bu tescilli ürünlerden bazıları;

Divriği pilavı, bir çeşit pirinç pilavıdır. Malzemeleri dana eti, pirinç, nohut, kuru üzüm, soğan, kara biber, yeni bahar, tereyağı, sıvı yağ, et suyu, tuzdur. Divriği Pilavı / Alatlı Pilavı 09.10.2020 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Gilaburu (viburnum opulus), kırmızı renkli, nohut büyüklüğünde meyve veren bir ağaç türüdür. Gemerek gilaburusu bahçelerde yetiştirildiği gibi dere kenarlarında da yabani formları bulunmaktadır. Gemerek Gilaburusu 23.11.2017 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Sivas Köftesi içeriğinde sadece et ve tuzun bulunduğu hazırlanış şekli diğer köftelerden farklı ve zor olan bir köftedir. Sivas köftesi 31.01.2011 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Sivas Pastırması 2 yaşını doldurmuş erkek dana etinin literatürde karıncabaş denilen 1-2 mm boyutundaki yeraltı kaynak tuzu ile tuzlanıp doğal hava şartlarında kurutulması ve çemen ile kaplanması suretiyle üretilen pastırmadır. 30.05.2022 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Sivas katmeri su, un, yağ, yaş maya, yumurta sarısı ve tuzdan oluşan unlu mamuldür. İçeriğinde bulunan ürünlerin harmanlanmasıyla tuzlu bir lezzete sahiptir. Şekli dikdörtgen biçiminde yassıdır. Sivas katmeri 26.12.2018 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Sivas Pezik Turşusu / Sivas Pezik Dal Turşusu yöreye has özel bir turşu çeşididir. Ürünü farklılaştıran temel malzeme pezik pancar dalının (şeker pancarı hariç pezik ve diğer saplı her türlü pancar türleri) üretimde kullanılmasıdır. 12.03.2020 tarihinde Türk Patent ve Marka Kurumu tarafından tescillenmiş ve coğrafi işaret almıştır.

Sivas'ta coğrafi işaret tescil başvurusu yapılan 4 ürün daha vardır (Tablo 2).



Tablo 2. Sivas'ta başvuru aşamasında olan coğrafi işaretli ürünler (Ekim, 2024)

Coğrafi İşaretin Adı	Türü	Ürün grubu
Gürün Ayvaniye Elması	Menşe Adı	İşlenmiş ve işlenmemiş meyve ve sebzeler ile mantarlar
Kelle Tatlısı	Mahreç İşareti	Fırıncılık ve pastacılık mamulleri, hamur işleri, tatlılar
Sivas Fırın Kelle	Mahreç İşareti	İşlenmiş İşlenmemiş Et Ürünleri
Sivas Kaynak Tuzu	Menşe Adı	Yiyecekler için çeşni / lezzet vericiler, soslar ve tuz

Çalışma kapsamında, Sivas'ta yaşayan ve Sivaslı olan 680 kişiyle açık uçlu soru sorarak görüşme yapılmıştır. Görüşme neticesinde “Sivas'taki hangi ürünlerin coğrafi işaret tescili yapılmalı?” sorusuna en çok “madımak” cevabı alınmıştır. Bu çalışmada sırasıyla şu cevaplar elde edilmiştir; madımak, hurma tatlısı, peskütan çorbası, kazan simidi, Sivas çöreği, evelik sarması, hingel, içli köfte pezik turşu kavurması, mumbar dolması, küp peyniri, karamuk mirik köfte, Sivas kebabı, İmranlı balı, etli bat etli ekmek, düğürcük çorbası.

Sonuç Ve Öneriler

Sivas, hem coğrafi konumu, hem bitki örtüsü, hem zengin kültürel yapısı ve geniş geleneksel mutfacı sayesinde sahip olduğu gastronomik değerleri koruması gereken kadim bir şehrimizdir. İlin sahip olduğu bu unsurlar coğrafi tescil potansiyeline sahip olup gelecek nesillere taşınması açısından önemlidir. Bu çalışma ile elde edilen sonuç ve öneriler şu şekilde sıralanmıştır;

- Sivas'ın coğrafi işaret tescili için yüksek potansiyele sahip birçok ürünü bulunmaktadır. Yerel üreticiler, ürünlerini korumak ve marka değerini artırmak için coğrafi işaret tescili başvurusunda bulunmalıdır.
- Tescilli ürünlerin tanıtımı için etkin pazarlama stratejileri geliştirilmelidir. Yerel ürünlerin kalitesini ve kültürel önemini vurgulayan reklam ve pazarlama kampanyaları düzenlenmelidir.
- Sivas'ın coğrafi işaret tescilini desteklemek için kamu kurumları, üniversiteler ve özel sektör arasında iş birliği yapılmalıdır. Yerel üreticilere danışmanlık ve finansal destek sağlanmalıdır.
- Coğrafi işaret tescilinin sürdürülebilirliği için yerel üretim teknikleri geliştirilmeli ve çevre koruma önlemleri alınmalıdır.





ID: 511

Isolation of Plastic Degrading Microorganisms from Soils Contaminated with Industrial and Municipal Waste

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Abstract

Plastics are the synthetic polymers formed by hydrocarbons. Their versatile properties and usage led to their massive production. This massive production and its improper disposal ultimately resulted in the plastic pollution. In the present study soil samples were collected from multiple dumpsites of Multan. The polymers targeted for degradation studies were PET, PVC and PE. Clear-zone plate assay was performed to isolate the plastic degrading fungi on media supplemented with PEG-6000. On the basis of plastic degradation potential one fungal isolate from each sample was selected for further studies. Liquid culture assay and soil burial simulation test were conducted with selected strains (named as F7 and F8) for the period of 60 days. In weight loss test, F8 showed cumulative better weight loss results as compared to other strains and consortia over a period of 60 days in both setups. Moreover, enzyme plate assays including amylase, protease and lipase were also conducted. The best cumulative activity for esterase with all four polymers was observed for F8 when analyzed by spectrophotometry. Salinity and temperature tolerance were also evaluated, where F8 gave the highest salinity tolerance of 15% while F9 was able to grow at maximum temperature of 50°C. FTIR results showed that F7 treated PET had formed new C-H and alcoholic O-H bonds while F8 treated polymer had new acidic O-H bonds. F7 treated PVC showed C-O bond breakage while F8 treated PET showed acidic O-H bonds breakage and also C=O and C-O bonds breakage. F7 treated PE film showed CH bonds breakage while F8 treated PE had more intense peaks showing increased number of bonds in treated polymer. Changes in thermal characteristics was observed using TGA-DSC where PET treated with F8 had increased weight loss in comparison to other selected strains. When PVC film was treated with F7, it had lower T_m than other strains. F8 treated PE had more change in T_m as compared to F7. Degradation analysis for liquid cultures were better as compared to the films treated by soil burial test mimicking the natural environment. Among the isolated strains F8 proved to be the efficient degrader of various polymers selected in the study.

Keywords:



ID: 513

Diallel analysis for combining ability for yield and fiber quality traits in upland cotton (*G. hirsutum* L.)

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Abstract

Cotton (*Gossypium hirsutum* L.) is an important fiber crop, grown in tropical and sub-tropical regions of the world. During 2022-23, cotton contributed approximately 0.3% to GDP and 1.4% to the value addition in agriculture of Pakistan. Seed cotton yield in Pakistan is lower as compared to other countries, emerging challenges of climate change, declining land and water resources require exploration of new breeding approaches like heterosis breeding for sustainable cotton production. For this purpose, a research was conducted in experimental area of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Three parent genotypes, i.e. CIM-663, FH-305 and BS-49 during winter season in glasshouse collected from seedbank of department and crosses made with full diallel mating design. Evaluation of six F₁ genotypes and three parent varieties were proceed in field by following randomized complete design with two replications during Kharif season 2023. The data for various quantitative traits like plant height, sympodial branches, boll weight, number of bolls per plant, number of nodes per plant, first fruiting node, seeds per boll, seed index, seed cotton yield, lint mass per plant, ginning out turn, fiber length, fiber strength, and fiber fineness were recorded. Recorded data subjected to analysis of variance and analyzed by using Griffing's approach for estimation of GCA and SCA. Among the parents FH-305 and BS-49 exhibited superior GCA for most of the traits. Among the crosses FH-305 × BS-49 showed high specific combining ability. Furthermore, SCA variance found to be better than GCA variance and RCA variance for most of the genotypes. In this study, most of the traits found under the control of dominance gene action. These best performing parents can be further utilized in future breeding programs for varietal improvement purpose.

Keywords: *Gossypium hirsutum*, Heterosis breeding, Diallel analysis, Combining ability, Climate Change



ID: 514

Green production of eco-friendly AgNPs and evaluation of larvicidal activity against *Cydia pomonella* (L.) (Lepidoptera: Tortricidae)

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Abstract

Cydia pomonella (L.) is an important apple pest and causes irreversible damage to apples if not controlled. Therefore, different control methods are intensively applied against this lepidopteran pest in apple orchards. Since the larval stage of the pest is very harmful for apples, many studies focus on this life stage and new control techniques are developed every year. After the production of metallic nanoparticles as a new nanotechnological product through green synthesis, it has been proven to be highly effective against the larval stage of many pests in recent years. This study covers the synthesis of silver nanoparticles (AgNPs) from the extract of Windmill palm (*Trachycarpus fortunei* (Hook.) H. Wendl.) fruits and the efficacy of this synthesised product in larval control of this lepidopteran pest. The morphological and functional structure of the synthesised AgNPs were determined by characterisation tests (UV-Vis, FT-IR, XRD, SEM, TEM, EDS) and it was determined that the synthesised AgNPs were approximately 10-20 nm in size and had high silver ion ratios. The synthesised AgNPs were applied to the 4th stage larvae of the pest by spraying method at 6 different doses (25, 50, 75, 100, 125 and 150 ppm) and larvicidal activity was evaluated in terms of mortality rates depending on the days after application. According to the results obtained, 18% mortality rate was reached at the lowest dose at the end of the 4th day, mortality rate increased as the dose increased and 100% mortality rate was reached at the highest dose. This study proved that the synthesised AgNPs were highly effective against this lepidopteran pest and provided a basis for similar nanotechnological studies in the future.

Key words: Green synthesis, AgNPs, Pest management, Green insecticide

Çevre dostu AgNP'lerin yeşil üretimi ve *Cydia pomonella* (L.) 'ya (Lepidoptera: Tortricidae) karşı larvisidal aktivitesinin değerlendirilmesi

Özet

Cydia pomonella (L.) önemli bir elma zararlısıdır ve kontrol edilmediği takdirde elmalarda geri dönüşü olmayan zararlara neden olur. Bu nedenle elma bahçelerinde bu lepidopter zararlısına karşı farklı mücadele yöntemleri yoğun olarak uygulanmaktadır. Zararlının larva evresi elmalar için çok zararlı olduğundan, birçok çalışma bu yaşam evresine odaklanmakta ve her yıl yeni kontrol teknikleri geliştirilmektedir. Yeni bir nanoteknolojik ürün olarak metalik nanopartiküllerin yeşil sentez yoluyla üretilmesinden sonra, son yıllarda birçok zararlının larva evresine karşı oldukça etkili olduğu kanıtlanmıştır. Bu çalışma, Windmill palmyesi (*Trachycarpus fortunei* (Hook.) H. Wendl.) meyvelerinin ekstraktından gümüş nanopartiküllerin (AgNPs) sentezini ve sentezlenen bu ürünün bu lepidopter zararlısının larva kontrolündeki etkinliğini kapsamaktadır. Sentezlenen AgNP'lerin morfolojik ve fonksiyonel yapısı karakterizasyon testleri (UV-Vis, FT-IR, XRD, SEM, TEM, EDS) ile belirlenmiş ve sentezlenen AgNP'lerin yaklaşık 10-20 nm boyutlarında olduğu ve yüksek gümüş iyonu oranlarına sahip olduğu tespit edilmiştir. Sentezlenen AgNP'ler 6 farklı dozda (25, 50, 75, 100, 125 ve 150 ppm) püskürtme yöntemiyle zararlının 4. evre larvalarına uygulanmış ve larvisidal aktivite uygulamadan sonraki günlere bağlı olarak ölüm oranları açısından değerlendirilmiştir. Elde edilen sonuçlara göre 4. günün sonunda en düşük dozda %18 ölüm oranına ulaşılmış, doz arttıkça ölüm oranı artmış ve en yüksek dozda %100 ölüm oranına ulaşılmıştır. Bu çalışma, sentezlenen AgNP'lerin bu lepidopter zararlısına karşı oldukça etkili olduğunu kanıtlamış ve gelecekte benzer nanoteknolojik çalışmalar için bir temel oluşturmuştur.

Anahtar Kelimeler: Yeşil sentez, AgNPs, Zararlı yönetimi, Yeşil insektisit



ID: 517

Quality Characteristics And Udder Health Of Raw Cow Milk In Banaz (Uşak) And Altıntaş (Kütahya) Districts

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Abstract

Milk is an indispensable nutrient in people's daily nutrition, especially for healthy milk consumption, quality and safe production is an indispensable element. The health and genotypic characteristics of animals directly affect productivity. For this purpose, efficient production is possible with correct animal feeding. However, in order to implement a correct nutrition program, it is necessary to know how the health status of cows and nutrition affect milk content. In this context, the study aimed to determine the udder health and milk composition of animals in Altıntaş district of Kütahya and Banaz district of Uşak. Milk samples were collected from 77 cows from 3 villages in Altıntaş and 49 cows from 2 villages in Banaz. The composition of milk was compared in terms of fat (%), dry matter (%), density (%), protein (%), lactose (%), salt (%), freezing point (°C), conductivity (ms/cm) and the prevalence of mastitis was investigated with the CMT test. According to the obtained data, while mastitis was not found in the majority of the enterprises, it was determined that the cows with mastitis symptoms were generally cows raised in the same enterprise. Among the districts, it was determined that the cows in Altıntaş district had lower fat ratio (3.51), higher dry matter ratio (9.26) and higher protein ratio (3.33). In Banaz district, it was determined that the milk had lower lactose ratios (4.78), lower density (28.08) and higher conductivity (4.95). It was determined that the cows raised in Çayırbaşı village had the highest values in terms of milk quality among the villages. It was observed that this was due to the high level of awareness of the producers, contracted production and attention to hygiene conditions.

Key Words: Milk Technology, Milk Quality, Cattle Breeding, Food Codex, Mastitis

Banaz (Uşak) Ve Altıntaş (Kütahya) İlçelerindeki Çiğ İnek Sütlerinin Kalite Özellikleri Ve Meme Sağlığı Yönünden Araştırılması

Özet

Süt insanların günlük beslenmesinde vazgeçilmez bir besin konumundadır özellikle sağlıklı süt tüketimi için kaliteli ve güvenli üretim vazgeçilmez bir unsurdur. Hayvanların sahip olduğu sağlık ve genotipik özellikleri verimi doğrudan etkilemektedir. Bu amaçla doğru bir hayvan besleme ile verimli bir üretim mümkün olabilmektedir. Ancak doğru bir beslenme programının uygulanabilmesi için ineklerin sağlık durumunun ve beslenmenin süt içeriğini nasıl etkilediğini bilmek gerekir. Bu kapsamda çalışmada Kütahya'nın Altıntaş ve Uşak'ın Banaz ilçelerindeki hayvanların meme sağlığını ve süt bileşimin belirlenmesi amaçlanmıştır. Altıntaş'ta 3 köyden 77 inekten, Banaz'da 2 köyden 49 inekten süt örnekleri toplanmıştır. Sütün bileşimi yağ (%), kurumadde (%), yoğunluk (%), protein (%), laktoz (%), tuz (%), donma noktası (°C), iletkenlik (ms/cm) yönünden karşılaştırılmış ve mastitis prevalansı CMT testi ile araştırılmıştır. Elde edilen verilere göre işletmelerin büyük bir çoğunluğunda mastitis varlığına rastlanmazken, mastitis belirtileri görülen ineklerin genellikle aynı işletmede yetiştirilen inekler olduğu belirlenmiştir. İlçeler arsında Altıntaş ilçesindeki ineklerin yağ oranı daha düşük (3.51), kuru madde oranı (9.26) ve protein oranının da daha yüksek (3.33) olduğu belirlenmiştir. Banaz ilçesinde de sütlerde laktoz oranları (4.78) daha düşük, yoğunluk (28.08) daha düşük, iletkenliğinde daha yüksek (4.95) olduğu tespit edilmiştir. Köyler arasında süt kalitesi yönünden en yüksek değerlere Çayırbaşı köyünde yetiştirilen inekler olduğu belirlenmiştir. Bunda üreticilerin bilinç düzeyinin yüksek olmasının, sözleşmeli üretim yapmasının ve hijyen koşullarına dikkat etmesinin sonucunda olduğu gözlemlenmiştir.

Anahtar Kelimeler: Süt Teknolojisi, Süt Kalitesi, Büyükbaş Hayvan Yetiştiriciliği, Gıda Kodeksi, Mastitis



The Effect Of Herbal Product Addition On The Chemical And Physical Properties Of Yogurt

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Abstract

With the developing technology, diversity in food types is increasing. These increases are based not only on consumers' food preferences but also on the fact that it is organic. The diversification and significant increase in the variety of artificial or processed foods in recent years increases the demand for high quality products by consumers. The fact that fermented products are beneficial for health and are highly preferred by consumers increases the demand for yogurt and yogurt combinations in food-based products. Yogurt is a fermented dairy product produced by *S. thermophilus* and *L. Bulgaricus* and consumed globally for health purposes. While traditional yogurt production was made using milk and yogurt cultures, the use of plant products in yogurt production has been increasing in recent years. Yoghurt fortification has an important value to improve the nutritional, sensory, functional and health-promoting effects of yogurt. In this context, vegetables, fruits, fibers, seed extracts and herbs are frequently used in yogurt production.

Key Words: Yogurt, Shelf Life, Food Quality, Chemical and Physical properties, Herbal Ectract

Bitkisel Ürün Katılmasının Yoğurdun Kimyasal ve Fiziksel Özellikleri Üzerinde Etkisi

Özet

Gelişen teknoloji ile birlikte gıda türlerinde de çeşitlilik artmaktadır. Bu artışlar tüketicilerin gıda tercihlerinde sadece isteğe değil aynı zamanda organik olmasına da dayanmaktadır. Son yıllarda yapay veya işlenmiş gıdaların çeşitlilik kazanması ve kayda değer oranda artması tüketiciler tarafından yüksek kalitedeki ürünlere olan talebi artırmaktadır. Fermantasyon ürünlerin sağlık yönünden faydalı olması ve tüketiciler tarafından çok tercih edilmesi gıda bazı ürünlerde yoğurt ve yoğurt birleşimlerine olan rağbeti artırmaktadır. Yoğurt, *S. thermophilus* ve *L. Bulgaricus* tarafından üretilen ve global dünyada sağlık amacıyla çok fazla tüketilen fermente bir süt mamulüdür. Geleneksel yoğurt üretimi süt ve yoğurt kültürleri kullanılarak yapılırken, son yıllarda bitkisel ürünlerin yoğurt üretiminde kullanımı artmaktadır. Yoğurdu zenginleştirme, yoğurdun besinsel, duyuşsal, fonksiyonel ve sağlığı geliştirici etkilerini daha iyi bir konuma getirmek için önemli bir değere sahiptir. Bu bağlamda, sebzeler, meyveler, lifler, tohum özleri ve bitkiler yoğurt üretiminde sıklıkla kullanılmaktadır.

Anahtar Kelimeler: Yoğurt, Raf Ömrü, Gıda Kalitesi, Kimyasal ve Fiziksel Özellikler, Bitki Ekstraktı

Giriş

Türk Gıda Kodeksi'ne göre yoğurt *Lactobacillus bulgaricus* ve *Streptococcus thermophilus* bakteriyel laktik asit fermantasyonu ile üretilen pıhtılaşmış bir süt ürünüdür. Türk Standartları Enstitüsü (TSE) TS 1330 yoğurt standardı daha ayrıntılı bir tanım vermektedir. Bu nedenle yoğurt; inek sütü, keçi/koyun sütü veya bunların karışımları pastörize veya gerekiyorsa *Lactobacillus bulgaricus* ve *Streptococcus thermophilus*'tan oluşan bir yoğurt kültürü süt tozu ilavesiyle homojenize edilmiş veya edilmeden Yoğurt yapımında standart kurallar (TS 10935)'e uygun olarak elde edilen üründür. Yüksek kalsiyum içeriği, riboflavin, protein, B12 ve B6 vitaminleri nedeniyle dünyada en çok tüketilen, besin değeri yoğun gıdalardan biri de yoğurttur. Beslenme; yaşamın sürdürülmesi, sağlığın korunması, büyüme ve gelişme için gerekli olan besinlerin tam ve dengeli olarak alınması ve kullanılmasıdır (Demirci, 1986). Bu nedenle protein, karbonhidrat, yağ, vitamin, mineral ve su olmak üzere altı grup besin maddesinin belirli oranlarda yeterli miktarda vücuda alınması gerekir (Anonim, 1992).

İnsanoğlunun beslenmesinde süt ve süt ürünleri oldukça önemli bir yere sahiptir. Sütün sindirilmesi kolay olup vücutta yaklaşık %95 sindirilir. Süt bünyesinde yaklaşık 85 ayrı besin unsuru, litresinde 905 g su, 34 g protein, 35 g yağ, 49 g laktoz, 9 g tuz ve en az 2 g miktarda vitaminler, organik asitler, enzimler, gazlar ve hormonlar gibi içerikleri içerisinde bulundurmaktadır. Süt ve süt ürünlerin yüksek besin değerleri kendi içerisinde barındırması, katıldıkları gıdalarda homojen olarak dağılması önemli özellikleridir (Ayar ve Demirulus, 2000).



İnek, koyun, keçi ve manda gibi çeşitli hayvanların meme bezleri tarafından üretilen bir sıvı olan süt, beyaz veya krem rengi, farklı tadı ve kıvamıyla karakterize edilir. Hiçbir katkı maddesi veya madde uzaklaştırıcı madde içermez (Besler ve Ünal, 2006). Sütün temel bileşenleri protein ve protein olmayan azotlu bileşenler olarak kategorize edilebilir. Protein bazlı nitrojenli bileşenler kazein ve serum proteinlerini içerir. Küresel bir yapıya sahip olan serum proteinleri, β -laktoglobulin, α -laktalbümin, serum albümini, proteoz-peptonlar, immünoglobulinler ve diğer küçük protein fraksiyonlarını kapsar (Smithers, 2008). Süt hem yetişkinler hem de yeni doğanlar için immünolojik koruma kaynağı olarak hizmet eder ve bu da onu vücut için besleyici bir gıda haline getirir. Ek olarak, temel besinleri sağlayan biyolojik olarak aktif elementler, özellikle biyoaktif peptitler içerir (Madureira ve diğerleri, 2007). Biyoaktif peptitlerin sentezi, hücre içinde büyük peptitlerin ilk üretimini içerir; bunlar daha sonra parçalanır ve aktif bileşikler oluşturmak üzere değiştirilir (George ve diğerleri, 1997). Bu biyoaktif peptitler, yapısal proteinlerin içine gömüldüklerinde aktif olmayan bir durumda kalırlar ve yalnızca enzimatik aktivite yoluyla salınabilirler (Haque ve diğerleri, 2009; Beermann ve Hartung, 2013). Süt, yumurta, et, balık, soya ve buğday dahil olmak üzere çeşitli besin kaynakları biyoaktif peptitler içerir (Hartmann ve Meisel, 2007). Ancak süt proteinlerinin şu anda biyoaktif peptitlerin birincil ve en önemli rezervuarı olduğu kabul edilmektedir (Korhonen ve Pihlanto-Leppala, 2003; Silva ve Malcata, 2005; Karakaya, 2009). Proteinler, vücudun ihtiyaç duyduğu tüm temel amino asitleri sağlayarak insan sağlığında çok önemli bir rol oynar. Bu proteinler arasında süt proteinleri son derece değerli bir biyoaktif peptit kaynağı olarak öne çıkıyor. Sığır sütü, kolostrum ve diğer süt çeşitleri, bu faydalı bileşiklerin en önemli doğal kaynakları olarak geniş çapta kabul edilmektedir. Gıdalarda bulunan sağlığı artırıcı maddeler, süttten elde edilen biyoaktif peptitlerde keşfedilmiştir. Bu peptitler sinir, mide-bağırsak, kardiyovasküler ve bağışıklık sistemleri de dahil olmak üzere çeşitli vücut sistemlerinin büyümesine ve korunmasına yardımcı olur. Sonuç olarak kanser, osteoporoz ve hipertansiyon gibi rahatsızlıkların önlenmesinde çok önemli bir rol oynarlar. Doğal proteinlerin birincil dizisi, enzimatik hidroliz, proteoliz veya mikrobiyal fermentasyon gibi işlemler yoluyla salınabilen biyolojik aktivitenin çoğunu içerir. Fermente süt ürünleri, ekşi süt, peynir altı suyu ve olgunlaştırılmış peynirler bu biyoaktif peptitlerin zengin kaynaklarıdır. Bu alıntılar Bankole AO vd.,(2023)'e göre; Günümüzde yoğurt, duysal özelliklerini geliştirmek ve besleyici ve nutrasötik özelliklerini etkilemek için farklı katkı maddeleri ile yükseltilmiştir (Rehman vd.,2022). Yoğurdun besin bileşimi onu yaygın olarak kabul gören bir süt ürünü haline getirmiştir. Karbonhidratlar, proteinler, mineraller ve gerekli vitaminleri içerir (Gilbert and Turgeon, 2021). Yoğurt tüketimi ayrıca, probiyotik bileşenlerine atfedilen sindirimi hızlandırmak, bağırsak mikroflorasını iyileştirmek ve kabızlık, şişkinlik ve ishal semptomlarını önlemek dahil olmak üzere çeşitli sağlık yararlarıyla da ilişkilendirilmiştir(Kumar vd., 2022). Beslenme açısından protein, yoğurttaki önemli besinlerden biridir. Yoğurtta bulunan protein kolayca sindirilebilir. Bu nedenle protein sindirimi bozuk bireyler için mükemmel bir günlük seçeneğidir (Mckinley,). Ayrıca yoğurt tüketiminin kalp sağlığını iyileştirdiği bildirilmiştir. Bunun nedeni yoğurdun kolesterol seviyelerini düşürdüğü ve böylece kalp hastalığı tehlikesini azalttığı kanıtlanmış olmasıdır (Kumar vd., 2022). Benzer şekilde, yoğurtta minerallerin, tam olarak kalsiyumun varlığının, tüketicilerinin kalp ve damar sağlığını iyileştirdiği kanıtlanmıştır. Çalışmalar, yoğurt tüketen hipertansif hastaların kan basıncının önemli ölçüde azaldığını göstermiştir. Ayrıca yoğurdun insülin duyarlılığını ve glikoz toleransını iyileştirerek tip 2 diyabet riskini azalttığı bulunmuştur. Yoğurt, özellikle menopoz sonrası dönemdeki kadınlarda kemik yoğunluğunun artmasıyla da ilişkilendirilmiştir, böylece yüksek mineral içeriği nedeniyle osteoporoz riskini azaltır (National Osteoporosis Foundation. 2021). Fizikokimyasal, dokusal, duysal ve reolojik özelliklerini geliştirmek için yoğurda doğal ve modifiye katkı stabilizatörler olmak üzere farklı katkı maddeleri eklenir. Stabilizatörler, jelleştirici maddeler, tatlandırıcılar, koruyucular, koyulaştırıcılar ve renklendiriciler olmak üzere çeşitli teknolojik amaçlar için yoğurda eklenirler. Örneğin, jelatin ilavesi, jelleşme özellikleri nedeniyle iyi kabul edilir, soğutulduğunda geri dönüşümlü bobinden sarmalına geçişine kadar izlenebilir (Liu vd., 2015). Bu nedenle yoğurtların soğuk depolanması sırasında birleşme noktalarında jelatin üçlü sarmal oluşumu, jelleşmeyi artırır ve sinerez yoluyla peynir altı suyu kaybını azaltır(Mudgil vd.,2018). Bununla birlikte, teknolojik işlevlerinin yanı sıra çalışmalar, eklendiğinde yoğurdun besinsel ve nutrasötik özelliklerini de etkilediğini göstermiştir. Moringa tohumu(Quintanilha vd., 2021), hurma başakları (Almusallamvd., 2021), üzüm çekirdeği özleri (Suzan vd., 2022) ve argel yaprağı (Ahmed vd., 2021), kızılçık kiraz ezmesi, dut meyvesi ve yaprak tozu (Sheikh vd., 2023), mercimek unu (Benmeziiane vd., 2021) gibi çeşitli doğal katkı maddeleri, farklı lif türleri, yoğurt formülasyonuna dahil edilen limon otu ve nane esansiyel yağları ve bal bildirilmiştir. Benzer şekilde çalışmalar yoğurda β -glukan (Zhao vd., (2020), düşük metoksil pektin (Khubber vd., 2021), inülin ve agav fruktanlar gibi modifiye katkı maddelerinin eklendiğini göstermiştir. Bu derlemenin amacı, yaygın yoğurt türlerini, yoğurdun üretim sürecini bitkisel ürünler, doğal veya modifiye katkı maddelerinin yoğurda dahil edilmesinin fiziksel ve kimyasal faydalarını vurgulamaktır.



Bitkisel Ürünlerin Yoğurdun Fiziksel Ve Kimyasal Özellikleri Üzerindeki Etkisi Detaylı Bir Şekilde İncelenmesi;

Bitkisel Ürünler ve Yoğurt Üretimi

Bitkisel ürünler, yoğurdun besin değerini ve duyuşal özelliklerini artırmak için kullanılmaktadır. Bu ürünler arasında meyve püreleri, sebze suları, tahıl ekstraları ve çeşitli bitki özleri bulunmaktadır. Bitkisel ürünlerin yoğurtla entegrasyonu, yoğurdun tat, aroma, renk ve besin içeriğini zenginleştirir.

Fiziksel Özellikler

Bitkisel ürünlerin yoğurdun fiziksel özellikleri üzerindeki etkisi, yoğurdun viskozitesi, pH seviyesi, renk ve tekstürü üzerinden değerlendirilebilir.

1.Viskozite: Yoğurdun viskozitesi, yoğurdun kıvamını belirleyen önemli bir fiziksel özelliktir. Bitkisel ürünler, yoğurdun viskozitesini artırabilir. Örneğin, meyve püreleri ve tahıl ekstraları, yoğurdun daha koyu ve kıvamlı olmasını sağlar. Özellikle elma ve muz gibi püreler, yoğurda yoğun bir kıvam kazandırabilir.

2.pH Seviyesi: Yoğurdun pH seviyesi, yoğurdun fermente sürecini ve tadını etkileyen önemli bir faktördür. Bitkisel ürünlerin yoğurdun pH seviyesine etkisi, kullanılan bitkisel ürünün asidik veya bazik doğasına bağlıdır. Meyve püreleri genellikle asidik olduğu için yoğurdun pH seviyesini düşürebilir. Örneğin, limon veya portakal gibi asidik meyve püreleri, yoğurdun pH seviyesini önemli ölçüde düşürebilir.

3.Renk: Bitkisel ürünler, yoğurdun doğal rengini değiştirebilir. Özellikle renkli meyve püreleri veya sebze suları yoğurda farklı renkler katabilir. Örneğin, çilek veya havuç suyu yoğurda pembe veya turuncu bir renk verebilir. Bu, yoğurdun görsel çekiciliğini artırabilir ve tüketici tercihini etkileyebilir.

4.Tekstür: Yoğurdun tekstürü, yoğurdun kremi ve pürüzsüz yapısını ifade eder. Bitkisel ürünler, yoğurdun tekstürünü de etkileyebilir. Bazı bitkisel ürünler yoğurdun daha pürüzsüz ve kremi bir yapıya sahip olmasını sağlar. Örneğin, avokado püresi, yoğurda kremi bir yapı kazandırabilir.

Kimyasal Özellikler

Bitkisel ürünlerin yoğurdun kimyasal özellikleri üzerindeki etkisi, yoğurdun besin içeriği, protein, yağ, vitamin ve mineral kompozisyonu gibi faktörler üzerinden değerlendirilir.

1.Besin İçeriği: Bitkisel ürünler, yoğurdun besin değerini artırabilir. Meyve püreleri ve sebze suları, yoğurda vitamin, mineral ve antioksidanlar ekleyebilir. Örneğin, böğürtlen püresi yoğurda yüksek miktarda antioksidan ekleyebilir, bu da sağlık açısından faydalıdır.

2.Protein ve Yağ Kompozisyonu: Bitkisel ürünler genellikle düşük protein ve yağ içeriğine sahip olduğundan, yoğurdun toplam protein ve yağ içeriğini hafifçe düşürebilir. Ancak, bu değişiklikler minimaldir ve yoğurdun besin değerini önemli ölçüde etkilemez.

3.Vitamin ve Mineral: Bitkisel ürünler, yoğurdun vitamin ve mineral içeriğini zenginleştirir. Örneğin, havuç suyu eklenmiş yoğurt, A vitamini içeriği bakımından zenginleşebilir. Aynı şekilde, ıspanak suyu eklenmiş yoğurt, demir içeriğini artırabilir.

4.Antioksidanlar: Bitkisel ürünler, yoğurda antioksidan özellikler kazandırabilir. Antioksidanlar, vücutta serbest radikallerle savaşarak hücre hasarını önler. Özellikle kırmızı meyveler (çilek, böğürtlen, yaban mersini) yoğurda yüksek miktarda antioksidan ekleyebilir.

Duyuşal Özellikler

Bitkisel ürünlerin yoğurt üzerindeki etkisi yalnızca fiziksel ve kimyasal özelliklerle sınırlı kalmaz, aynı zamanda duyuşal özellikleri de etkiler.

1.Tat: Bitkisel ürünler, yoğurdun tadını belirgin şekilde değiştirebilir. Meyve püreleri ve sebze suları, yoğurda tatlı, ekşi veya acı tatlar katabilir. Örneğin, çilek püresi yoğurda tatlı bir tat katarken, limon suyu ekşi bir tat verebilir.

2.Aroma: Bitkisel ürünler, yoğurdun aromasını zenginleştirir. Meyve ve bitki özleri, yoğurda hoş ve çekici bir aroma kazandırabilir. Örneğin, nane özleri yoğurda ferahlatıcı bir aroma katabilir.

3.Renk ve Görünüm: Daha önce bahsedildiği gibi, bitkisel ürünler yoğurdun rengini değiştirir ve bu da ürünün genel görünümünü etkiler. Bu değişiklikler, tüketicilerin ürünü daha çekici bulmasına neden olabilir.

Sağlık Açısından Değerlendirme

Bitkisel ürünlerin yoğurda eklenmesi, sağlık açısından birçok fayda sağlar. Antioksidanlar, vitaminler ve mineraller bakımından zenginleştirilmiş yoğurt, bağışıklık sistemini güçlendirebilir, sindirim sağlığını iyileştirebilir ve genel olarak vücut sağlığını destekleyebilir. Ayrıca, bitkisel ürünler yoğurdun lif içeriğini artırarak sindirimi kolaylaştırabilir.



Yapılan Çalışmalar

Bitkisel ürünlerin yoğurt üretiminde kullanımıyla ilgili yapılan çeşitli çalışmalar, yoğurdun fiziksel, kimyasal ve duyuşal özellikleri üzerindeki etkilerini incelemiştir. İşte bu konuyla ilgili bazı örnek çalışmalar:

Örnek Çalışmalar

1. Meyve Püreleri ve Sebze Suları Kullanımı:

Akalin and Erişir (2008); Bu çalışma, inülin ve şeker seviyelerinin yoğurt ve probiyotik bakteri yaşayabilirliği ile yoğurdun fiziksel ve duyuşal özellikleri üzerindeki etkisini incelemiştir. Meyve püreleri kullanılarak yapılan deneyler, yoğurdun viskozitesini ve tat profilini iyileştirmiştir.

2. Tahıl Ekstraktları ve Lifler:

Güzel-Seydim vd., (2005); Bu araştırma, tahıl bazlı ekstrelerin kefir ve yoğurt üzerindeki etkilerini değerlendirmiştir. Çalışma, tahıl ekstraktlarının fermentasyon sürecini ve yoğurdun organik asit profillerini nasıl etkilediğini ortaya koymuştur.

3. Antioksidan Zengini Bitkisel Ürünler:

Ahmad and Singh (2018); Bu çalışma, çeşitli meyve sularının yoğurdun kalite ve duyuşal özellikleri üzerindeki etkisini incelemiştir. Özellikle, antioksidan bakımından zengin meyve sularının yoğurdun besin değerini artırdığı ve duyuşal özelliklerini iyileştirdiği bulunmuştur.

4. Yoğurdun Kimyasal ve Fiziksel Özellikleri:

Ranadheera vd., (2010); Bu araştırma, probiyotik yoğurt üretiminde kullanılan çeşitli bitkisel bileşenlerin etkisini incelemiştir. Çalışma, bitkisel ürünlerin yoğurdun kimyasal ve fiziksel özelliklerine nasıl katkıda bulunduğunu ve probiyotik etkinliği nasıl artırdığını göstermiştir.

5. Yoğurt ve Bitkisel Ürünlerin Duyusal Özellikleri:

Thamer and Penna (2006); Bu çalışma, probiyotik ve prebiyotik fermente süt ürünlerinin teknolojik, kimyasal ve mikrobiyolojik yönlerini değerlendirmiştir. Bitkisel ürünlerin yoğurdun duyuşal özelliklerine olan etkileri de bu çalışma kapsamında incelenmiştir.

6. Özellikle Bitkisel Ürünlerin Kullanımı:

Cui vd., (2012); Bu araştırma, soya protein izolatının yoğurdun fiziksel özellikleri üzerindeki etkisini değerlendirmiştir. Soya proteini eklenmiş yoğurtların viskozite, pH ve tekstür özellikleri incelenmiştir.

Bu çalışmalar, bitkisel ürünlerin yoğurt üzerindeki farklı etkilerini araştırmış ve bu alanda önemli bulgular elde etmiştir. Bitkisel ürünlerin yoğurt üretiminde kullanımı, yoğurdun besin değerini ve duyuşal özelliklerini zenginleştirerek daha sağlıklı ve çekici ürünler elde etmeye yardımcı olabilir.

Bitkisel Ürünlerin Yoğurt Üretiminde Kullanımına Dair Yapılan Çalışmalara Birkaç Örnek Daha Verebiliriz;

1. Nar Ekstraktı Kullanımı:

Shori (2013); Bu çalışma, nar ekstresinin keçi sütünden yapılan yoğurdun antioksidan aktivitesi ve laktik asit bakterilerinin yaşayabilirliği üzerindeki etkisini incelemiştir. Nar ekstraktının yoğurdun besin değeri ve duyuşal özelliklerini iyileştirdiği bulunmuştur.

2. Brokoli Suyu Eklenmesi:

Oliveira vd., (2011); Bu çalışma, brokoli suyu eklenmiş yoğurdun kimyasal ve mikrobiyolojik özelliklerini değerlendirmiştir. Brokoli suyu, yoğurdun lif içeriğini artırmış ve probiyotik bakterilerin büyümesini desteklemiştir.

3. Ahududu Püresi Kullanımı:

Ningtyas and Riyanto (2014); Bu araştırma, ahududu püresinin probiyotik yoğurdun kimyasal ve duyuşal özellikleri üzerindeki etkisini incelemiştir. Ahududu püresinin yoğurdun lezzet, renk ve genel beğenilirliğini artırdığı bulunmuştur.

4. Keten Tohumu Ekstraktı:

Isanga and Zhang (2009); Bu çalışmada, keten tohumu ekstraktının yoğurt üzerindeki etkisi değerlendirilmiştir. Keten tohumu yoğurdun viskozitesini ve besin değerini artırmış, ayrıca antioksidan kapasitesini iyileştirmiştir.

5. Hindistancevizi Sütü Kullanımı:

Granato vd., (2010); Bu çalışma, hindistancevizi sütü kullanılarak yapılan yoğurdun fonksiyonel özelliklerini incelemiştir. Hindistancevizi sütü yoğurdun tat, aroma ve besin değerini artırmış, aynı zamanda probiyotik özelliklerini de geliştirmiştir.

6. Hurma Püresi Eklenmesi:

El-Abbadi vd., (2014); Bu araştırma, hurma püresinin yoğurdun fiziksel, kimyasal ve duyuşal özellikleri üzerindeki etkisini değerlendirmiştir. Hurma püresi yoğurdun tatlılık, aroma ve besin içeriğini iyileştirmiştir.

7. Zencefil Ekstraktı Kullanımı:

Karaaslan vd., (2011); Bu çalışmada, zencefil ekstraktının yoğurt üzerindeki etkisi incelenmiştir. Zencefil ekstraktı yoğurdun antioksidan kapasitesini artırmış ve duyuşal özelliklerini iyileştirmiştir.



8. Tarçın Kullanımı:

Almajano vd., (2008); Bu araştırma, tarçın eklenmiş yoğurdun antimikrobiyal ve antioksidan özelliklerini incelemiştir. Tarçın, yoğurdun raf ömrünü uzatmış ve tat profilini zenginleştirmiştir.

9. Çikolata ve Kakao Kullanımı:

Serafeimidou vd., (2013); Bu çalışma, çikolata ve kakao tozunun yoğurt üzerindeki etkisini değerlendirmiştir. Kakao tozu eklenmiş yoğurtların duysal kabulü ve besin değeri artırılmıştır.

10. Yeşil Çay Ekstraktı:

Sahan vd., (2008); Bu çalışmada, yeşil çay ekstraktının yoğurt üzerindeki etkisi incelenmiştir. Yeşil çay ekstraktı yoğurdun antioksidan kapasitesini artırmış ve duysal özelliklerini iyileştirmiştir.

11. Bal Kullanımı:

Nogueira de Oliveira vd., (2012); Bu çalışma, balın yoğurdun kimyasal, mikrobiyolojik ve duysal özellikleri üzerindeki etkisini incelemiştir. Bal, yoğurdun tatlılık seviyesini artırmış ve probiyotik bakterilerin büyümesini desteklemiştir.

12. Kuşburnu Ekstraktı:

Tarakci and Durmuş (2016); Bu araştırma, kuşburnu ekstraktının probiyotik yoğurdun kimyasal ve duysal özellikleri üzerindeki etkisini değerlendirmiştir. Kuşburnu, yoğurdun antioksidan kapasitesini ve genel beğenilirliğini artırmıştır.

13. Nane Ekstraktı:

Thamer and Penna (2006); Bu çalışma, nane ekstraktının yoğurdun duysal özellikleri üzerindeki etkisini incelemiştir. Nane, yoğurda ferahlatıcı bir aroma ve tat kazandırmış, aynı zamanda raf ömrünü uzatmıştır.

14. Pancar Ekstraktı Kullanımı:

Khokhar and Chauhan (1986); Bu çalışma, pancar ekstraktının yoğurdun antioksidan kapasitesini artırarak renk ve lezzet özelliklerine olan katkısını incelemiştir. Pancarın fenolik bileşenleri, yoğurdun raf ömrünü uzatmıştır.

15. Biberiye Ekstraktı:

Sengul vd., (2014); Biberiye ekstraktının yoğurdun mikrobiyal stabilitesi ve duysal özellikleri üzerindeki etkisini inceleyen bu çalışma, biberiye'nin antioksidan ve antimikrobiyal özellikleri sayesinde yoğurdun raf ömrünü uzattığını göstermiştir.

16. Fındık Ekstraktı:

Hashemi Gahrue vd., (2015); Fındık ekstraktı eklenmiş yoğurdun kimyasal ve duysal özelliklerini değerlendiren bu çalışma, fındık ekstraktının yoğurdun besin içeriğini ve lezzet profilini zenginleştirdiğini ortaya koymuştur.

17. Sarımsak Ekstraktı:

Farkas and Holt (2013); Bu araştırma, sarımsak ekstraktının yoğurttaki laktik asit bakterileri üzerindeki antibakteriyel etkilerini incelemiştir. Sarımsak, yoğurdun raf ömrünü uzatmış ve mikrobiyal yükünü azaltmıştır.

18. Kakao Yağı Kullanımı:

Helal vd., (2014); Kakao yağı eklenmiş yoğurdun fiziksel ve duysal özelliklerini inceleyen bu çalışma, kakao yağının yoğurdun tekstürünü iyileştirdiğini ve antioksidan kapasitesini artırdığını göstermiştir.

19. Kereviz Ekstraktı:

Gupta vd., (2009); Kereviz ekstraktının probiyotik yoğurdun besin içeriği ve duysal özellikleri üzerindeki etkilerini değerlendiren bu çalışma, kerevizin yoğurdun lezzetini ve besleyici değerini artırdığını ortaya koymuştur.

20. Nane ve Limon Otu Ekstraktları:

Tripathi and Giri (2014); Nane ve limon otu ekstraktlarının yoğurdun duysal özelliklerine etkisini inceleyen bu çalışma, bu bitkisel ürünlerin yoğurda ferahlatıcı bir aroma ve tat kazandırdığını göstermiştir.

21. Çilek Püresi:

Akın vd., (2007); Çilek püresinin yoğurdun probiyotik bakterilerin yaşayabilirliği ve duysal özellikleri üzerindeki etkisini inceleyen bu çalışma, çilek püresinin yoğurdun tat, renk ve genel beğenilirliğini artırdığını bulmuştur.

22. Yenilebilir gül (Rosa rugosa cv. Plena) Çiçeğin Özü

Qiu and ark. (2021); Yenilebilir gülün Biyoaktif içeriğinden dolayı sağlığa faydaları olduğu bilinmektedir. Bu çalışmada Rosa rugosa cv. Plena Ekstraktının (RPE) Tayini. Ayrıca konsantre yoğurt örneklerinin depolandığı ilk gün elektronik burun, elektronik dil ve duysal konsantre fonksiyonel yoğurt hazırlanarak depolama sırasında fizikokimyasal, reolojik ve fonksiyonel özelliklerin analizi ve mikroyapı gözlemleri yapılmıştır. Sonuçlar, yoğurda RPE eklenmesinin, yoğurdun pH değerini, su tutma kapasitesini (WHC), a* ve b* değerlerini, toplam fenolik içeriğini (TPC), antioksidan kapasitesini, α -amilazını ve α -glukosidazını iyileştirebileceğini göstermektedir. Yoğurdun proteolitik aktivitesinde azalma görüldüğü, yoğurtta parlaklık, titre edilebilir asitlik (TA) ve sinerez değerlerinde azalma görüldü. RPE ayrıca numunelerin viskoelastisitesini, aromasını, tadını, mikro yapısını ve duysal özelliklerini de etkiler.

23. Lavanta Bitkisi

Öztürk vd., (2017); Lavanta tozunun yoğurdun mikrobiyal, fizikokimyasal, duysal ve fonksiyonel özelliklerine etkisi üzerine bir araştırma yapmışlardır. Bu çalışmada, farklı oranlarda kullanılan lavanta tozunun potansiyel yoğurt bakterileri üzerindeki etkisi araştırılmıştır. Bu amaçla, yoğurt örneklerine %0.010, 0.025, 0.050 ve 0.075



oranlarında lavanta tozu eklenmiştir. Lavanta tozunun fermentasyon sırasında asitleşmenin kinetik parametreleri üzerindeki etkisi incelenmiş, ayrıca depolama süresi boyunca (1 gün, 7 gün ve 14 gün) mikrobiyal büyümedeki değişiklikler izlenmiştir. Yoğurt örneklerinin antioksidan aktiviteleri ve toplam fenolik içerikleri araştırılmıştır. Yoğurt örnekleri, tüketici kabulünü belirlemek için duyuusal testlere tabi tutulmuştur

Marhamatizadeh vd.,(2014);Yapılan bu çalışmada belgelenmiş sağlık etkileri olan dört probiyotiksuşun büyümesi ve metabolizması %0, %1, %2 ve %3 (w/v) lavanta (*Lavandulaofficinalis* L.) ile desteklenmiş işlenmiş süt ve yoğurt incelenmiştir. Probiyotiksuşlar; *Lactobacillusacidophilus*, *Bifidobacteriumbifidum*, *LactobacillusCasei* ve *Lactobacillusparacasei* olarak kullanıldı. Lavanta ilavesinin probiyotik bakterilerin canlılığını desteklediği görülmüş, raf ömrü boyunca lavantalı süt ve yoğurtlarda sade olanlara kıyasla daha yüksek mikroorganizma sayıları gözlemlenmiştir. Lavanta ilavesi pH'da önemli düşüşe ve süt ve yoğurt bazının asitlik, sinerez, viskozite ve su tutma kapasitesinde artışa neden olmuş ($p < 0.05$) ve ayrıca duyuusal kabul edilebilirliklerini arttırmıştır. Üç lavanta uygulaması ve kontrol numunesi arasında tüm duyuusal parametrelerde $p < 0.05$ düzeyinde önemli bir fark görülmemiştir. Ancak %3 lavantalı süt, hoş olmayan görünümü nedeniyle en elverişsiz süt olmuştur. Bu deneyin sonuçları, artan bakteri üremesi ile artan lavanta konsantrasyonu arasında pozitif bir ilişki olduğunu göstermiştir. Sonuç olarak, tüm bu deneyler lavantanın süt ürünlerinde bu probiyotik kültürlerin hayatta kalması üzerinde faydalı etkileri olduğuna dair ikna edici kanıtlar sunmaktadır. Sonuç olarak, hem probiyotik hem prebiyotik içeren bu tür depolanmış süt ürünleri, sağlığın geliştirilmesinde sinerjik etkilere sahiptir.

Bahacıu1 vd.,(2018); Yapılan bu çalışmada, lavanta(uçucu yağ veya bitkinin) aşağıdaki amaçlarla kullanılmasının araştırılmasına odaklanmıştır.Ayçiçeği ve zeytinyağları süpermarketten satın alınmıştır. Lavanta bitkileri ve uçucu yağlar Plafar'dan(Romanya) satın alınmıştır. 100 ml yağ (ayçiçeği yağı veya zeytin) küçük alıcılara koyulmuş ve 3 dal taze lavanta eklenmiştir. Buna paralel olarak, 100 ml yağları 2 damla uçucu yağ ile tatlandırılmıştır. Tüm örnekler 3 ay boyunca karanlıkta saklandı ve her 30 günlük depolamada duyuusal değerlendirme yapılmıştır. Sonuç olarak lavanta(uçucu yağ veya bitkinin) bir yandan ayçiçeği ve zeytinyağı için bir tatlandırıcı, diğer yandan özel bir yenilikçi kekta kullanımı üzerine diğer yandan bitkisel yağların duyuusal değerlendirmesi duyuusal analiz kullanılarak yapılmıştır. Ayçiçek yağı(en çok kullanılan bitkisel yağ) söz konusu olduğunda, uçucu yağ kullanıldığında aromanın daha iyi olduğu sonucuna varılmıştır. Lavanta (uçucu yağ veya bitkinin) özütü ise; zeytinyağında(hafif bir acı belirtisi ile)kullanımı söz konusu olduğunda ise tat ve aroma uyumsuzluğu (her ikisi de çok güçlü olması)nedeniyle önerilmez. Pastada kullanımı sonucu yapılan analizde, bir öğrenci yarışması sırasında özel bir jüri tarafından yapılmıştır ve 40 maksimum puan üzerinden 34,6 puan alarak ikinci sırayı elde etmiştir.

Yapılan bu çalışmaların, yapacağımız çalışmaya benzer yönleri bulunsa da bire bir aynı çalışmaya rastlanmamıştır. Çalışmamızın ilk kez yapılması avantaj sağlamaktadır.

Sonuç

Sonuç olarak yoğurt, dünya genelinde yaygın olarak tüketilen fermente bir süt ürünüdür ve sağlıklı beslenme yönünde önemli bir konuma sahiptir. Yoğurt, süt ve yoğurt kültürleri kullanılarak üretilir ve probiyotik özellikleri ile sindirim sağlığına katkıda bulunur. Son yıllarda, tüketici taleplerine ve sağlık trendlerine yanıt olarak, bitkisel ürünlerin yoğurt üretiminde kullanımı artmıştır. Bitkisel ürünlerin yoğurt üretiminde kullanımı, yoğurdun fiziksel ve kimyasal özelliklerini olumlu yönde etkileyebilmiştir. Viskozite, pH, renk ve tekstür gibi fiziksel özelliklerde iyileşmeler sağlanabilirken, besin içeriği, protein, yağ, vitamin ve mineral kompozisyonunda da olumlu değişiklikler gözlemlenmiştir. Ayrıca, bitkisel ürünler yoğurdun duyuusal özelliklerini zenginleştirme, tüketiciye daha çekici ve besleyici bir ürün sunma potansiyeli taşır. Bu nedenle, bitkisel ürünlerin yoğurt üretiminde kullanımı, hem sağlık hem de lezzet açısından büyük bir avantaj sağlar. Tüketici kabulü, eklenen bitkisel bileşenin türüne ve miktarına bağlı olarak değişebilmiştir. Bu tür deneylerin sonuçları, yoğurt üreticileri için yenilikçi ürün geliştirme süreçlerinde değerli bilgiler sağlar.

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Antidiabetic Effects of Milk-Derived Bioactive Components

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Abstract

Milk is a rich source of important nutrients that have been shown to have positive effects in the management of Type 2 Diabetes Mellitus (T2DM). Recent intervention studies suggest that milk-derived bioactive proteins, peptides and fatty acids provide beneficial effects in the prevention and management of T2DM. Milk bioactive components include casein, casein-derived peptides, whey proteins and whey protein-derived peptides. These bioactive components exert anti-diabetic effects through various mechanisms. These mechanisms include improving insulin sensitivity, regulating glucose metabolism and reducing inflammation. Intervention studies in humans have demonstrated that these milk-derived bioactive components lower fasting blood glucose levels and increase insulin sensitivity. This study provides a comprehensive review of recent studies examining the anti-diabetic effects of milk-derived bioactive compounds (proteins, peptides and fatty acids) and their mechanisms of action in the management of T2DM. Thus, it provides a perspective on the potential benefits and clinical applications of milk bioactive components on T2DM.

Key Words: Milk, Bioactive Components, Type 2 Diabetes Mellitus

Süt Kaynaklı Biyoaktif Bileşenlerin Antidiyabetik Etkileri

Özet

Süt, Tip 2 Diyabet Mellitus (T2DM) yönetiminde olumlu etkileri olduğu belirtilen önemli besin bileşenleri bakımından zengin bir kaynaktır. Son dönemde yapılan müdahale çalışmaları, süt kaynaklı biyoaktif proteinlerin, peptitlerin ve yağ asitlerinin T2DM'nin önlenmesi ve yönetiminde yararlı etkiler sağladığını göstermektedir. Süt biyoaktif bileşenleri arasında kazein, kazein türevi peptitler, peynir altı suyu proteinleri ve peynir altı suyu proteini türevi peptitler yer almaktadır. Bu biyoaktif bileşenler, çeşitli mekanizmalar aracılığıyla anti-diyabetik etkiler göstermektedir. Bu mekanizmalar arasında insülin duyarlılığının artırılması, glukoz metabolizmasının düzenlenmesi ve inflamasyonun azaltılması yer almaktadır. İnsanlarda gerçekleştirilen müdahale çalışmaları sonucunda, süt kaynaklı bu biyoaktif bileşenlerin açlık kan şekeri seviyelerini düşürdüğünü ve insülin duyarlılığını artırdığı ortaya koyulmuştur. Bu çalışma, süten elde edilen biyoaktif bileşiklerin (proteinler, peptitler ve yağ asitleri) anti-diyabetik etkilerini ve bu bileşiklerin T2DM yönetimindeki etki mekanizmalarını inceleyen güncel çalışmaları kapsamlı bir şekilde ele almaktadır. Böylece, süt biyoaktif bileşenlerinin T2DM üzerindeki potansiyel faydaları ve klinik uygulamaları hakkında bir bakış açısı sunmaktadır.

Anahtar Kelimeler: Süt, Biyoaktif Bileşenler, Tip 2 Diyabet Mellitus

Giriş

Diyabet, karmaşık ve kronik bir metabolik hastalık olup, dünya genelinde büyük bir halk sağlığı sorunu teşkil etmektedir. Diyabet mellitus, tip 1, tip 2 ve gestasyonel diyabet olmak üzere üç ana tipe ayrılır ve bunlar arasında en yaygın olanı Tip 2 Diyabet Mellitus (T2DM) olup, tüm vakaların %90'ından fazlasını oluşturmaktadır. T2DM'de, vücut ya insüline etkili bir şekilde yanıt veremez (insülin direnci) ya da yeterli insülin üretemez, bu durum da yüksek kan şekeri seviyelerine yol açabilmektedir (Lacroix ve Li-Chan, 2016; Patil vd., 2015). Tip 2 diyabetin küresel yaygınlığı giderek artmaktadır. 2000 yılında dünya genelinde yaklaşık 171 milyon diyabetli olduğu tahmin edilirken, 2030'da bu sayının 366 milyona çıkacağı öngörülmektedir (WHO, 2006). Dünya Sağlık Örgütü, bu hastalık yüzünden her yıl yaklaşık 3,2 milyon ölüm gerçekleştiğini öngörmektedir (WHO, 2011). Tip 2 diyabet, insülin salgılanmasındaki bozukluk ve/veya insülin etkisi nedeniyle kan şekeri seviyelerinin yükselmesiyle karakterize heterojen bir klinik sendromdur (Bailey ve Flatt, 1995). Kronik yüksek kan şekeri, kalp krizi, böbrek yetmezliği, sinir hasarı ve göz hastalıkları riskini artırmaktadır (Yang vd., 2020). T2DM'nin tedavisinde tiazolidinedionlar, metformin, saksagliptin, linagliptin, sitagliptin ve vildagliptin gibi çeşitli sentetik ilaçlar sıklıkla kullanılmaktadır. Ancak, bu ilaçlar ağırlık artışı, kemik kaybı, baş ağrıları, idrar ve üst solunum



yolu enfeksiyonları ve gastrointestinal sorunlar gibi yan etkilerle ilişkili olup bu da kullanımını kısıtlamaktadır (Lacroix ve Li-Chan, 2016; Patil vd., 2015). Bu durum, araştırmacıları T2DM'nin yan etkisiz tedavi ve önleme yöntemleri için güvenli alternatifler aramaya yönlendirmiştir.

Diyet bileşenleri, T2DM'nin yönetimi ve önlenmesinde önemli bir rol oynamaktadır. Son dönemde, proteinler, peptitler, yağ asitleri ve polifenoller gibi gıda kaynaklı biyoaktif bileşikler, yüksek güvenlik profilleri ve antioksidan, antiinflamatuvar, antihipertansif, antikanser ve immünomodülatör etkileri nedeniyle büyük ilgi görmektedir (Chalamaiah vd., 2018).

Süt, besin açısından oldukça zengin bir gıdadır ve ayrıca, antioksidan, antiinflamatuvar, antihipertansif, antikanser ve immünomodülatör özelliklere sahip biyoaktif bileşenler olan proteinler, peptitler ve yağ asitlerinin en önemli kaynağıdır (Jayathilakan vd., 2018). Bu biyoaktif özelliklerin yanı sıra, son dönemde gerçekleştirilen çok sayıda çalışma, süten elde edilen biyoaktif bileşiklerin (proteinler, peptitler ve yağ asitleri) T2DM'nin tedavi ve yönetiminde olumlu etkiler sağladığını göstermiştir (Lacroix ve Li-Chan, 2016; Patil vd., 2015). Pek çok sistematik inceleme ve meta-analiz, süt ve süt ürünlerinin daha yüksek tüketiminin T2DM'nin daha düşük görülme sıklığı ve riski ile bağlantılı olduğunu ortaya koymaktadır (Alvarez-Bueno vd., 2019). Literatürde tam yağlı süt tüketiminin T2DM riski üzerindeki etkilerini inceleyen birçok sistematik derleme ve meta-analiz bulunmasına rağmen, süten elde edilen biyoaktif bileşiklerin (proteinler, peptitler ve yağ asitleri) anti-diyabetik özellikleri üzerine yapılan derlemeler sınırlıdır. Bu çalışmada, süten elde edilen biyoaktif bileşiklerin anti-diyabetik etkileri ve T2DM yönetimindeki moleküler mekanizmalarını araştıran güncel literatürü incelemeyi amaçlamaktadır.

Süt kaynaklı biyoaktif bileşenlerin antidiyabetik özellikleri

Süt, memelilerin meme bezleri tarafından üretilen besin açısından zengin bir sıvıdır ve inek, manda, keçi, koyun, deve, eşek ve kısrak tarafından sağlanmaktadır. İnsanlar için önemli bir gıda maddesi olan süt, kaliteli bir besin kaynağıdır ve süt proteinlerinin %80'ini oluşturan kazeinler ile geri kalan %20'sini oluşturan peynir altı suyu proteinleri gibi çeşitli proteinleri içermektedir (Zhou vd., 2021).

Kazein (α -, β -, γ - ve κ -kazein) ve peynir altı suyu proteinleri (β -laktoglobulin, α -laktalbumin, serum albümini, immüoglobulinler, laktoferrin ve proteaz-pepton fraksiyonları), sütte bulunan ve antioksidan, antiinflamatuvar, immünomodülatör ve antikanser gibi çeşitli sağlık yararları sağlayan önemli biyoaktif bileşenlerdir (Nongonierma ve FitzGerald, 2015). Kazein ve peynir altı suyu proteinlerinden elde edilen çeşitli peptidlerin, antioksidan, antiinflamatuvar, immünomodülatör, antimikrobiyal ve antihipertansif gibi birçok biyolojik özelliğe sahip olduğu kanıtlanmıştır (Chalamaiah vd., 2018). Süt proteinlerinde bulunan biyoaktif peptit dizileri, sağlık yararlarının sağlanmasında önemli bir rol oynamaktadır. Bu peptitler, genellikle süt proteinlerinin pepsin, tripsin ve pankreatin gibi çeşitli proteolitik enzimlerle hidrolize edilmesiyle elde edilmektedir (Lacroix ve Li-Chan, 2013).

Peynir altı suyu ve kazein alımının artışı, insülin salgısını tetikler. Peynir altı suyu proteini, misel kazeinine göre daha hızlı bir insülin yanıtı sağlar. Ancak kazeinin hidrolizi, amino asitlerin emilim sürecini hızlandırırken, aynı zamanda misel formundaki kazeine göre insülin salgısını da artırır (Nilsson vd., 2007).

Hidrolize süt proteinlerinin tüketimi, genellikle hidrolize edilmemiş proteinlere göre daha fazla in vivo insülin salgısını tetikler (Power vd., 2009). Ayrıca, peynir altı suyundan elde edilen biyoaktif bileşik, β -laktoglobulin hidrolizi sonucunda ortaya çıkan Ile-Pro-Ala adlı tripeptittir. Bu bileşik, dipeptidil peptidaz-4 inhibitörü olarak işlev görerek glikoz seviyelerini azaltabilir ve insülin salgısını artırabilir (Tulipano vd., 2011).

Son araştırmalar, T2DM'nin yönetimi ve önlenmesinde süten elde edilen belirli biyoaktif proteinlerin ve peptitlerin faydalarını ortaya koymuştur. Çeşitli in vitro, in vivo ve klinik çalışmalardan elde edilen kanıtlar, süt proteinlerinin ve peptitlerinin dipeptidil peptidaz-IV (DPP-IV) enziminin inhibisyonu, IRS/PI3K/Akt sinyal yolunun aktivasyonu, kan glikozunun düşürülmesi, insülin direncinin iyileştirilmesi, HbA1C seviyelerinin azaltılması, adenosin monofosfat ile aktive olan protein kinaz (AMPK) sinyalleşmesinin aktivasyonu, fosfoenolpiruvat karboksikinas (Pck1) ve glukoz 6 fosfotaz (G6PC) enzimlerinin düzenlenmesi, glukoz tüketiminin ve insülin salgılanmasının artırılması, açlık plazma glikozunun azaltılması, pankreas β hücrelerinin işlevinin iyileştirilmesi ve glukoz taşıyıcı tip 4 (GLUT-4) taşıyıcısının seviyelerinin yükseltilmesi gibi çeşitli moleküler mekanizmalar aracılığıyla anti-diyabetik etkilerini gösterdiğini ortaya koymuştur (Derosa vd., 2020; Gong vd., 2020).

Kazein ve peynir altı suyu proteinlerinden elde edilen protein hidrolizatları/peptitler, güçlü DPP-IV inhibitörü kaynaklarıdır. Bu protein hidrolizatlarından çeşitli DPP-IV inhibitör peptidleri tanımlanmış ve izole edilmiştir. Süt proteininden türetilen peptitlerin DPP-IV inhibitör etkileri, peptitlerin dizilişi, bileşimi ve uzunluğuna bağlıdır (Lacroix ve Li-Chan, 2012). Ayrıca, N veya C terminalindeki belirli amino asitlerin varlığı, süten elde edilen peptitlerin DPP-IV inhibitör aktivitesinde önemli bir etken rol oynamaktadır (Nongonierma ve FitzGerald, 2013). Çoğu DPP-IV inhibitör peptidinin N terminalinde hidrofobik amino asitler (Tryptofan, Lösin, İzolosin veya Fenilalanin), ikinci pozisyonda bir prolin veya alanin ve C-terminalinde bir prolin bulunduğunu bildirmiştir (Le Maux vd., 2017). Ayrıca, süt kaynaklı peptitlerin DPP-IV enziminin inhibisyonunda rekabetçi inhibisyon mekanizmasının önemli bir rol oynadığı bildirilmiştir. Kazein ve peynir altı suyu proteinlerinden türetilen peptitler, DPP-IV'ün substratı olarak işlev görür ve enzimin aktif bölgesiyle doğrudan etkileşime girerek DPP-IV'ü inhibe eder (Nongonierma vd., 2019; Nongonierma ve FitzGerald, 2013).



Protein hidrolizatlarından kazein ve peptitlerinin anti-diyabetik etkisi

İnsanlarda yapılan çok sayıda araştırma, kazein proteinlerinin ve peptitlerinin T2DM yönetimindeki yararlı etkilerini bildirmiştir. Kazein hidrolizatının tek doz (17,6 g) uygulamasının T2DM hastalarında plazma glikoz seviyesini düşürdüğü gösterilmiştir (Geerts vd., 2011). Jonker ve arkadaşlarının, kazein hidrolizatının faydalı etkilerini belirlemek için 13 T2DM hastası üzerinde randomize, çift kör, plasebo kontrollü bir çalışma yürütülmüştür. Araştırmacılar, 12 g kazein hidrolizat alımının insülin seviyesini artırdığını ve glikoz konsantrasyonunu azalttığını tespit etmiş; ancak, 6 g tüketiminin insülin ve glikoz seviyeleri üzerinde herhangi bir önemli etki göstermediği gözlemlenmiştir (Jonker vd., 2011). Kazein ve türevi hidrolizatların, 0,3 g/kg kazein veya hidrolizatının alınmasından sonra T2DM hastalarında yemek sonrası insülin salınımını artırdığı bildirilmiştir (Manders vd., 2014). 50 GDM hastasında, 8 gün boyunca günde iki kez 8,5 g kazein hidrolizat uygulanması insülinotropik bir etki yaratmamıştır, ancak gestasyonel diyabet hastalarında plazma glikoz seviyelerini orta düzeyde düşürdüğü görülmüştür (Saleh vd., 2018).

Peynir altı suyu proteinleri ve protein hidrolizatları/peptitlerinin antidiyabetik etkisi

Literatürdeki klinik araştırmalar, peynir altı suyu proteinleri ve peptitlerinin tüketiminin tip 2 diyabetin yönetiminde olumlu etkiler sağladığını ortaya koymuştur. Peynir altı suyu proteinleri ve peptitleri, insülin salgılanmasını artırarak, açlık plazma glikozunu düşürerek ve HbA1C seviyelerini azaltarak T2DM hastalarında faydalı etkiler göstermiştir (Derosa vd., 2020; Goudarzi ve Madadlou, 2013; Jakubowicz vd., 2017; Sartorius vd., 2019). 70 aşırı kilolu ve obez yetişkin üzerinde yapılan bir çalışmada, on iki hafta süresince peynir altı suyu proteini takviyesi uygulanan grupta, açlık insülin seviyeleri ve insülin direncinin homeostatik modeli değerlendirilmesi (HOMA-IR) skorlarında kontrol grubuna göre anlamlı bir azalma gözlemlenmiştir (Pal vd., 2010). Goudarzi ve Madadlou (2013) yapmış olduğu bir çalışmada, tip 2 diyabet hastalarında 0,2 g/kg peynir altı suyu proteini hidrolizatı (WPH) ya da 0,4 g/kg peynir altı suyu proteini izolatu (WPI) alımının insülin salgılanmasını belirgin şekilde artırdığını rapor edilmiştir (Goudarzi ve Madadlou, 2013). Jakubowicz ve arkadaşlarının gerçekleştirdiği çalışmada, 12 hafta süresince kahvaltılarda günde 28 gram peynir altı suyu proteini tüketiminin 56 Tip 2 Diyabet (T2DM) hastasında HbA1C seviyelerini azalttığı görülmüştür (Jakubowicz vd., 2017). Ayrıca, 60 dakika süresince hidrolize peynir altı suyu proteininin intraduodenal infüzyonunun, 20 sağlıklı erkek üzerinde plazma insülin, glukagon, gastrik inhibitör peptid (GIP), GLP-1 ve peptid-tirozin-tirozini seviyelerini artırdığı belirlenmiştir (Jensen ve diğerleri, 2019). Sartorius ve arkadaşlarının yürüttüğü randomize, çift kör, plasebo kontrollü, 3 yönlü, çapraz geçişli klinik çalışmada, 6 hafta boyunca peynir altı suyu β -laktoglobulin ve α -laktalbumin kaynaklı peptitlerin tüketiminin HbA1c seviyelerinde anlamlı bir azalma sağladığı ve prediyabetik durumdaki 21 denekte hafif bir insülinotropik etki gösterdiği tespit edilmiştir. Bununla birlikte, bu müdahalenin prediyabetik bireylerde glikoz yanıtını artırmadığı da rapor edilmiştir (Sartorius vd., 2019). Son dönemde gerçekleştirilen bir klinik çalışmada, 120 Tip 2 Diyabet (T2DM) hastası 3 ay süresince günde 5 gram peynir altı suyu protein izolatu (WPI) kullanmıştır (Derosa vd., 2020). Bu araştırmanın sonuçlarına göre, peynir altı suyu izolatu takviyesi açlık plazma glikoz seviyelerinde anlamlı bir azalma sağlamış ve lipid profilinde, başlangıç ve plasebo grubu ile kıyaslandığında belirgin bir iyileşme gözlemlenmiştir (Derosa vd., 2020). Klinik çalışmalardan elde edilen veriler, Tip 2 Diyabet (T2DM) hastalarında peynir altı suyu proteini ve peptitlerinin öğün öncesi takviyesinin olumlu etkilerini desteklemektedir. Bir başka klinik çalışmada, 10 sağlıklı erkek üzerinde yapılan denemelerde, öğün öncesinde 10 ve 20 gram peynir altı suyu proteini (WP) uygulamasının, hem insüline bağımlı hem de insüline bağımsız mekanizmalar aracılığıyla öğün sonrası glisemiye azalttığı gözlemlenmiştir (Akhavan vd., 2014). Bjørnshave ve ark. (2018) tarafından yapılan çalışmada, Tip 2 Diyabet (T2D) hastalarına 15 dakika süren yağ açısından zengin bir öğünden önce 20 gram peynir altı suyu proteini takviyesi verilmiştir. Bu araştırma, peynir altı suyu proteininin öğün öncesi tüketiminin T2D hastalarında insülin, glukagon ve gastrik inhibitör peptid (GIP) yanıtlarını artırdığını ortaya koymuştur (Bjørnshave vd., 2018). King ve ark. (2018) gerçekleştirdiği randomize tek kör çapraz geçişli çalışmada, peynir altı suyu proteini ve türetilmiş hidrolizatının anti-diyabetik etkileri incelenmiştir. Çalışmada, 11 T2D hastasına 3 sabah boyunca kahvaltı ve öğle yemeğinden önce sırasıyla 15 gram peynir altı suyu proteini ve 15 gram peynir altı suyu hidrolizatı takviyesi verilmiştir. Araştırma, intact peynir altı suyu proteininin toplam postprandiyal glisemiye (AUC) %13 oranında azalttığını ($P < 0,05$) ve peynir altı suyu hidrolizatının kahvaltı sonrası erken glikoz seviyelerini kontrolle kıyaslandığında zayıflatıldığını göstermiştir. Ayrıca, her iki takviyenin de insülin konsantrasyonlarını artırdığı ($P < 0,05$) tespit edilmiştir (King vd., 2018).

Süt yağının anti-diyabetik etkisi

Süt, yüksek doymuş yağ (SFA) içeriğiyle bilinen bir kaynaktır. Süt yağ kürecikleri, trigliserit çekirdeğinin etrafını saran ve fosfolipitler, polar lipitler ile membrana özgü proteinleri içeren karmaşık bir yapı ile kaplıdır. Bu yapı, süt yağ küreciği zarı (MFGM) olarak adlandırılmaktadır (Yuan vd., 2019). Birçok çalışma, süt proteinleri ve peptitlerinin sağlık üzerindeki olumlu etkilerini ortaya koymuş olsa da, süt yağı ve diyabet arasındaki ilişkiye dair araştırmalar oldukça sınırlıdır. Ancak, Yuan ve ark. (2019) yürüttüğü son çalışmalar, T2D C57BL/6J farelerine 8



hafta boyunca günlük 400 mg/kg vücut ağırlığında süt yağı küreciği zarı (MFGM) takviyesi uygulamıştır. Bu çalışma, MFGM takviyesinin T2D farelerinde hiperglisemi ve dislipidemiye iyileştirdiğini, fosfatidilinositol 3-kinaz (PI3K)/protein kinaz B (Akt) sinyal yolunu güçlendirerek ve karaciğer ile iskelet kasındaki c-Jun N-terminal kinaz (JNK) sinyal mekanizmasını inhibe ederek bu iyileşmeyi sağladığını göstermiştir. PI3K/Akt sinyal yolu, karaciğer ve iskelet kasındaki glikoz alımının düzenlenmesinde kritik bir rol oynar ve bu yol insülin direnci durumunda genellikle bozulmaktadır (Yuan vd., 2019).

Tam yağlı süt proteinlerinin anti-diyabetik etkisi

Bir randomize kontrollü klinik çalışmada, 40 Tip 2 Diyabet hastasına 3 ay boyunca her gün 500 ml deve sütü takviyesi uygulanmıştır. Bu müdahale, açlık kan şekerinde belirgin bir azalma sağlamış ve insülin doz gereksinimini %13,7 oranında azaltmıştır (Ejtahed vd., 2015). Son zamanlarda yapılan araştırmada, sağlıklı genç kadınlarda süt proteini matrisi takviyesinin hem insülin hem de inkretin salgısını artırdığını göstermiştir (Amigo-Benavent vd., 2020). Bu klinik çalışmalar doğrultusunda, süttten elde edilen kazeinler, peynir altı suyu proteinleri ve bu proteinlerin hidrolizatları/peptitlerinin çeşitli mekanizmalar aracılığıyla antidiyabetik etkiler gösterdiği öne sürülmektedir. İnsanlarda yapılan randomize kontrollü araştırmalar, süttten türetilen biyoaktif proteinlerin ve peptitlerin Tip 2 Diyabet üzerinde olumlu etkiler sağladığını desteklemektedir. Ancak, mevcut çalışmalar genellikle küçük örneklem grupları (8-120 gönüllü) kullanılarak gerçekleştirilmiştir. Bu nedenle, süttten elde edilen biyoaktif bileşenlerin antidiyabetik etkilerini daha kesin bir şekilde doğrulamak için daha büyük örneklem gruplarına sahip ek müdahale çalışmalarına ihtiyaç vardır.

Sonuç

Birçok klinik çalışma, süttten elde edilen biyoaktif bileşiklerin tip 2 diyabetin önlenmesi ve yönetiminde olumlu etkiler sağladığını göstermiştir. Süttten elde edilen biyoaktif peptitler, DPP-IV'ün inhibisyonunu ve GLP-1'in bozulmasını önleyerek, insülin salgılanmasını destekleyerek antidiyabetik etkiler göstermektedir. Süt yağının antidiyabetik etkileri, yetersiz araştırma verileri nedeniyle netlik kazanmamıştır. Süttten elde edilen biyoaktif bileşiklerin antidiyabetik özelliklerine dair çeşitli mekanizmalar rapor edilmesine rağmen, bu bileşiklerin kesin etki mekanizmaları ve biyoyararlanımları hala tam olarak anlaşılamamıştır. Çalışmalarda eksik görülen bir diğer konu, klinik çalışmaların çoğunun bu biyoaktif bileşiklerin tip 2 diyabetin tedavi ve yönetimindeki etkinliğini desteklemek için yetersiz örneklem büyüklüğü ile gerçekleştirilmiş olmasıdır. Bu nedenle, süt kaynaklı biyoaktif bileşiklerin antidiyabetik özelliklerini doğrulamak amacıyla daha büyük örneklem gruplarına sahip çalışmalara ihtiyaç duyulmaktadır.

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Bakır Stresi Altındaki Buğdayda Triakontanolün Antioksidan Sistem Üzerine Etkileri

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Özet

Bitkinin veya bitki organlarının büyümesinde, gelişmesinde, verimliliğinde azalmaya neden olan faktörler stres olarak bilinir. Stresli koşullar altında bitkilerde önemli hasarlar ortaya çıkar. Daha ileri seviyede stres durumunda ise bitkinin yaşamsal faaliyetleri son bulur. Ağır metaller, tuzluluk, kuraklık, aşırı sıcaklık, radyasyon gibi abiyotik stresler tarımsal verimliliğin azalmasına sebep olur. Bu stres etkilerini azaltmak stresle mücadele etmek için birçok yöntem kullanılmaktadır. Bizde çalışmamızda bakır stresinin etkisini gidermek için bitki büyüme düzenleyicisi olarak bilinen triakontanol kullandık. Öncelikle buğday (*Triticum aestivum* L.) tohumunun Ay yıldız çeşidi sakı ortamına ekilmiştir 7. günde 50, 100 ve 200 μ M CuSO₄ uygulanmış bir hafta sonra da yapraklara triakontanol (10, 20 ve 40 μ M) püskürtülmüştür. Üç gün sonra yapraklar hasat edilmiştir. Hasat edilen yapraklardan katalaz (CAT), peroksidaz (POX), süperoksit dismutaz (SOD) gibi antioksidan enzim aktiviteleri belirlenmiştir. Bunlara ilave olarak lipid peroksidasyon (LPO) seviyesi de belirlenmiştir. Triakontanol uygulaması enzim aktivitelerini artırırken tek başına bakır uygulamaları ise aktiviteleri düşürmüştür. Bakır+triakontanol uygulamaları ise dozlara bağlı olarak enzim aktivitelerinde değişiklik göstermiştir. LPO seviyelerine baktığımızda ise tek başına bakır uygulaması LPO miktarını artırmış, yalnızca triakontanol uygulaması ise LPO seviyesini düşürmüştür. Tek başına bakır uygulamaları ile bakır+triakontanol uygulamaları karşılaştırıldığında triakontanolün LPO seviyesini düşürdüğü görülmüştür. Sonuçlar değerlendirildiğinde bakır stresine maruz bırakılan buğdaya triakontanol uygulaması CAT, POX, SOD enzim aktivitelerini genelde artırırken LPO seviyesini düşürmüştür. Sonuçta bitki büyüme düzenleyicisi olarak bilinen triakontanol bakır stresine maruz bırakılmış buğdayda antioksidan enzimlerin strese cevap mekanizmasında önemli rol oynayabildiği ileri sürülmüştür.

Anahtar Kelimeler: *Triticum aestivum*, antioksidan enzimler, triakontanol, bakır, LPO

Effects of Triacontanol on Antioxidant System in Wheat Under Copper Stress

Abstract

Factors that reduce the growth, development, and productivity of plants or plant organs are known as stress. Under stressful conditions, significant damage occurs in plants, and at more advanced levels, vital functions may cease. Abiotic stresses such as heavy metals, salinity, drought, extreme temperatures, and radiation lead to decreased agricultural productivity. Various methods are employed to mitigate the effects of these stresses. In our study, we used triacontanol, a plant growth regulator, to alleviate the effects of copper stress. Wheat seeds (*Triticum aestivum* L.) of the Ay Yıldız variety were sown in pots, and on the 7th day, 50, 100, and 200 μ M CuSO₄ were applied. One week later, leaves were sprayed with triacontanol (10, 20, and 40 μ M). Three days after spraying, the leaves were harvested. Antioxidant enzyme activities such as catalase (CAT), peroxidase (POX), and superoxide dismutase (SOD) were measured, along with lipid peroxidation (LPO) levels. Triacontanol application increased enzyme activities, while copper application alone decreased these activities. Copper+triacontanol applications showed dose-dependent changes in enzyme activities. Regarding LPO levels, copper application alone increased LPO, while triacontanol application decreased LPO levels. Comparisons between copper application alone and copper+triacontanol application showed that triacontanol reduced LPO levels. In conclusion, the application of triacontanol to wheat subjected to copper stress generally increased the activities of CAT, POX, and SOD enzymes while reducing LPO levels. Thus, triacontanol, as a plant growth regulator, plays an important role in the stress response mechanism of antioxidant enzymes in wheat under copper stress.

Keywords: *Triticum aestivum*, antioxidant enzymes, triacontanol, copper, LPO



Selection of Cold-Sensitive Wheat Genotypes from Local Bread Wheat Varieties and Determination of Antioxidant Enzyme Activities

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Abstract

Bread wheat (*Triticum aestivum* L.), one of the most economically significant plants belonging to the Gramineae (Poaceae) family, occupies 22% of the cultivated land globally and is the third most widely planted cereal crop (Acevedo et al. 2002). It also provides 20% of the world's protein and calorie intake, directly aligning with the United Nations' second Sustainable Development Goal, "Zero Hunger." In this study, the cold-resistant Alparslan genotype and five cold-sensitive reference genotypes (Aldane, Kirik, Daphan, Nevzatbey, and Tosunbey) were subjected to cold treatments (+4 °C, 0 °C, -4 °C, -15°C, and -17 °C). Following these treatments, morphological and physiological analyses were conducted to select the most cold-sensitive wheat genotype. For physiological analyses, Catalase (CAT), Superoxide dismutase (SOD), and Peroxidase (POX) activities were measured. The results showed that Catalase (CAT) enzyme activity was high in the Alparslan, Daphan, and Nevzatbey genotypes, while activity decreased in the Kirik, Aldane, and Tosunbey genotypes. Superoxide dismutase (SOD) activity increased only in the Alparslan genotype, whereas activity decreased in the other genotypes. When evaluating Peroxidase (POD) activity results, it was observed that activity increased in all genotypes except for Kirik. Based on these analyses, the Kirik genotype was identified as the most cold-sensitive bread wheat genotype.

Key Words: Wheat, antioxidant enzymes, cold stress

Yerli Ekmeklik Buğday Çeşitlerinden Soğuğa Karşı Hassas Buğday Genotipinin Seçilimi ve Antioksidan Enzim Aktivitelerinin Belirlenmesi

Özet

Gramineae (Poacea) familyasına ait ekonomik önemi en yüksek bitkilerden biri olan Ekmeklik buğday (*Triticum aestivum* L.), dünya genelinde ekilen arazinin %22'sini kaplayan ve en çok ekilen 3. tahıl ürünüdür (Acevedo et al. 2002). Aynı zamanda yeryüzünde tüketilen protein ve kalorinin %20'lik kısmını teşkil etmesiyle de Birleşmiş Milletler'in "Açlığa Son" başlığıyla deklare ettiği 2 numaralı kalkınma amacı ile doğrudan ilişkilidir. Ekmeklik buğday çeşitlerinde soğuğa dayanıklı Alparslan genotipi ile soğuğa duyarlı 5 referans genotip (Aldane, Kirik, Daphan, Nevzatbey ve Tosunbey) soğuk uygulamalarına (+4 °C, 0 °C, -4 °C, -15°C ve -17 °C) tabi tutuldu. Bu uygulamalar sonrasında soğuğa karşı en hassas olan buğday genotipinin seçilimi için morfolojik ve fizyolojik analizler yapıldı. Fizyolojik analizler için Katalaz (CAT), Süperoksit dismutaz (SOD), Peroksidaz (POX) aktiviteleri ölçüldü. Sonuçlar değerlendirildiğinde Katalaz (CAT) enzim aktivitesinin Alparslan, Daphan, Nevzatbey genotiplerinde yüksek olduğu, Kirik, Aldane, Tosunbey genotiplerinde ise aktivitenin azaldığı görülmüştür. Süperoksit dismutaz (SOD) aktivitesi yalnızca Alparslan genotipinde artarken diğer genotiplerde aktivitenin azaldığı görülmüştür. Peroksidaz (POD) aktivite sonuçları değerlendirildiğinde ise Kirik genotipi haricindeki genotiplerde aktivitenin arttığı görülmüştür. Yapılan bu analizler sonucunda soğuğa karşı en hassas Ekmeklik buğday genotipinin Kirik olduğu belirlenmiştir.

Anahtar Kelimeler: Buğday, Antioksidan enzimler, Soğuk stresi

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Synthesis of Visible-light-Induced Sulfanilic-based composites for the degradation of Azo dyes

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Abstract

The effluent discharge from the textile industry contains dyes that are harmful to the environment and human beings. This effluent requires a effective treatment method before release into the environment. Photocatalytic degradation of dyes emerges as an alternate option to replace conventional methods such as coagulation, oxidation, etc. Keeping in view, the current study is designed to study the photodegradation of Congo Red and Malachite Green. For this purpose, three sulfanilic-based composites were synthesized i.e., sulfanilic-based composite with graphitic carbon nitride, sulfanilic-based composite with manganese, and sulfanilic-based composite with cobalt using the solvothermal method. FTIR spectrum of sulfanilic acid showed different absorption bands at 2703cm⁻¹ and 2858cm⁻¹ was assigned to -CH (symmetric and antisymmetric vibration) of sulfanilic acid. The absorption band at 1497cm⁻¹ represented the benzene ring of the compound. FTIR spectrum of sulfanilic base composite with graphitic carbon nitride showed an absorption band at 3190 cm⁻¹ assigned to the NH₂ group of graphitic carbon nitride. The absorption bands at 1753cm⁻¹ and 1361cm⁻¹ are assigned to -C=N, C-N confirming the composite formation. The bands at 980cm⁻¹ are assigned to the vibration of the metal-oxygen bond (Co-O and Mn-O) and these bands are very sharp and prominent. XRD pattern showed peaks at 8° and 26° assigned to 100 and 002 planes of g-C₃N₄. SMn showed sharp peaks from 30° to 60° assigned to manganese nanoparticles and SC showed peaks at 31°, 33°, 38°, 48° and 54°, between 30° to 60° indicating the cobalt nanoparticles. The synthesized sulfanilic-based composites with manganese showed a good 98% photocatalytic degradation of Congo red at 1mg/L and pH 10 within 180 minutes. Meanwhile, sulfanilic-based composites with graphitic carbon nitride showed 91% photocatalytic properties for Malachite green at 1mg/ L, pH 8, and 100mg catalyst dosage within 220 minutes.

Key Words: Malachite Green, Congo Red, Photodegradation, Sulfanilic acid, composites



Effect of Some Halotolerant Bacteria and Archaea Applications on Protein Metabolism of Alfalfa Under Different Salinity Conditions

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Abstract

Alfalfa is an important forage crop grown widely worldwide. However, its productivity and quality can be significantly affected by various environmental stresses such as high salt levels in the soil (Athar et al, 2022). Salt stress can negatively affect the growth, development and physiology of alfalfa plants, leading to reduced yields and reduced nutritional value (Khan, et al 2019). One of the main metabolic pathways affected by stress in plants is protein metabolism, and alleviating the negative effects of stress factors on protein metabolism through various applications is one of the main strategies to increase plant yield today (Ramadoss et al 2013). In this study, the effects of different halotolerant bacteria (*Salicola marasensis*, *Halobacillus trueperi*, *Salinicoccus amylolyticus*) and different halotolerant archaea (*Haloarcula japonica*, *Halorubrum californiense*, *Haloterrigena thermotolerans*) on protein metabolism of alfalfa grown in the presence of NaCl at different concentrations (0, 50, 100, 200 and 400 mM) added to Hoagland medium were investigated. For this purpose, seedlings grown for 14 days at 25/15°C day/night temperature and 14 hours of natural daylight were collected at the end of the experiment and ground in liquid nitrogen in a mortar. The ground plant samples were then homogenized again by adding 4 times the dry matter PBS-t pH 7.4 with an ultraturrax homogenizer, and total protein level analysis with the BCA method (He, 2011) and protein profile analysis with the SDS-PAGE method (Laemmli, 1970), which are the main methods used to examine changes in protein metabolism in these homogenates, were performed.

While the total protein level of the alfalfa in the control group was determined to be 8.62 g/100 g, it was determined that the total protein amount increased with increasing salt concentration and reached 9.48 g/100 g at 50 mM NaCl concentration, 9.51 g/100 g at 100 mM NaCl concentration, 10.10 g/100 g at 200 mM NaCl concentration and 11.30 g/100 g at 400 mM NaCl concentration.

As a result of SDS-PAGE analysis, 18 individual proteins between 10.3 kDa and 374 kDa were found. Of these individual proteins, the protein with a molecular weight of 25.7 kDa was not expressed at all with salinity, while proteins with a molecular weight of 10.3 and 12.9 kDa were overexpressed. As a result of SDS-PAGE analysis, it was determined that general protein synthesis was suppressed with salinity, but overexpression of the 10.3 kDa protein increased the total protein concentration. As a result, when the total protein amount and protein profile were evaluated together, it was determined that all bacterial and archaeal applications used in the experiment could alleviate the negative effects of salt stress on alfalfa seedlings. However, at 50 mM salt concentration, *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica*; at 100 mM salt concentration, *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica*, *Halorubrum californiense*; At 200-400 mM salt concentration, *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica* were found to be the most effective in reducing stress. These findings suggest that halotolerant bacteria or archaea applications may be a promising approach to reduce the negative effects of salinity on alfalfa production.

Key Words: Stress, alfa alfa, bacteria, archaea, SDS-PAGE, TLC



Bazı Halotolerant Bakteri ve Arkea Uygulamalarının Farklı Tuz Konsantrasyonlarında Yetiştirilen Yonca Bitkisinde Protein Metabolizması Üzerine Etkisi

Özet

Yonca, dünya çapında yaygın olarak yetiştirilen önemli bir yem bitkisidir. Ancak, verimliliği ve kalitesi, topraktaki yüksek tuz seviyeleri gibi çeşitli çevresel streslerden önemli ölçüde etkilenebilir (Athar et al, 2022). Tuz stresi, yonca bitkilerinin büyümesini, gelişimini ve fizyolojisini olumsuz yönde etkileyerek verimin azalmasına ve besin değerinin düşmesine neden olabilir (Khan, et al 2019).

Bitkilerde stres altında etkilenen başlıca metabolik yollardan birisi protein metabolizmasıdır ve stres faktörlerinin protein metabolizması üzerine olumsuz etkilerini çeşitli uygulamalar ile hafifletmek günümüzde bitki verimini artırmaya yönelik başlıca stratejilerden biridir (Ramadoss et al 2013). Bu çalışmada, Hoagland mediumuna eklenmiş farklı konsantrasyonlarda (0, 50, 100, 200 ve 400 mM) NaCl varlığında büyüyen yoncada protein metabolizması üzerine farklı halotolerant bakteri (*Salicola marasensis*, *Halobacillus trueperi*, *Salinicoccus amylolyticus*) ve farklı halotolerant arkeanın (*Haloarcula japonica*, *Halorubrum californiense*, *Haloterrigena thermotolerans*) etkileri araştırılmıştır.

Bunun için 14 gün 25/15°C gündüz/gece sıcaklık ve 14 saat doğal gün ışığı altında büyütülen fideler deneme sonunda toplanarak havanda sıvı azot içinde öğütülmüştür. Öğütülen bitki örnekleri daha sonra ultraturrax homojenizatör ile kuru maddenin 4 katı PBS-t pH 7,4 eklenerek tekrar homojenize edilmiş ve bu homojenatlarda protein metabolizmasındaki değişimlerin incelenmesinde kullanılan başlıca yöntemler olan BCA yöntemi ile (He, 2011) total protein düzeyi analizi ve SDS-PAGE yöntemi ile (Laemmli, 1970) protein profil analizi gerçekleştirilmiştir.

Kontrol grubundaki yonca fidelerinin total protein düzeyi 8,62 gr/100gr tespit edilirken, artan tuz konsantrasyonu ile birlikte toplam protein miktarının arttığı ve 50 mM NaCl konsantrasyonunda 9,48 gr/100gr, 100 mM NaCl konsantrasyonunda 9,51 gr/100gr, 200 mM NaCl konsantrasyonunda 10,10 gr/100gr ve 400 mM NaCl konsantrasyonunda 11,30 gr/100gr'a ulaştığı tespit edilmiştir.

SDS-PAGE analizi sonucunda ise 10,3 kDa ile 374 kDa arasında 18 bireysel protein bulunmuştur. Bu bireysel proteinlerden 25,7 kDa molekül ağırlığındaki proteinin tuzlulukla birlikte hiç eksprese olmadığı, 10,3 ve 12,9 kDa molekül ağırlığındaki proteinlerin ise aşırı eksprese olduğu görülmüştür. SDS-PAGE analizi sonucu tuzlulukla birlikte genel protein sentezinin baskılandığı ancak 10,3 kDa' luk proteinin aşırı ekspresyonunun toplam protein konsantrasyonunu arttırdığı belirlenmiştir.

Sonuç olarak total protein miktarı ile protein profili beraber değerlendirildiğinde denemede kullanılan tüm bakteri ve arkea uygulamalarının yonca fideleri üzerindeki tuz stresinin olumsuz etkilerini hafifletebildiği tespit edilmiştir. Bununla birlikte 50 mM tuz konsantrasyonunda *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica*; 100 mM tuz konsantrasyonunda *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica*, *Halorubrum californiense*; 200-400 mM tuz konsantrasyonunda ise *Salicola marasensis*, *Halobacillus trueperi*, *Haloarcula japonica*'nın stresi azaltmada en etkili olduğu belirlenmiştir.

Bu bulgular, halotolerant bakteri veya arkea uygulamalarının, tuzluluğun yonca üretimi üzerindeki olumsuz etkilerini azaltmada umut verici bir yaklaşım olabileceğini göstermektedir.

Anahtar Kelimeler: Stres, yonca, bakteri, arkea, SDS-PAGE, TLC

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Bioactivities and Health Benefits of *Ximenia americana* L.: A Wild Edible Fruit

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Abstract

Ximenia americana is one of the most valuable wild edible fruits in the world, but it is still neglected and underexplored. The fruit is reported as indispensable source of phytochemicals and health imparting components. However, review on the bioactivities of *X. americana* is still scarce. *X. americana* contain many bioactive compounds, such as polyphenols, anthocyanins and flavonoids. Many studies have shown that *X. americana* possess various bioactivities and health benefits, such as free radical scavenging, antioxidant, antiinflammatory, antidiabetic, antimicrobial, antitrypanosomal, antiviral, anticancer and analgesic activities. It was demonstrated that the fruit's antioxidant activity was correlated with its anthocyanin, flavonoid, and polyphenol contents. They are also used as food source for the native people. Therefore, *X. americana* has the potential to be developed into functional foods or pharmaceuticals to enhance, prevent and treat a variety of chronic diseases. In this study, we review researches regarding the bioactivities and health benefits of *X. americana*, which is important for its exploitation and utilization. The therapeutic efficacy of *X. americana* is no longer in doubt. It is anticipated that this review will aid researchers, herbal medical practitioners and agriculturists, and it will also improve the plant's optimal utilization for its several benefits.

Keywords: *Ximenia americana* L., Polyphenols, Flavonoids, Vitamin C, Antioxidant activity

Introduction

Wild edible fruits have the potential to be valuable and intriguing sources of nutrients, such as dietary fiber and bioactive compounds with strong antioxidant activity. These nutrients could serve as the basis for functional foods, food supplements, and nutraceuticals (Heinrich et al., 2006). Unfortunately, these species' potential as a source of energy, carbohydrates, vitamins, minerals, and bioactive substances is still unknown, and they are still neglected and unexplored. These wild edible fruits can be used as food source for the native people (Hegazy et al., 2019). Due to decrease in both immune and non-immune defenses, deficiencies of essential micronutrients can increase the risk of illness or death from infectious diseases. In low and middle-income countries where wild fruits are a source of these compounds, such nutrient deficiencies are widespread (Fernández-Ruiz et al., 2017). Because wild fruit contain phytochemicals with diverse bioactivities, researchers suggest that their consumption may help in the prevention or treatment of numerous diseases such as diabetes, cardiovascular problems, digestive and urinary tract disorder (Erşan et al., 2020; Islary et al. 2016).

Ximenia americana is one of the wild edible fruit which belongs to Olacaceae family. *X. americana* is a small tree or shrub, native to tropical area of Africa and seen distributed in many parts of the world. The fruit can be used for innovative drug formulation due to its medicinal value. Generally, the fruit is obtained in Africa, India, New Zealand, Central America and South America (Mohamed & Feyissa, 2020). *Ximenia* has common names as wild plum, sour or monkey plum, sea lemon or false sandal wood and is known in the Northern part of Nigeria as 'Tsada', and in Eastern part (Igbo land) as 'Anya Nwona'; while the in Western part (Yoruba) it is called 'Igo' (Adamu et al., 2005). The various parts of the plant are used traditionally to treat a variety of ailments (Agyigra et al., 2017). The fruit is green colored at the early stage of ripening and turn to yellow or red colored when ripen (Maikai et al., 2009).

Research revealed that the flesh of the *X. americana* fruit has a significant amount of total polyphenol, vitamin C, and free radical scavenging activity. Not only the fruit flesh but also the seed presents high polyphenols and antioxidant activity making it potential raw material for medicinal use (Sarmiento et al., 2015; Almeida et al., 2016; Lamien-Meda et al., 2008; Muhammad et al., 2019). The leaves are reported to have antibacterial activity and also used in the treatment of fever, tuberculosis, tooth decay and wounds (Ogunleye & Ibitoye, 2003). Numerous studies have confirmed the effectiveness of using roots to cure wounds, syphilis, leprosy, and dysentery. There have been reports of anti-trypanosomal properties in the stem bark. Northern Nigerians employ *X. americana* leaves and roots as herbal remedies to treat a variety of illnesses (Maikai et al., 2008a; Maikai et al., 2008b). The aqueous and methanolic leaf extracts of *X. americana* showed significant antioxidant and anti-inflammatory activities in previous studies (Arun et al., 2015).



In a study conducted in Africa with various wild fruit trees, including *X. americana*, it was observed that the fruits of this specimen was among those with the potent antioxidant activity, correlated to the contents of phenolics and flavonoids compounds. This suggests *X. americana* to be a potential source of antioxidants that can be used medically or as food to avoid the oxidation of cells in the human body (Lamien-Meda et al., 2008).

It was confirmed by a study conducted in some semi-arid regions of the Brazilian northeast that *X. americana* are used in the area of pharmacology and as medicinal plant in rural communities (Oliveira et al., 2010). A phytochemical analysis of the plant extract made with the stem bark, revealed the presence of several bioactive compounds, as alkaloids, anthraquinones, glycosides, flavonoids, saponins, tannins, terpenoids, giving it an elevated antioxidant activity (Maikai et al., 2010). According to findings from another study, extracts from the stem containing these compounds can be used for the treatment of infectious diseases caused by pathogens with *S. aureus*, *P. aeruginosa*, *E. coli*, *B. subtilis*, *P. vulgaris* and *C. albicans* (Maikai et al., 2009).

From an extensive literature review it was observed that *X. americana* is widely used as a popular substitute remedy in certain regions of the Africa (Guinea, Ethiopia, Nigeria, Sudan) and in the Brazil. Several biological activities such as antimicrobial, pesticidal, analgesic, antipyretic, anticancer and antitrypanosomal among others were demonstrated by the plant extracts, particularly aqueous and methanolic (Magassouba et al., 2007; Maikai et al., 2008a, 2008b; Maikai et al., 2009; Rezanka & Sigler, 2007; Siddaiah et al., 2009; Soro et al., 2009; Voss et al., 2006). A further investigation revealed that *Ximenia americana* leaf extracts, both aqueous and methanolic, were potent anti-inflammatory and antioxidant agents (Arun et al., 2015).

Nonetheless, there is paucity of data on the review of bioactive compounds of the fruit. Considering this and its various phytotherapeutic properties, the present article aimed to review the bioactive compounds and health benefits of fruits of *X. americana*.

Botanical description of *Ximenia americana*

Ximenia americana L., commonly known as wild plum, blue sour plum and tallow nut belongs to family *Olacaceae*. It is a spiny shrub or small tree up to 6 m, commonly less than 4 m, that spreads or, less often, scrambles. Branches normally arching down often armed with straight spines. Leaves are simple, alternate or clustered on spur shoots with rounded and slightly notched; broadly tapering base or rounded and occasionally softly haired. Small greenish white, fragrant flowers, born on short shoots (Maundu et al., 1999) and greenish-cream, scented and 5-10 mm long; in small, branched inflorescences (Sacande & Vautier, 2006). Fruits are oval, shiny and up to 3 cm long. Light green, turning yellow, orange or red on ripening and contains one large endospermic seed within its green pulp containing a small embryo near a thin testa. They have up to 60% oil content. Seedling morphology is variable, when young the leaves are densely hairy, but become smooth and shiny with growth (Maundu et al., 1999; Sacande & Vautier, 2006).



Figure 1: *Ximenia americana*

Importance of *Ximenia americana* in Different Parts of the World

The fruits and leaves of *X. americana* have traditionally been used in a variety of humans and animals medications (Mwangi et al., 1994). The plant's leaves and twigs are used for fever, cold, as a solution for toothaches, as a laxative and eye lotion, and poison cure (De Menezes et al., 2019; Le et al., 2012; Feiberger et al., 1998). The plant's root parts also used to treat guinea worm attack, skin burns, leprosy, some sexually transmitted diseases,



headaches, hemorrhoids, sleeping thickness, and puffiness (Teo, 1997). The fruits are eaten in large quantities and act as a vermifuge to treat constipation caused by eating heavy foods (Kuroki & Conn, 1989; Niemi et al., 2005). Following various local processing methods such as drying and powdering, the bark is applied topically to cure skin ulcers. Headaches can be treated using the leaves. Additionally, evidence suggests that *Ximenia americana* has a significant role in controlling many more different humans as well as animal diseases (Le et al., 2012; Omer et al., 1998).

Ximenia americana bark contains approximately 17% oils; heartwood and flowers contain essential oils (Fatope & Adam 2005). The processed and extracted oil which is mainly edible, nondrying, can also be used to make soap, as lubricant, traditionally as body anointing, and as a cure for dry chapped feet (Sallamander, 2010).

It is reported that *Ximenia americana* oil have a higher amount of saturated and monounsaturated fatty acids (about 99%), which gave it stability to oxidation. Research conducted on the oil revealed that it is highly effective in treating dry skin, which is prone to premature senescence and increases sebaceous tissue activity. The primary function of unsaturated fatty acids derived from the plant's fruit is to moisturize, soften, and revitalize skin (Sarmiento et al., 2015).

Orally taken *Ximenia americana* as fresh or processed form also works well for healing skin sores, hemorrhoids, and helps with looseness of the bowels. It also functions as a decent pain-relieving agent that lowers fevers; at the same time and effective against viral diseases like the measles (Koné & Atindehou, 2004). Certain compounds found in this plant have been shown to help treat insulin-resistant diabetes, treat Alzheimer's disease, enhance cognition, and lower cholesterol.

Powerful compounds with anticancer, antifungal, antiallergic, antiparasitic, antiviral, and antibacterial activities have been found in the fruit and the stems and it is also a very good antioxidant (Maikai et al., 2009; Omer & Elnima, 2003; Anonymous, 2010). Additionally, evidence suggests that it works well to relieve arthritis. The seeds contain higher amount of healthy fatty acids, and the leaf extract has shown to have antibacterial capacity comparable to penicillin and is effective for killing gonorrhea and cancer cells (Anonymous, 2010).

Shagal et al., (2013) concluded that phytochemical screening of three different plant parts using ethanol and water as solvent revealed the presence of tannins, saponins, flavonoids, phenols, and volatile oils. Additionally, ethanol extracts of the plant parts were found to have antimicrobial activity on *S. aureus*. They also found that the water extract showed antimicrobial activity on *S. aureus* and *E. coli*.

The orange shaped fruit that tastes a little bit like almonds has been found by researchers worldwide to be extremely high in vitamin C. Vitamin C is a great antioxidant that helps to prevent cancer, strokes and cardiovascular disease. According to reports, *Ximenia* fruit has high protein content along with significant amount of fiber, carbohydrates, starches, minerals, and vitamin E. It also has nonessential proteins, and the tree's stem, bark, and leaves also are rich in naturally occurring steroids that may be used in the future for treating diseases such as strokes and cardiovascular disease (Hou et al., 2008; Oladipo et al., 2013; Lucilania et al., 2016).

This suggests that the plant has numerous advantages on the environment, food security, and medicinal value, input for industries, and if properly handled as well as invested on, it may be a source of income for developing countries.

Bioactivities of *Ximenia americana*

Antioxidant Activity

Normally, free radicals are produced as a byproduct of cellular metabolism. Free radicals are capable of killing bacteria, damaging biomolecules, trigger immunological reactions, activate oncogenes, causing atherogenesis, and accelerate the ageing process (Ansari, 1997). Reactive oxygen and nitrogen species (ROS and RNS) are the most important classes of radical species generated in living systems. Numerous chronic human diseases, including as atherosclerosis, diabetes mellitus, cancer, rheumatoid arthritis, cataracts, and Parkinson's disease, may be significantly impacted by the overproduction of ROS and RNS (Halliwell & Gutteridge, 1990). Various natural products such as fruits, vegetables, cereal grains, edible flowers, wine, herbal plants, and their infusions have been proved to have antioxidant activities (Li et al., 2014; Li et al., 2013; Deng et al., 2012; Fu et al., 2011; Song et al., 2010; Alezandro et al., 2013; Margraf et al., 2016; Macedo et al., 2013; Granato et al., 2015). Therefore, natural resources of antioxidants have been considered as quite important. Numerous studies have demonstrated the antioxidant properties of numerous wild fruits, including *Ximenia americana*.

Antioxidants and Free Radical Scavenging Activity

DPPH is a stable free radical that is used to determine a fruit/plant extract's ability to scavenge free radicals (Silva & Sirasa, 2018). Ethiopian *X. americana* yellow and red colored varieties' flesh and seeds were examined for bioactive components, antioxidant activity, fatty acid profiles, and physicochemical characteristics (Bazezew et al., 2021). At 200 µg/mL concentration, the red flesh of *X. americana* fruit demonstrated stronger radical scavenging (97%) compared to the yellow *X. americana* flesh (94%) (Bazezew et al., 2021). At the same concentration, the red *X. americana* seed exhibited greater scavenging activity (75%) compared to the yellow *X.*



americana seed (68%). This may be because the fruit has a comparatively greater naturally occurring bioactive compound like total phenol in the fruit which enables it to be used in food and pharmaceuticals to prevent oxidation of cells in human body. The red *X. americana* seed also demonstrated higher antioxidant capacity (IC_{50} = 147 μ g/mL) in comparison to the yellow fruit seed (IC_{50} = 154 μ g/mL) without significant variations. According to Sarmiento (2015), the flesh and seed of the yellow *X. americana* fruit grown in Mossoró-Assu, RN, Brazilian semiarid region had also significant antioxidant activities.

According to studies by researchers from different countries Lamien-Meda et al., (2008); Le et al., (2012) and Sarmiento (2015), the yellow *X. americana* fruit had high antioxidant activity. Hence, the fruit can be used for the value addition in food processing and pharmaceutical industries due to the high free radical scavenging activities (Schubert et al., 2007).

Antidiabetic Activity

Approximately 25% of people worldwide, in both industrialized and developing nations are affected by diabetes mellitus (Kayarohanam & Kavimani, 2015; Benalla et al., 2010; Rahimi, 2015). With an estimated 110 million people living with the disease globally, China led the field, followed by the United States (30 million) and India (70 million). Diabetes is predicted by the WHO to rank seventh among all causes of death in 2030. Cardiovascular problems associated with diabetes constitute a serious hazard to human health, accounting for one fatality every ten seconds (Das & Rai, 2008). Due to societal influences and changes in lifestyle, the number of cases of diabetes is rising dramatically on a global scale (Gupta & Misra, 2007). Diabetes mellitus is considered as the group of metabolic disorders with different causes, which are characterized by imbalancing in carbohydrates, proteins and fat metabolism that lead to the effect on insulin action or secretion (American Diabetes Association, 2007). There is still no reasonable effective therapy or drug to cure diabetes in modern medicine (Ali et al., 2006). Anti-diabetic medicines that are currently available for use include thiazolidinedione, sulfonylureas, and α -glycosidase inhibitors like acarbose, which are commonly used to treat hyperglycemia. However, these drugs fail to cure the disease in addition, causes several diabetic complications and side effects, including diarrhea, stomach discomfort, and soft feces in colon (Ahmed et al., 2004; Davis & Granner, 2001).

When compared to other solvent extracts *in vitro* antidiabetic studies show that aqueous extract exhibited significant activity. The study provides scientific evidence that leaves of *Ximenia americana* have anti-diabetic efficacy (Shettar et al., 2017).

In another study, significant reduction of blood glucose was observed from the second day of the investigation on antidiabetic activity of *Ximenia americana* in alloxanised rats. The comparable effect of the extract with glibenclamide may suggest similar mode of action since alloxan permanently destroys the pancreatic B cells and the extract lowered blood sugar level in alloxanised rats, demonstrating that the extract possesses extra pancreatic effect. From the phytochemical analysis it was found that the main chemical constituents of the extract and some of this active principle including flavonoids are known to be used for the treatments of diabetes. Based on the above evidence, it is plausible that the observed antidiabetic activity is due to the presence of flavonoids and tannins (Siddaiah et al., 2011).

Antimicrobial Activity

Many bacterial, fungal, and viral species are known to cause diseases in plants, animals, and humans. These infections can lead to crop loss, food spoilage, or even food poisoning, which can be harmful to an individual's health (Cilerdzic et al., 2014; Garcia & Blanco, 2000). Therefore it is important to develop natural effective antimicrobial agents. Numerous researches have shown that *Ximenia americana* exhibited potential antiviral, antifungal, and antibacterial properties.

Antibacterial and Antifungal Activities

Some studies examined the antimicrobial activity of a certain species of *X. americana*. To evaluate the scientific basis for the use of numerous plants species used to treat diseases of infectious origin, crude extracts of these plants were investigated. The presence of secondary metabolites such as polyphenols, triterpenes, sterols, saponins, tannins, alkaloids, glycosides, and polysaccharides appears to be the cause of the antimicrobial activity of the extracts of the different parts of the investigated plants, such as roots, leaves, seeds, stem barks, and fruits (Geyid et al., 2005; James et al., 2007; Maikai et al., 2009; Ogunleye et al., 2003).

According to Shagal et al., (2013), ethanolic and aqueous extracts were analysed for the qualitative phytochemicals of three different parts of *Ximenia americana*. The results indicated the presence of tannins, saponins, flavonoids, phenols, and volatile oils, as well as the fact that ethanol extracts of the plant parts exhibited antimicrobial activity against *S. aureus*. Additionally, they discovered that the water extract had antibacterial efficacy against *E. Coli* and *S. aureus* (Shagal et al., 2013).

At dilutions as low as 250 μ g/ml, the MeOH extract from *X. americana* leaves prevented or retarded the growth of *Neisseria gonorrhea*. At a dosage of 4000 μ g/ml, the same extract demonstrated antifungal activity against *Cryptococcus neoformans* and *Candida albicans*. Chemical screening conducted on the extract revealed the presence of several secondary metabolites as tannins, sterols, terpenoids, flavonoids and saponins (Geyid et al.,



2005). *P. aeruginosa*, *P. vulgaris*, *B. subtilis*, *E. coli*, *S. aureus*, and *C. albicans* were the six common bacterial isolates against which the ethanol extract of the leaves was tested for antimicrobial activity, and it demonstrated activity against all of them. *P. aeruginosa* had the highest level of activity (inhibition zone: 20 mm), which was followed by *B. subtilis* and *C. albicans* (10 mm). The plant's organic extract exhibited similar levels of activity as the commercially available penicillin disc (2 µg), which demonstrated greater efficacy against *P. aeruginosa* but less effective against *S. aureus*. According to the findings of the phytochemical screening, cyanogenic glycosides, tannins, flavonoids, and saponins were present (Ogunleye et al., 2003). *X. americana* was tested against five different bacteria, the aqueous and methanolic extracts of its roots, stem bark, and leaves inhibited the growth of *S. aureus* and *Klebsiella pneumonia*, but only the methanolic leaf, aqueous bark, and aqueous leaf extracts inhibited the growth of *Shigella flexneri*. These extracts had no effect on *E. coli* or *S. typhi*. The Minimum Inhibitory Concentration (MIC) was only evident for the methanolic extracts at $1.25 \times 10^4 \mu\text{g mL}^{-1}$ (1:4) against *S. aureus* while the Minimum Bactericidal Concentration (MBC) of the extracts was obtained at $2.50 \times 10^4 \mu\text{g mL}^{-1}$ (1:2) (James et al., 2007). According to the findings, the extracts' (methanolic root) inhibitory action was more noticeable on *Klebsiella pneumonia*, while it was inactive against *Shigella flexneri*, *Salmonella typhi*, and *E. coli*. Comparing the methanolic bark extract and leaf extracts against *Klebsiella pneumonia*, the methanolic root extract exhibited highly significant ($p < 0.05$) activity. With the exception of aqueous and leaf extracts, the phytochemical constituents present in the extracts included cardiac glycosides, saponins, tannins, and flavonoids in addition to carbohydrates in the form of sugars and soluble starch. The findings indicate that methanolic root, stem bark, and leaf extracts exhibit bactericidal properties at concentrations between 2.5×10^4 and $1.25 \times 10^4 \mu\text{g mL}^{-1}$. The antibacterial properties of these extracts are attributed to the presence of flavonoids, carbohydrates, glycosides, and tannins.

To ascertain whether *Ximenia americana* crude extracts possessed antimicrobial activity, numerous more investigations were carried out (Magassouba et al., 2007; Maikai et al., 2009). Overall, it was discovered that the different extracts had a broad spectrum effect against standard organisms (*Salmonella typhi*, *Bacillus subtilis*, *Proteus vulgaris*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Proteus aureus*, *Candida albicans*, and *Shigella flexneri*). This finding supports the plant's traditional use as a remedy for microbial infections.

In general, the presence of secondary metabolites appears to be the cause of antimicrobial activity of extracts of the various parts of the plants. Cyanogenic glycosides are reported to possess antimicrobial activity. Tannins have long been used as an antidote for heavy metal poisoning, as well as for the protection of inflamed surfaces of the mouth and treatment of catarrh, cuts, hemorrhoids, and diarrhea. They have the ability to inactivate microbial adhesions, enzymes, cell envelope transport proteins and also complex with polysaccharide (Maikai et al., 2009; Scalbert, 1991; Ya et al., 1988). Flavonoids are naturally occurring phenols with a wide range of biological activities, such as anti-inflammatory, anti-allergic, antibacterial, antifungal, and vasoprotective properties. They have also been shown to form complexes with bacterial cell walls and extracellular and soluble proteins (Dixon et al., 1983; Geyid et al., 2005; Hostettman et al., 1995; James et al., 2007; Maikai et al., 2009; Ogunleye et al., 2003). There have also been report of Terpenoids to be active against bacteria, the mechanism of action involve membrane disruption by the lipophilic compounds (Geyid et al., 2005; James et al., 2007; Maikai et al., 2009; Ogunleye et al., 2003). The existence of these secondary metabolites is undoubtedly responsible for the extracts' antimicrobial activity, even though it is challenging to infer the exact mechanism of action of the extracts' contents based on research done to date. In the case of extracts of *Ximenia americana*, probably, due the presence of tannins, flavonoids, triterpenes/steroids, saponins or cyanogenic glycosides.

In conclusion, the findings supported the use of *X. americana* as an agent in novel medications for the treatment of infectious diseases caused by pathogens and validated the plant's claimed antimicrobial properties.

Analgesic Activity

Because of its analgesic properties, the aqueous extract of *X. americana* stem bark is widely used in Tanzania, Senegal, Zimbabwe, and Nigeria. When taken in dosages ranging from 10 to 100 mg/kg P.C., the extract of *X. americana* suppresses abdominal contractions while having analgesic properties similar to those of phenylbutazone. In fact, 45.2% of patients get pain inhibition by phenylbutazone at doses of 100 mg/kg P.C. At the same concentration, the *X. americana* extract exhibits a percentage of inhibition of 61.1%. These characteristics are most likely caused by the extract's flavonoids and saponins (Soro et al., 2009).

Using chemical models of nociception in mice, the analgesic efficacy of *X. americana* leaf methanol extract was examined. The extract inhibited the acetic acid-induced abdominal writhes in mice by 54.13, 63.74, and 66.4% at dosages of 200, 400, and 600 mg/kg i.p. In the formalin test, the administration of 200, 400, and 600 mg/kg i.p. exhibited a dose-dependent analgesic effect on the second phase (15 to 40 min) with inhibitions of the licking time of 29.3, 47.8, and 59.8%, respectively, but had no impact on the first phase (0 to 5 min). These findings suggested that *X. americana* methanol leaf extract has analgesic activity (Siddaiah et al., 2009).

Anti-trypanosomal Activity



Trypanosoma congolense was used to test the methanolic and aqueous extracts of *X. americana*'s stem bark for their *in vitro* anti-trypanosomal activity. Blood obtained from a high infected mice with *T. congolense* (10(7) was incubated with methanolic and aqueous extracts at 20, 10 and 5 mg/ml and Diminal (R) (diminazene aceturate) at 200, 100 and 50 µg/ml in a 96 micro plate. The findings showed that at 20 and 40 mg/ml, both methanol and aqueous extracts had activity; however, at 10 and 5 mg/ml, methanolic extracts were more active than aqueous extracts. Phytochemical screening of the methanolic and aqueous extracts of the bark showed that they both revealed the presence of flavonoids, anthraquinones, saponins, terpenes and tannins. The aqueous and methanolic extracts appear to show some potential activity against *T. congolense* (Maikai et al., 2008).

Anticancer Activity

Worldwide, cancer is recognized as a leading cause of death. Fruit consumption has been linked to a lower risk of cancer (Chu et al., 2002; Liu, 2003). A variety of natural products, such as fruits, vegetables, and herbal plants, have been widely proved to possess antiproliferative activities (Li et al., 2013; Zhou et al., 2016; Li et al., 2013). It has been demonstrated that a number of wild fruits, including wild blueberries and red raspberries from Jamaica, have anticancer properties against cancer cells of the breast, colon, prostate, and cervical regions. It has been demonstrated that plants are a good source of natural compounds that can be used to cure human neoplastic diseases. Information recorded from ancient civilizations has shown the use of plants in search of treatment for various types of cancer (Hartwell, 1967-1971). Examples of anticancer agents developed from higher plants are the antileukemic bis-indole alkaloids vinblastine and vincristine from the *Catharantus roseus* (Apocynaceae); diterpene taxol, used to treat breast cancer, lung cancer, and ovarian cancer and also used to treat AIDS-related (Kaposi's sarcoma) from *Taxus breviflora* (Taxaceae); pyrrolo [3,4,b]-quinoline alkaloid camptothecin (antileukemic) from *Camptotheca acuminata* (Nyssaceae) and pyridocarbazole alkaloid elipticine (antitumor) contained in *Ochrosia elliptica* (Apocynaceae). Various extracts from *Ximenia americana*, a plant used in African traditional medicine for treating cancer were tested for their antineoplastic activity *in vitro* (Voss et al., 2006). A detailed investigation of the most active aqueous extract was conducted on a panel of 17 tumor cell lines, 16 of which originate from human and 1 from rat, showing an average IC₅₀ of 49 mg raw powder/ml medium. The majority of cell lines, 11 out of 17 were classified as sensitive (the sensitivity varied from 1.7 mg/ml in MCF7 breast cancer cells to 170 mg/ml in AR230 chronic-myeloid leukemia cells) and three of these (MCF7 breast cancer, BV173 CML and CC531 rat colon carcinoma) showed a particularly high sensitivity, with ratios lower than 0.1 of the average IC₅₀. Using CC531 colorectal rat model, the *in vivo* antitumor activity was assessed. Following peroral administration, significant anticancer activity was observed, showing 95% reduction in activity.

Antiviral Activity

By using the plaque reduction neutralization assay, the stem bark of MeOH extract of *X. americana* and a few other plant species employed by the Maasai pastoralis of East Africa demonstrated an antiviral activity against the measles virus *in vitro*. Extracts of all the plants contain potentially active constituents including polyphenols, glycosides, alkaloids, terpenes, tannins, sterols and saponins (Parker et al., 2007).

Food Use

Blends of glyceride containing ximenynic acid (9) from *X. americana* are useful for the preparation of food compositions or food supplements, such as margarine, mayonnaises, cheese, chocolate, drinks, icecream, dry soups, snack bars, cereal bars and sauces. The blends offers a composition with health benefits ranging from lowering blood cholesterol levels, improving memory function, preventing the onset of Alzheimer's disease symptoms, insulin resistance or related disorders like diabetes, anticancer effects, or skin anti-aging effects (Koenen et al., 2004).

Conclusion

There is no longer any doubt about *X. americana*'s medical potential. A wide range of diverse biological activities and industrial applications, including free radical scavenging, antioxidant, anti-inflammatory, antidiabetic, antimicrobial, antitrypanosomal, antiviral, anticancer, and analgesic activities, were demonstrated by the phytochemical diversity found in *X. americana*. Many of these activities support the assertions made by herbal medical practitioners, although more human subjects' clinical trials are still required. Many researchers have also linked some of the plant's medicinal activities to the high level of antioxidant components such as polyphenols, flavonoids, anthocyanins, Vitamins C and E and antioxidant property of the plant. On the other hand, the presence of other phytochemicals such as tannins, saponins, may also play valuable roles in the plant's activities. It is anticipated that more of the medicinal properties of the plant will be discovered, as researchers continue to focus their investigation on this plant. But little research has been done on the plant's chemistry. This is a major drawback. Hence, researchers should focus their investigation on the isolation and identification of the plant's bioactive compounds. It is essential to know the identity of the components that are responsible for each of the



identified medicinal properties of the plant. This could lead to the discovery of novel drugs from *X. americana*. It will also enhance the effective exploitation of the medicinal benefits of this significant yet underutilized plant.

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Optimization of the extraction process of phenolic compounds from eggplant peel

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Abstract

In this study, the extraction process of phenolic compounds from eggplant peels, an important industrial waste, with the help of ultrasound was optimized by Taguchi method. Experiments were carried out according to Taguchi L₉ (3³) experimental matrix. Ethanol ratio (50, 70, 90% (v/v)), sonication time (15, 30, 45 min) and sonication temperature (30, 40, 60 °C) were selected as independent variables. In this study, which aimed to maximize the total phenolic matter (TPM) content of the extracts, the optimum conditions were determined as 70% ethanol ratio, 45 min sonication time and 60 °C sonication temperature. ANOVA results showed that ethanol ratio (83.06%) and sonication temperature (14.38%) were the most significant parameters contributing to the process. According to the validation experiments carried out to verify the optimum conditions, 66.02% improvement was achieved in the TPM content obtained under optimum conditions compared to the initial process conditions.

Key Words: Ultrasound, Taguchi, phenolic, ANOVA, optimization

Patlıcan kabuklarından fenolik bileşen ekstraksiyon sürecinin optimizasyonu

Özet

Bu çalışmada önemli bir endüstriyel atık olan patlıcan kabuklarından fenolik bileşenlerin ultrases yardımıyla ekstraksiyon süreci Taguchi yöntemiyle optimize edilmiştir. Deneyler Taguchi L₉ (3³) deney matrisine göre gerçekleştirilmiştir. Bağımsız değişkenler olarak etanol oranı (A; %50, 70, 90 (v/v)), sonikasyon süresi (B; 15, 30, 45 dak) ve sonikasyon sıcaklığı (C; 30, 40, 60 °C) olarak seçilmiştir. Ekstraktların toplam fenolik madde (TFM) içeriğinin maksimize edilmesinin amaçlandığı bu çalışmada optimum koşullar %70 etanol oranı, 45 dak sonikasyon süresi ve 60 °C sonikasyon sıcaklığı olarak belirlendi. ANOVA sonuçları proses sürecine en fazla katkı sağlayan parametrelerin etanol oranı (%83.06) ve sonikasyon sıcaklığı (%14.38) olduğunu gösterdi. Optimum koşulların kontrolü amacıyla gerçekleştirilen doğrulama deneylerine göre optimum koşullarda elde edilen TFM içeriğinde başlangıç proses koşullarına göre %66.02 oranında iyileşme sağlanmıştır.

Anahtar Kelimeler: ultrases, Taguchi, fenolik, ANOVA, optimizasyon

Introduction

Eggplant (*Solanum melongena* L.) is an important vegetable crop due to its nutritional and economic values (Ferarsa et al., 2018). Eggplant fruits, which are mostly produced in subtropical and tropical regions, are widely consumed annual vegetables worldwide (Zhang et al., 2020). According to FAO data for 2022, around 59 million tons of eggplant is produced in the world. Nearly half of this (~23 million tons) is produced by China.

A significant amount of waste is generated as a result of the further processing of agricultural foods in food facilities (Philippi et al., 2016). Eggplant peels, which are considered as a waste in food processing, can be a potential threat to the environment if not properly utilized. Recent studies have focused on the extraction of bioactive components from plant by-products using different extraction techniques (Kainat et al., 2023).

Traditional methods such as soxhlet and maceration with low extraction yields are widely used in the recovery of phenolic compounds from industrial by-products. The relatively long extraction time causes degradation/loss of heat sensitive components in these methods. In addition, high energy costs and solvent costs are among the most important disadvantages of traditional extraction methods (Ferarsa et al., 2018). The development of eco-friendly and sustainable extraction methods for natural products has become a prominent area of research in food applications. These innovative techniques, known as clean or green technologies, aim to minimize or eliminate the use of harmful solvents, safeguard the environment, and decrease energy usage (Popovic et al., 2022). Recently, eco-friendly methods like ultrasonically-assisted extraction (UAE), microwave-assisted extraction, and enzymatic-assisted extraction have been developed to extract bioactive compounds from plant sources (Hong et al., 2023). Ultrasound-assisted extraction, in particular, has several benefits over traditional methods, including reduced extraction time, lower solvent usage, and higher yields (Güldane, 2023). In this study, it was aimed to improve the extraction process of phenolic substances from eggplant peel, which is considered as a waste, with the help of ultrasound. The optimal levels of process parameters in the extraction process were determined using Taguchi method.



Material and Methods

Material

Eggplants used in this study were obtained from a local market. Eggplant peels were cut with a peeling apparatus with a thickness of 1 cm and dried in an oven at 40 °C until constant weight. The peels were then ground with a blender and passed through a 0.2 mm sieve and stored at room temperature until the analysis stage.

Extraction of phenolics from eggplant peels

Ethanol ratio, sonication time and sonication temperature were selected as independent variables for the extraction of phenolic compounds from eggplant peel (Table 1). For extraction, 5 g of eggplant peel powder was transferred to a beaker and 100 ml of solvent containing different ratios of ethanol (50%, 70% and 90%, v/v) was added. The beaker was placed in an ultrasonic water bath (Creworks, PS-30A, China) operating at constant frequency (40 kHz) and power (180 W), pre-set to a certain temperature (30, 45 and 60 °C) and sonicated for different times (15, 30 and 45 min). After extraction, solid particles were removed from the mixtures by filtration with Whatman No:1 filter paper.

Determination of total phenolic matter (TPM) content

The method proposed by Singleton et al. (1999) was partially modified and used to determine the TPM content of the samples. For this purpose, 100 µL Folin reagent was added to 100 µL extract and vortexed. After 3 min, 4 mL of 1 M sodium carbonate (Na₂CO₃) solution was added to the test tube. The samples were kept at 45 °C for 5 min, then cooled rapidly and their absorbance at 760 nm was determined with a spectrophotometer (Shimadzu, UVmini1240, Japan). TPM contents of the samples were calculated as mg gallic acid equivalent (mg GAE/g) using the calibration curve graph equation prepared with standard gallic acid solutions (0-1 mg/mL).

Experimental design

Taguchi L⁹ (3³) experimental design presented in Table 1 was used for the extraction of phenolic compounds from eggplant peel. In the process optimization, the effect of solvent ethanol content ((50%, 70% and 90%, v/v), sonication time (15, 30 and 45 min) and sonication temperature (30, 45 and 60 °C)) variables on total phenolic matter (TPM) extraction was investigated.

Table 1. Taguchi L₉ (3³) design matrix

Run	Ethanol ratio (%)	Sonication time (min)	Sonication temperature (°C)	TPM (mg GAE/g)	S/N (dB)
1	50	15	30	4.62	13.29
2	50	30	45	5.82	15.30
3	50	45	60	6.23	15.89
4	70	15	45	6.95	16.84
5	70	30	60	7.64	17.66
6	70	45	30	6.64	16.44
7	90	15	60	4.74	13.52
8	90	30	30	4.04	12.13
9	90	45	45	4.48	13.03

In the Taguchi experimental matrix, each column represents the selected parameters and each row represents the corresponding parameter levels. In this method, experimental data are converted into signal (S)/noise (N) ratios. Here "S" represents the targeted output and "N" represents the variance. There are 3 types of S/N ratio norms in Taguchi optimization: "Larger is better", "nominal is best" and "smaller is better". The main objective is to maximize the selected norm (Tansel et al., 2022). In this study, the following Equation 1 was preferred since it was aimed to maximize the TPM response in ultrasound-assisted extraction of phenolic compounds.

$$S/N = -10 \log \left[\frac{1}{n} \sum_{i=1}^n \frac{1}{y_i^2} \right] \quad (1)$$

Where; y_i: results for ith experiment, n: total number of scenario.

Statistical analysis

Minitab 17.0 software was used to obtain the Taguchi experiment matrix and to evaluate and predict the experimental results.



Results and Discussion

Taguchi Optimization

The Taguchi optimization method was employed to assess the impact of different parameters (ethanol ratio, sonication time, and sonication temperature) on the total phenolic matter (TPM) in the ultrasound-assisted extraction of phenolic compounds. The experiments followed the Taguchi L9 experimental design, and the results, along with the corresponding signal-to-noise (S/N) ratios, are presented in Table 1. The S/N ratios graph of the experimental results is shown in Figure 1. The graphical representation of the results shows the main effects of the independent factors on the response. These interactions are used to estimate the effect of each parameter on the TPM during the extraction process.

Water and ethanol mixtures were used to extract phenolic compounds from eggplant peel. Ethanol was preferred for extraction because it is both easily available in high purity and widely used in food applications (Ferarsa et al., 2018). Figure 1 shows that when the ethanol content in the solution was increased up to a certain level, an increase in extraction efficiency was observed. The extraction efficiency of the solution containing 70% EtOH was found to be better than the solution containing 50% and 90% EtOH. This can be explained by the ability of two solvents of different polarity to extract different phenolic compounds. In the study, the amount of phenolic substances extracted increased as the sonication time applied to the samples increased. Similar data were obtained for sonication temperature. As a result of the increase in sonication temperature, TPM yield increased. These results are closely related to the data reported by Ferarsa et al. (2018) in the ultrasound-assisted extraction of anthocyanins from eggplant peels. Similar observations were also made by Dranca & Oroian (2016). These studies revealed that increasing the temperature improved extraction efficiency by lowering the viscosity of the solvent, allowing it to penetrate the sample cells more effectively. As a result, the solubility and desorption of phenolic compounds were enhanced. Based on the extraction parameters, the optimal conditions for extracting phenolic compounds from eggplant peels were identified as using a solvent with 70% ethanol, a duration of 45 minutes, and a temperature of 60°C (A₂B₃C₃).

ANOVA data are utilized to express the degree of influence of independent parameters on TFP. The percentage contribution of each parameter to the result is calculated by taking into account the contribution of the Adj SS value of the relevant process parameter to the total Adj SS value. The results are given in Table 2. According to the ANOVA with high reliability ($R^2=0.99$; $R^2_{adj}=0.98$; $R^2_{pred}=0.92$) the effect of ethanol ratio and sonication temperature on TPM response was found to be significant at 83.06% and 14.38%, respectively ($p<0.05$). However, sonication time had no significant effect on the response variable ($p>0.05$).

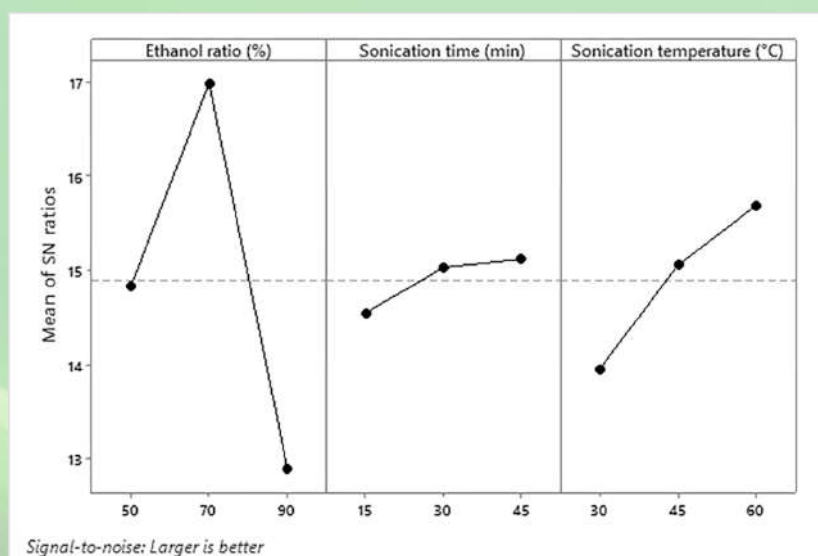


Figure 1. S/N ratio graph

Table 2. ANOVA results for TPM response

Source	DF	Adj SS	Adj MS	F-Value	P-Value	Contribution(%)
Ethanol ratio	2	10.6603	5.33014	216.87	0.005*	83.06
Sonication time	2	0.2800	0.14001	5.70	0.149	2.18
Sonication temperature	2	1.8454	0.92268	37.54	0.026*	14.38
Error	2	0.0492	0.02458			0.38
Total	8	12.8348				100

* $p<0.05$; $R^2=99.62\%$; $R^2_{adj}=98.47\%$; $R^2_{pred}=92.24\%$



The mathematical equation developed to explain the relationship between the independent variables (Ethanol ratio (A), sonication time (B) and sonication temperature (C)) and the output parameter (TPM) was obtained with Minitab 17.0 software. The regression equation (Equation 2) for the ultrasound-assisted extraction of phenolic compounds from eggplant peels was established.

$$\text{TPM}=5.68-0.13*A_{50}+1.39*A_{70}+1.26*A_{90}-0.25*B_{15}+0.15*B_{30}+0.1*B_{45}-0.58*C_{30}+0.07*C_{45}+0.52*C_{60} \quad (2)$$

Confirmation experiments

In order to verify the optimization results, validation experiments with 3 replications were performed. The results are given in Table 3. When the results were examined, it was seen that the experimental result was close to the result predicted by the Minitab. In addition, as a result of the optimization, 66.01% improvement was achieved compared to the initial parameter levels.

Table 3. Confirmation test results

	Initial process parameters	Optimum conditions	
		Prediction	Experiment
Parameter levels	A ₁ B ₁ C ₁	A ₂ B ₃ C ₃	A ₂ B ₃ C ₃
TPM (mg GAE/g)	4.62	7.69	7.67±0.03
Improvement (%)			66.02

Conclusions

In this study, ultrasound was utilized as a novel extraction method to obtain phenolic compounds from eggplant peel. Experiments were conducted using the Taguchi L9 orthogonal array for optimization. Various ethanol ratios were tested as solvents, with 70% ethanol found to be the most effective. Additionally, the results indicated that both extraction time and temperature positively influenced phenolic content. Statistical analysis revealed that the ethanol ratio was the most significant parameter affecting the extraction process.

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Analysis of Rubber Farming Income using Stimulants in Tebo District

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Abstract

This study aims to describe the rubber farming of farmers who use stimulants in Tebo District. The number of samples of farmers who use stimulants is 48. Sampling is done using the method purposive or intentionally. This study was conducted from March to May 2024. The results of the study showed that based on the problems and phenomena that occurred, the decline in rubber prices and low production caused low income, so farmers used stimulants to increase their productivity with the aim of meeting needs and increasing farmers' income. In this study, the use of stimulants did have an impact on the production and income of farmers in Tebo District.

Key Words: Income, Rubber Farming, Stimulants, Rubber Price, Low Productions

Tebo Bölgesinde Uyarıcılar Kullanılarak Kauçuk Çiftçiliği Gelirinin Analizi

Özet

Bu çalışma, Tebo District'de uyarıcı kullanan çiftçilerin kauçuk çiftçiliğini tanımlamayı amaçlamaktadır. Uyarıcı kullanan çiftçilerin örnek sayısı 48'dir. Örneklem, amaçlı veya kasıtlı olarak yöntemi kullanılarak yapılmıştır. Bu çalışma Mart-Mayıs 2024 arasında yürütülmüştür. Çalışmanın sonuçları, meydana gelen sorunlara ve olgulara dayanarak, kauçuk fiyatlarındaki düşüşün ve düşük üretimin düşük gelire neden olduğunu, bu nedenle çiftçilerin ihtiyaçlarını karşılamak ve çiftçilerin gelirini artırmak amacıyla üretkenliklerini artırmak için uyarıcıları kullandığını göstermiştir. Bu çalışmada, uyarıcıların kullanımı Tebo District'deki çiftçilerin üretimi ve geliri üzerinde bir etkiye sahip olmuştur.

Anahtar Kelimeler: Gelir, Kauçuk Çiftçiliği, Uyarıcılar, Kauçuk Fiyatı, Düşük Üretimler

Introduction

The agricultural sector is one of the sectors that needs to get great attention from the government because some farmers, both food crop farmers, plantation farmers, forestry farmers and other types of agricultural activities. stated that the development of the agricultural sector is directed at increasing the productivity of agricultural products to meet the food needs of the community and the needs of the domestic industry, increase exports, increase farmers' income, expand employment opportunities and encourage business opportunities (Soekartawi, 2016).

Tebo District is one of the regencies that cultivates rubber plants quite extensively in Jambi Province. The area of rubber plants in Tebo District is 18.5% which is the third largest land area after Merangin and Sarolangun, for rubber production it is 14.09% which is in 4th place, but the problem is that its productivity is relatively low which is 0.87% where the figure is in 7th place. The possibility of low productivity in Tebo District is due to the inaccurate management of farming businesses so that it produces low production results (Direktorat Jendral Perkebunan, 2017).

Rubber plants are one of the commodities cultivated by most farmers in Tebo District and have an area that is already producing. However, the production produced does not match the area because it is not accompanied by an increase in maximum production. This is because farmers do not use superior seeds, many plants are old, and there is no fertilization and tapping that is not in accordance with recommendations. The obstacles faced by these farmers are due to the problem of quite expensive costs in carrying out maintenance, fertilization and rejuvenation of the rubber plants. To increase latex production, most farmers in Tebo District have used stimulants to increase latex production and it is known that the actual age of the plant for the use of stimulants itself is above 6 years. The increase in latex production cannot be separated from the costs and production factors of the farming business (Statistik Karet Indonesia, 2021).

Long-term use of stimulants if not implemented according to recommendations can reduce latex production. The reduction in latex production can occur because stimulants can dry out tapping grooves. This can reduce farmers' motivation to use stimulants. In general, it can be said that in addition to having an impact on increasing costs to buy stimulants, the use of stimulants is also feared to reduce the productivity of rubber plants (Marselly et al., 2022).

Overview of the Research Area

The area that is the object of research is Tebo District. In the general description section of this research, it will explain the geographical and topographic location, population conditions, agricultural support facilities and infrastructure and the livelihoods of the population.



Geographical Location and Territorial Boundaries

Tebo District is located in the western part of Jambi Province with coordinates 0° 52' 32" - 01° 54' 50" LS and 101° 84' 57" - 102° 49' 17" BT. The area of Tebo District is 11.86% of the area of Jambi Province, consisting of 12 sub-districts, 116 villages and 5 sub-districts. It has a tropical climate with an altitude of between 50-1,000 m above sea level (asl). The distance from Tebo to Jambi City is 206 KM. Tebo District has an area that borders other regencies in Jambi Province. The boundaries are as follows: to the north it borders Indragiri Hilir District and Kuantan Singingi District (Riau Province), the south side borders Tabir District (Merangin District), The west side is bordered by Jujuhan Ilir District (Bungo District) and Damasraya District (West Sumatra Province) and to the east it borders on Tungkul Ulu District (West Tanjab District) and Muaro Sebo Ulu District (Batang Hari District). Tebo District is one of the most developed regencies with the highest population and high level of education. Tebo District is located between 1.20 to 1.25 LS and between 101.51 to 101.55 BT. The land conditions of Tebo District are generally lowlands with an altitude of 50-100 meters.

Population

Livelihood

The livelihoods of the population in Tebo District are mostly based on the agricultural and plantation sectors. In addition, there are other sectors that are also the livelihoods of the population in Tebo District. The number of residents in Tebo District by type of work according to the potential of the region in 2022 is as follows Table 1.

Table 1. Distribution of Tebo District Population

No	Type of Livelihood	Percentage (%)
1	Rubber Farmer	75
2	Trader	6
3	Fisheries/Livestock	10
4	Government employees	7
5	Etc	2
Total		100%

Social and Cultural Conditions

The majority of people in Tebo District are Muslim. People in Tebo District can carry out religious activities routinely, peacefully and with high tolerance. This can be seen from the harmonious atmosphere with the family nature that is still attached among them, such as mothers' wiritan, yasinan and other worship in each village. Social values are also strongly embedded in this area, for example the values of mutual cooperation, the level of mutual trust and high tolerance between each other, not only for daily life but also in farming is inseparable from social values. Although the population of Rimbo Bujang District is heterogeneous consisting of various ethnic groups, this ethnic diversity does not affect the culture and customs in Rimbo Bujang District, because the community highly upholds the culture and customs that have been inherited from generation to generation.

Socio-Economic Conditions and Infrastructure

Tebo District is a region with great potential in the agricultural sector, especially plantation crops, namely rubber and oil palm. Village development cannot be separated from education, both formal and non-formal. Educational facilities in Tebo District are 25 elementary school buildings, 7 junior high school buildings, 1 senior high school building, 2 vocational school buildings, 4 MTs buildings and 2 MA buildings. Health buildings in Tebo District are 3 hospitals, 4 health centers and 7 assistant health centers and 29 toddler health posts. The majority of the population of Tebo District is Muslim where there are 32 mosques and 123 prayer rooms and 9 churches that can be used by the people of Rimbo Bujang District for worship.

Kaynaklar

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Proliferation and nutritional profile of wheat and maize derived hydroponic fodder produced at small scale farmers' level

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Abstract

In Rwanda, livestock is a key sector playing an important role in the economic development of the country and community wellbeing. Livestock subsectors provide meat, milk, and eggs that are necessary to meet the nutritional requirements of a rapidly growing population. Despite its role in community development, the livestock subsector in Rwanda is still challenged by numerous factors, including but not limited to poor animal genetic potential, animal diseases, and poor nutrition in both quality and quantity. Hydroponic production is an ideal solution responding to the need for good-quality livestock fodder despite the high cost of establishing the required infrastructure. This study was conducted to assess the proliferation and nutritional profile of wheat and maize-derived hydroponic fodder produced at small-scale farmers' levels. By using locally available materials, small-scale hydroponic infrastructure were constructed, and two cereal grains were used as treatments: maize and beans in Randomised Complete Block Design (RCBD) with 6 replicates. Growth parameters like shoot length, leaf width, and root length data were collected daily from day 1 up to day 8, and 6 parameters of nutritional composition were tested in the laboratory. The results indicated that at 8th day shoot length, leaf width, and root length were 16.7, 12.3, and 1.7 cm, respectively, for maize and 17.8, 14.5, and 1.5 cm, respectively, for wheat shoot length, leaf width, and root length. For nutritional composition; the dry matter (DM) content was 19.30% for maize and 12.84% for wheat; protein and crude fibre were respectively 14.69% and 14.50% in wheat and 12.00% and 4.97 in maize, while other parameters, ash content, were 2.22% in maize and 2.12% in wheat; calcium residues were 0.08% in maize and 0.17 in wheat; and phosphorus were 0.10% in maize and 0.35 wheat. The study results revealed that locally available materials can be used to produce high-quality hydroponic fodder to be fed to livestock. To farmers, this study recommend the adoption of hydroponic production for the purpose of decreasing cost of production which is mostly associated with feeding.

Key words: Livestock, hydroponic, shoot, root, leaf

Introduction

Livestock production plays an important role in economy and community welfare in developing countries by providing employment to producers and acting as a source of income necessary to cover family needs (Herrero et al., 2013; Smith et al., 2013). Beside its role in national and household economy, livestock provide meat, milk, egg and fish products that are sources of proteins, carbohydrates, lipids, minerals and vitamins required to provide a healthy food to human population (Lambrini et al., 2021; Balami et al., 2019; Wyness, 2016). In Rwanda, the Ministry of Agriculture and Animal Resources (MINAGRI) reported that the livestock sector produced 1,061,301 MT of milk; 197,778 MT of meat and 17,344 MT of eggs in 2022/2023 fiscal year (MINAGRI, 2023). Despite its role in livelihood and country economy, the livestock subsector in Rwanda is still challenged by numerous factors. Generally, the production system is mostly dominated by extensive production system which is essentially based on natural pasture where supplementary feeding of concentrates and cultivated pastures is uncommon in small ruminants (IFAD, 2019). The competition between livestock and human for cereals and other grains is another challenge for monogastric animal producers as it increases the cost of production due to increased demand of required inputs (IFAD, 2019; Steinfeld & Opio, 2010). To alleviate those challenges feeding hydroponic fodder might be an ideal solution for livestock producers.

Hydroponic involves utilization of water or enriched solution to sprout or grow plant in a controlled environment and without soil (Pastorelli et al., 2023). Hydroponic technology allow farmers to produce fodder for livestock on a small piece of land especially in densely populated areas or in areas where agriculture is difficult (Bekuma, 2019; Girma et al., 2018). Maize and barley are among cereal grains used to produce hydroponic fodder of 18.1 cm and 18.4 cm at the day five respectively (Murthy et al., 2017). The production per kg of grains used to produce hydroponic fodder stands at 4.82 kg for maize and 5.06 kg for barley (Murthy et al., 2017). At day eight, Gebremedhin et al., 2015 reported that the production from one kg of barley stands at 8 to 9 kg at the day 8. The nutritional analysis on the day 8 demonstrated that hydroponic fodder produced from barley contains 13.9% Crude



Proteins, 3.62% Ether Extract and 14.24% Crude Fiber on Dry Matter Basis (Gebremedhin *et al.*, 2015). Despite its role in livestock industry, production of hydroponic fodder is still high and unaffordable by smallholder livestock farmers. Apart from the cost of establishment which is relatively high due to need of special equipment and infrastructure, hydroponic production for smallholder farmers is challenged by operational cost required to cover energy needed to maintain temperature, humidity and lighting levels as per requirement (Vyshnavi *et al.*, 2023). The present study aims at characterizing the proliferation and nutritional profile of wheat and maize derived hydroponic fodder produced at small scale farmers' level using locally available materials.

Materials and methods

Study area

The present study was conducted in the Musanze District of Northern Province, Rwanda. Musanze is a densely populated district with a population density of 1,157 inhabitants/km², with a population of 476,522 residents representing 23.4% of the total population of Northern Province according to NISR, 2023. As reported by NISR, 2023, at least 66.3% of households are engaged in agriculture, in which 59.4% practice crop farming while 44.4% are engaged in livestock husbandry practices. Maize, sorghum, wheat, beans, soybean, cassava, sweet potato, Irish potato, yams & taro, banana, vegetables, and fruits are commonest crops, respectively, cultivated by 46,263; 7,990; 3,759; 52,297; 327; 3,493; 20,351; 19,893; 1,422; 6,917; 8,584; and 39,924 households, from NISR, 2023. Livestock are raised by 25,952 households for cattle, 15,924 households for sheep, 12,765 households for pigs, 9,689 households for goats, 6,891 households for chickens, and 1,191 households for rabbits, according to NISR, 2023. The average monthly maximum temperature in Musanze District ranges from 20 to 24 °C, while the minimum temperature ranges from 11 to 13 °C, and there is an annual rainfall of 1,400 mm (LODA, 2021).

Establishment of hydroponic growing space

This study utilized a range of tools and equipment to construct a hydroponic house. This structure was assembled using trees, plastic sheets, and nails, with dimensions measuring 6 meters in length and 3 meters in width. Recycled plastic materials were repurposed to fabricate growing trays with small drainage holes to regulate water flow effectively and a size of 43cm x 30 cm for hydroponic fodder cultivation. Additionally, scrap lumber was repurposed to create a support platform with a gentle slope, facilitating the placement of the hydroponic growing trays. Inside the constructed house, a non-slip concrete floor with a slope was constructed to facilitate cleaning and drainage of used water.

Experimental design and Hydroponic cultivation

The experiment was set up in a Randomised Complete Block Design (RCBD) with 2 treatments, wheat and maize, and each treatment was replicated six times. Unbroken maize and wheat that are healthy, free from diseases and molds were selected for experiment. Selected seeds were washed using clean water and vinegar where 10 ml of vinegar were diluted within 20 liters of clean water to eliminate microbes and minimize the risk of mold growth in subsequent stages. During cleaning immature seeds floated to the surface were removed to ensure consistent growth. Cleaned seeds were soaked in plastic bucket which in turn were placed in dark room for 24 hours for maize and 12 hours for wheat. After soaking, the seeds were placed in a damp gunny bag to initiate germination and left to sprout for 24 hours for each. The sprouted seeds were then transferred into trays cleaned with water and vinegar at a rate of 1 kilograms of seeds per tray. On a daily basis, watering was done manually using cans at 5 hours interval to ensure that seeds are adequately kept moist. On a daily basis, shoot length, leaf width and leaf length were measured by using a ruler up to day 8 for 5 selected plant per tray.

Nutritional analysis

At day 8, obtained fodder were harvested and transported to the laboratory of Rwanda Agriculture and Animal Resources Development Board/Rubona Station for nutritional analysis on dry basis. Crude Protein content were determined using Kjeldahl method while Dry matter, Crude fiber, Ash content, Calcium and Phosphorus were respectively determined using dry oven method, calcination method, combustion method, titration method and colorimetric method.

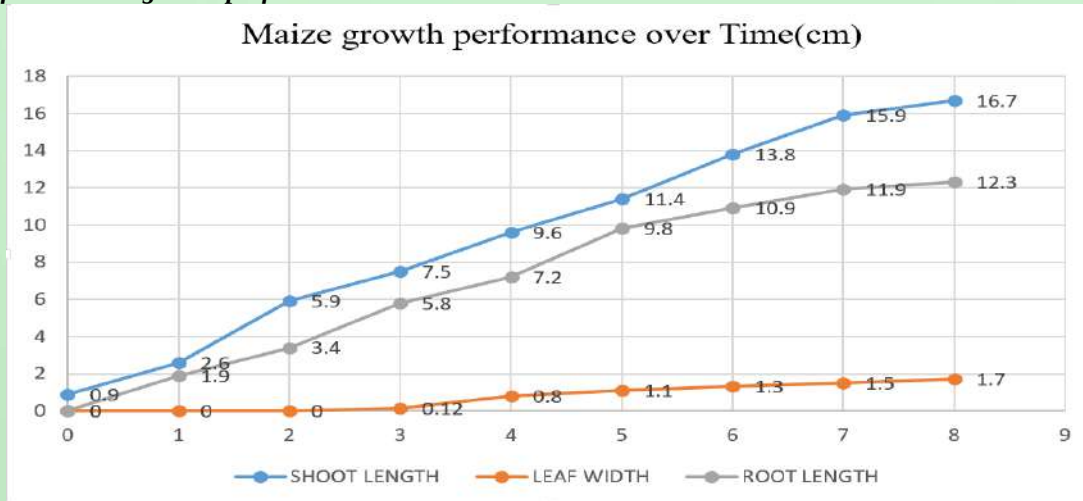
Data analysis

Collected data were recorded into Microsoft Excel, then imported into Statistical Package for Social Sciences Version 26 (SPSS, 26) for further analysis.

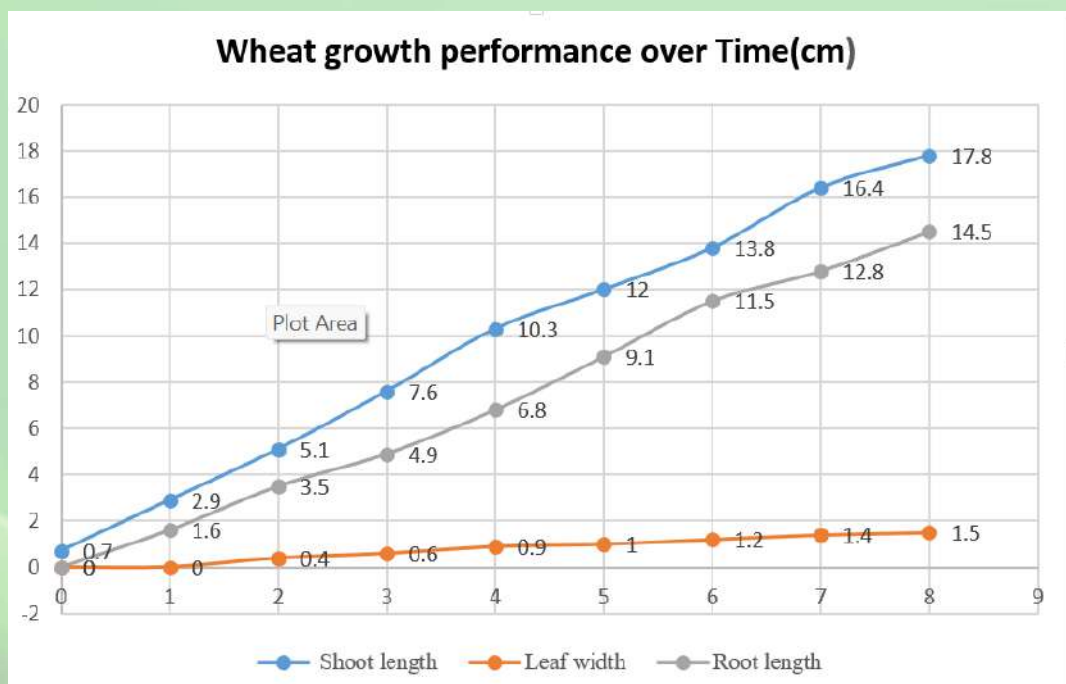


Results

Proliferation and growth performance



The present study demonstrated growth performance of maize plants in a hydroponic setting. In 8-day period a robust development was noticed across shoot length, leaf width, and root length of hydroponically cultivated maize plants (Figure 1). Beginning with a shoot length of 0.9 cm on day 0, the plants showed consistent and significant growth, reaching 16.7 cm by day 8. A noticeable development in leaf width was observed from day 3 onwards, achieving 1.7 cm by day 8. Root length displayed a continuous growth from 0 cm at day 0 to 12.3 cm by day 8.



This study demonstrated that the growth performance of wheat hydroponic fodder over 8 day's period exhibit strong development across shoot length, leaf width, and root length. The shoot length initially was 0.7 cm on day 0 reached 17.8 cm by day 8. The leaf width of 0.4 cm was noticed on the day 2, achieving 1.5 cm by day 8. The root length showed a continuous progression from 0 cm on day 0 to 14.5 cm by day 8.

Nutritional composition of produced fodder

The present study determined the nutritional profile of hydroponically produced maize and wheat (Table 1). The dry matter content was 19.30% for maize and 12.84% for wheat. The higher proportion of protein and crude fiber of respectively of 14.69% and 14.50% were observed in wheat. Other important nutrients observed were calcium observed at a rate of 0.08% for maize and 0.17% for wheat, and phosphorus observed at 0.10% for maize and 0.35% for wheat.



Grain	Parameters						
	Dry matter (%)	Crude protein (%)	Crude fiber (%)	Ash content (%)	Calcium (%)	Phosphorus (%)	
Maize	19.30	12.00	4.97	2.22	0.08	0.10	
wheat	12.84	14.69	14.50	2.12	0.17	0.35	

Discussion

In the present study, normal water and affordable locally available materials were used to produce hydroponic fodder in a plastic sheet based infrastructure. Results of the study showed that the maize and wheat fodder with lush vegetation can be produced in 8 days from planting to harvest using hydroponic technique. A total of 6 and 7 kg of hydroponics was produced respectively on wheat and maize. Results from this study are not far from findings reported by Kide *et al.*, 2015 in Dapoli where from one kg of Maize, the hydroponic fodder produced under green shed infrastructure and tap water was 6.75 kg at day 6, 7.47 kg at day 7 and 8 kg at day 8. The shoot length has grown from 2.6 cm at day 1 ; 9.6 cm at day 4 and 16.7 cm at day eight for maize. For wheat, shoot had a length of 5.1 cm at day 2; 10.3 cm at day 4 and 17.8 cm at day 8. The shoot length indicated by the findings of this study is slightly small when compared to the findings of the study conducted in Tamil by Jolad *et al.*, 2018 in which for maize, the shoot length was 3.17cm, 10.08 cm and 25.12 cm while were 2.21 cm, 6.93 cm and 18.40 cm observed in wheat respectively at day 2, day 4 and day 8. In Nepal, Upreti *et al.*, 2022 reported a plant height of 21.77 cm for maize and 25.03 cm for wheat at day 8. This disparity might be attributed to difference in growing conditions as reported by Khatri *et al.*, 2024 present study indicated that under hydroponic fodder cultivation, wheat grow well compared to maize.

Nutritional analysis revealed that hydroponic maize contains 19.30% Dry matter, 12.00% Crude Protein, 4.97% Crude Fiber, 0.08% Calcium and 0.10% Phosphorus. On the other hand, hydroponically produced wheat contains 12.84% Dry matter, 14.69% Crude Protein, 14.50% Crude Fiber, 0.17% Calcium and 0.35% Phosphorus. It is obvious that hydroponic fodder produced from wheat is nutritionally better than that from maize. This is in accordance with the study conducted by Upreti *et al.*, 2022 in which wheat produced good quality fodder compared to that produced from maize.

Conclusion and recommendations

The present study revealed that locally available materials are useful in production of nutrient rich hydroponic fodder that are necessary to feed livestock. Wheat demonstrated an optimum result in terms of proliferation and growth with a highly nutritious products than maize. To smallholder farmers it is strongly recommended to adopt this affordable mode of producing green fodder at a limited piece of land. To future researchers, beside studying the effect of produced hydroponic fodder on growth and survival rate of different livestock, it is strongly recommended to also emphasize on microbiological contamination of produced hydroponic fodder.

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Effects of Tree Species on Mental Wellbeing and Physical Health Conditions of Community Dwellers around Oluyole Forest Environment, Oyo State, Nigeria

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Abstract

This study assessed the effects of tree species on mental wellbeing and physical among community dwellers in the selected study area. A three-stage procedure was employed for sampling of the study with 1st stage being a purposive selection of 4 wards selected from 10 wards in Oluyole Municipality. The 2nd stage was systematic selection of houses from each ward and the 3rd stage was a random selection of 2 household heads from selected houses with a final sample size of 82 respondents. Structured questionnaires were used to obtain data for the study. Data was analysed with frequencies, percentages, Chi square, PPMC and linear regression. Majority of household heads were mostly male (72.0%), active age (67.6%), had tertiary education (61.0%), were indigene (64.6%) and about 46.3% practiced farming as major occupation. Different trees species were identified with most residents having benefited and agreeing to their impact on their health. The ethnicity ($\chi^2=5.109$) and land acquisition ($\chi^2=8.064$) had significant association with perceived impact of trees on residents' health at $\alpha_{0.05}$. In addition, age, marital status were extant factors that influenced the dependent variable. Policy instrument of government through incentives to residents' participation in conservation practices and clogging sharp practices of government officials would suffice for optimal benefits of community trees.

Keywords: Tree species, Physical and Mental stability, Community dwellers, Forest environment

Introduction

In recent time, the environmental challenges stem from destruction of the forest cover (Ritchie, 2021). The world's forest estates are under great pressure and many observers are concerned that without quick action for its rescue, it might be plunge into complete destruction (Wassie, 2020). The livelihood of people is premised on many resources including forest resources and man would always use forests for his habitation, source of protection, food security, medication as well as their environment (Shaikh et al., 2021). According to FAO (2010) the global rate of deforestation annually is about 13 million hectares, most of which took place in the under-developed countries and a large amount of forests are plundered exposing land excessive use due its dependence for urbanisation and industrialisation. The Food and Agriculture Organisation listed the requirement of sustainable forest management as utilization of resources, reforestation, afforestation and a legal policy and institutional framework. FAO (2005) reposed that the survival of people is associated with their dependency on forest ecosystem and resources, and anything short of that is detrimental to their wellbeing. *When there is high level of deforestation, temperature rises and rainfall reduces culminating into widespread desertification in certain regions of Nigeria with its attendant effects on the public health status of many people* (Nwokocha, 2015). In the same vein, Igu (2017) reposed that the deficit of wood in Niger Delta Nigeria resulted from the loss of forest ecosystem which invariably creates direct ultraviolet ray causing various health conditions for the inhabitants residing in the region.

Chukwu & Bada (2019) submitted that a typical challenge the world is facing now is loss of forests through deforestation which has resulted in deprivation of man's means of livelihood. *All over the globe, many people now suffer from the destructive process that deprives them of the benefits from the natural resources on which they have always sustained their livelihood* FAO (2005). At the same time, a new forest management model should be adopted that will ensure the conservation of these forest ecosystems (Babalola, 2009). In this respect, it is important to note that in most countries of the world, there are many examples of appropriate forest management in which environmental sustainable utilisation is assured among benefiting local communities. According to World Health Organisation (2017) *determinants of individual's health are social and economic status, the environment, social circumstances, personal behavior and lack of social security*. Further, the basic factors that could influence man's health stability are income, improved social status, education, social environment, physical environment and coping strategies (WHO, 2017).

Past studies have delve into ethno-medicinal use of forest trees for treatment of various health challenges, preventive and curative measures using herbal treatment, yet health challenges are still on the increase, most



especially nasal congestion, cold and catarrh, and other respiratory diseases. However, there is dearth of findings on preventive significance of trees either in the forest rural communities or in the urban centers where people reside as compared with the curative methodologies arising from the utilisation of trees parts such as leaves, twigs, barks or roots. According to Yilmaz *et al.* (2018) plant trees improve the aesthetic quality of the environment, thereby contribute to the aesthetic values of the environment like playing important roles in the ecosystems by providing canopy effect, enhances the water vapor of the environment through evapotranspiration process, helps air pollutant reduction and carbon emission reduction, enables storage structure heating and cooling cost reduction. Although, trees and vegetation are germane parts of the environment both built and unbuilt as enunciated above for many purposes like pollution control, energy conservation, storm water mitigation and management, education, ethno-medicine, and many more, however the presence of trees itself could be an asset to furnish and contribute to human health. It is against this backdrop that this study assessed the perceived impact of community trees on residents' physical health and mental wellbeing in Oluyole forest community, Oyo State, Nigeria. The specific objectives of the study were to examine the personal characteristics of respondents; identify the type of tree species; examine benefits of community trees; examine factors influencing impact of community trees on residents' health; and assess perception of impact of trees on residents' health.

Materials And Methods

Description of the Study Area

Oluyole forest communities of Oluyole Municipality, Ibadan, Oyo State was selected as the study site to conduct the research. The municipal area has its headquarters situated at Idi-Ayure town. It was established in 1976 and occupied 4000Km². The population of the municipal area is 202,725 people according to 2006 Census in Nigeria. It has geographical coordinates of 7°13'59.99" North and 3°52'0.01 East. The municipal area comprises 10 wards which are divided into two sections. The Idi-Ayunre section and Olode section respectively. The wards in Idi-Ayunre section are Orita/Odo Ona Elewe, Odo-Ona Nla/Idi-Ayunre, Abanla, Olonde, Onipe/Busogboro and Orisunbare, while the wards in Olode section are Ayegun, Pegba/ Egbeda Tuba, Muslim/Ifelodun, Latunde and Olomi/ Olunde. The available natural resources of the council include land, water, forest, and agricultural products such as cocoa, coffee, kolanuts, cashew, teak, poultry products and so on.

Sampling Procedure and Sample Size

A multistage sampling procedure was used for the conduct of the study. Firstly, a purposive selection of 4 wards with concentration of trees from 10 wards in Oluyole municipal area which were Odo- Ona Nla/ Idi Ayunre; Abanla/ Olonde, Onipe /Busogboro; and Orisunbare was conducted. The 2nd stage was the systematic selection of houses in each ward and in all the selected of houses in the wards, multiple houses were selected as follows, Odo-Ona/Idi-Ayunre, 15 houses; Abanla/Olonde, 12 houses; Onipe/Busogboro, 8 houses, and Orisunbare, 6 houses. In the 3rd stage, 2 household heads from the selected houses were selected with a simple random sampling to arrive at 82 respondents as the study sample size. Data was collected with the aid of structured questionnaire. Analysis of data was conducted with frequencies, percentages whereas hypotheses were tested with Chi square, Pearson product moment correlation and linear regression.

Model Specification for linear regression was stated as:

$$Y = B_0 + B_1 X_1 + B_2 X_2 + B_3 X_3 + B_4 X_4 + B_5 X_5 + B_6 X_6 + B_7 X_7 + \mu \quad (1)$$

Where:

Y is the predicted perceived impact of community trees on health and mental wellbeing

B₀ is the intercept, the predicted value of Y when X is 0.

X₁..... X₇ are the independent variables expected to influence Y.

μ is the error of the estimate or how much the variation there is in estimate of regression coefficient.

Results And Discussion

Socio-Economic Characteristic of the Respondents

Table 1 presented the distribution of residents' socio-economic characteristics in Oluyole Forest Environment, Oyo State. This revealed the parameters of population of study in the study area. The Table showed the distribution of respondents' sex with 72.0% of them being male and female (32.0%). This was followed by respondents' age where the majority were in the age bracket of 21-30 (38.8%) and aged 31-40 (28.8%). Furthermore, the Table showed that about 55.0% of respondents were married, with 61.0% of them having tertiary education. In addition, about 65.0% were indigene of the studied area. The distribution of the respondents' major occupation revealed 46.3% were practicing farming while 26.8% were artisans. Also, about 57.0% possessed farm size of 1-5 hectares.



Other distributions; Yoruba (56.0%), 1-10 years of experience (35.0%), and about 40.0% of them had land acquisition through inheritance. The result in Table 1 shows that majority of respondents (72.0%) were male. This indicates that men play a major role as the head of families and are more committed to agricultural activities in the study area. This result corroborates the submission of Philips and Ceesay (2020) that the people that depend on forest trees for their survival are male dominated especially in Ijaiye Forest of Nigeria. The result revealed that 38.8% of the respondents was within the age bracket 21-30 years followed by those aged 31-40 (28.8%). This implies that most of the respondents were still in their active and productive age. Further, it was revealed that 54.9% of the respondents were married and this indicate that marriage confers some level commitments and social responsibility which portends that residents are matured and had versatility. Furthermore, Table 1 showed that 48.8% of respondents practices Islam as religion, follow by Christian (46.3%), while the least (4.9%) are traditional worshipers. This indicates that Islam and Christian worshipers were dominants religious practices because community trees enhance shelter for worship sites during special programs and festivities in the study area. It was also revealed that most residents (61.0%) had tertiary education. This implies that most residents in the study area were literate which usually increases their ability to adopt innovations. This agrees with the findings of Oladele *et al.* (2020) that most of the respondents were educated in the rural areas as against the belief system of many people. In addition, most respondents (64.6%) were indigene while 35.4% were non-indigene which indicates a heterogeneous population of the study area. Also, 46.3% of the respondents prioritized farming as their major occupation.

Types of Trees Identified

Table 2 presented the types of trees identified in Oluyole Forest Environment, Oyo State. The list of the tree species common names and their scientific name are shown in the Table below. The Table showed the distribution of available tree species with *Adamsonia digitata* (76.8%), *Azadirachta indica* (79.3%), *Ceiba petandra* (84.1%), *Etanda Africana* (100.0%), and *Magnifera indica* (79.3%) which are much more pronounced in the studied area. However, there are presence of other trees in the studied area. The results in Table 2 showed the types of trees identified in the study area. It was revealed that majority of the respondents (76.8%) identified the availability of *Adamsonia digitata* in their environment. The Table also revealed that 79.3% of residents identified *Azadirata indica* in their area. Furthermore, the results showed that 75.6% of the respondents signified having a matured *Angeissus leiocarpa* in their compound. The Table further showed that 68.3% of respondents planted *Butyrospemum paradoxa* in their environment. The respondents (84.1%) had *Ceiba pentandra* within their environment. The result showed that *Diospyros mespiliformis* was planted by 62.2% of residents in the study area. It was also observed that (100.0%) of the respondent planted *Entada africana*. This indicates that most trees identified were very popular trees in the study area. Furthermore, the study showed that these trees were in abundance in the study area because most of them are indigenous trees. This implies that residents would not stress themselves in searching for nursery to buy seedlings. It was also gathered from the residents that most of these trees grew naturally with little or no supervision, and the residents just need to conserve and be custodian the community trees in the study area.

Factor Influencing Perceived Effect of Community Trees

Table 3 presented factors that may influence perceived effects of trees on community dwellers in Oluyole Forest Environment, Oyo State. The Table showed the distribution of the pronounced factors which influenced perceived impact of community trees, and these are access of people to community trees (68.3%), sustainable management of trees (70.7%), readiness to engage in tree planting and its maintenance (65.9%), rampant illegal felling (72.0%) and so on. The result in Table 3 revealed the factors influencing the impact of community trees on resident' health. Table 3 showed that most residents (68.3%) had access to community trees in their environment. This implies that the residents are having free access to trees in their community. Furthermore, the majority (70.7%) revealed that proper and sustainable management is an important factor that influence the impact of community trees on resident health. The result also signified that 58.5% of respondents' social interactions enhance the impact of trees on their health. This implies that social interaction among residents with community tree is one of the major factor that influence the effect of community trees on resident' health. Further, it was observed that 65.9% of respondent were ready to engage in tree planting and maintenance of existing forest trees in their environment. The result revealed that 67.1% of respondents were ready to fund tree planting and private forest ownership. This indicates that most residents were ready to support and establish private forest as a long term business project and for the betterment of the society. The study showed that some residents (29.3%) agreed that trees do not have any benefits but just standing there, whereas 70.7% of respondents identified trees as being beneficial to man. It was observed that 40.2% believed that trees is only useful for fuel wood only. This result implies that majority of the residents know that trees have many benefits on their health apart from using it as fuel wood. The study revealed that 72.0% of residents signified illegal felling of trees as rampant in the study area. Lastly private forest ownership was encouraged among most residents (67.1%) in the study area.



Table 1: Socio-Economic Characteristics of the Respondents

Socio-Economic Variables	Frequencies	Percentages
Sex		
Male	59	72.0
Female	23	28.0
Age		
21-30	32	38.8
31-40	23	28.8
41-50	15	18.2
51-60	11	13.4
60 and Above	1	1.2
Marital status		
Single	31	37.8
Married	45	54.9
Divorced	4	4.9
Widow (er)	2	2.4
Religion		
Islam	40	48.8
Christianity	38	46.3
Traditional worship	4	4.9
Education		
Non-Formal Education	2	2.4
Primary	11	13.4
Secondary	19	23.2
Tertiary	50	61.0
Nativity		
Indigene	53	64.6
Non-Indigene	29	35.4
Major Occupation		
Farmers	38	46.3
Artisans	22	26.8
Loggers	6	7.3
Non-Timber Forest Products Collectors	10	12.2
Hunters	1	1.2
Others	5	6.1
Farm Size (ha)		
1-5	47	57.3
6-10	22	26.8
11-15	10	12.2
16 and Above	3	3.7
Ethnicity		
Yoruba	46	56.1
Igbo	17	20.7
Fulani	15	18.3
Others	4	4.9
Source of Land Acquisition		
Lease	18	22.0
Inheritance	33	40.2
Purchase	18	22.0
Rent	13	15.8
Years of Residence		
1-10	29	35.4
11-20	21	25.6
21-30	15	18.3
30 and Above	17	20.7
Secondary Occupation		
Trading	44	53.7
Food Vendor	11	13.4
Civil Servants	17	20.7
Others	10	12.2

Source: Field survey, 2023



Table 2: Types of Trees Identified in the Study Area

Tree species (Scientific Name)	Common Name	Yes	No
<i>Adamsonia digitata</i>	Baobab tree	63 (76.8)	23 (28.2)
<i>Azadirachta indica</i>	Neem tree	65 (79.3)	17 (20.7)
<i>Angeissus leiocarpa</i>	African birch	62 (75.6)	20 (24.4)
<i>Butyrospermum paradoxa</i>	Shea tree	56 (68.3)	26 (31.7)
<i>Ceiba petandra</i>	Silk cotton tree	69 (84.1)	13 (15.9)
<i>Diospyros mespiliformis</i>	Jackal berry	51 (62.2)	31 (37.8)
<i>Entada africana</i>	African dream herb	82 (100.0)	0 (0.0)
<i>Eucalyptus camaldulensis</i>	River red gum tree	52 (63.4)	30 (36.6)
<i>Fiscus glumosa</i>	Mountain tree	48 (58.5)	34 (41.5)
<i>Magnifera indica</i>	Mango tree	65 (79.3)	17 (20.7)

Note: Percentage in Parentheses; Source: Field survey, 2023

Table 3: Factors Influencing Perceived Impact of Community Trees

Factors Influencing Perceived Impact of Community Trees	Yes	No
Access to community trees around the resident habitation	56 (68.3)	26 (31.7)
Proper and sustainable management of forest trees	58 (70.7)	24 (29.3)
Social interaction among residents with community trees	48 (58.5)	34 (41.5)
Readiness to engage in tree planting and its maintenance	54 (65.9)	28 (34.1)
Readiness to fund tree planting and start private forest ownership	55 (67.1)	27 (32.9)
It has no value of benefit just standing there	24 (29.3)	58 (70.7)
It is useful for fuel wood only	33 (40.2)	49 (59.8)
Illegal felling is rampant in my area	59 (72.0)	23 (28.0)
Private forest ownership is encouraged among the residents	55 (67.1)	27 (32.9)

Note: Percentage in Parentheses; Source: Field survey, 2023

Benefits of Community Trees to Residents

Table 4 presented the benefits of trees to residents' physical health and mental wellbeing in Oluyole Forest Environment, Oyo State. This Table shows the benefits derivable from trees in the studied communities. The Table showed the distribution had more of moderate derivable benefits of community trees such as cleansing by trees intercept particulate materials (69.5%), reduction of emotional and psychological stress (67.1%), improve cardiovascular function (62.2%), reduction in effect of ultraviolet radiation (URV) (67.1%) and so on. The result in Table 4 revealed most people in the study area moderately benefited in the management of community trees. The majority of residents (69.5%) moderately benefited and agreed that cleansing by trees intercept particulate materials, followed by 67.1% who optimally benefited in the values trees serve as reducing agent of emotional and psychological stress and enhancing reduction of ultraviolet radiation (URV). Thus the level at which residents benefited whether high or moderate was spellbinding. This may be as a results of the fact that most of our ancestors over the decades had lived in villages and from generation to generation have enjoyed the benefits of community trees and thereby more committed to its physical utilisation. This results however corroborates the findings of Seif *et al.* (2021) who stated that most rural communities actively benefited from the physical presence of community trees and their proper conservation management.

Perceived Effects of Trees on Residents' Mental Wellbeing and Physical Health

Table 5 presented the perceived effects of trees on Dwellers' mental and physical wellbeing in Oluyole Forest Environment, Oyo State. The distribution showed that most residents' perception of trees towards health were positive. It revealed respondents' favourable attitude towards spending time around the trees reduces stress and lower blood pressure (76.8%), the presence of trees would contribute greatly to their health (76.0%). About 72.0% of respondents had favourable attitude towards trees in making them feel comfortable and relaxed while few residents agreed that trees make them enjoy serenity and tranquility in their environment (12.2%). Result in Table 5 revealed that perceived effects of community trees on residents' health. The result showed that most residents' perception of trees towards health was highly positive. It was revealed that most residents (76.8%) signified that spending time around the trees reduces stress, lower blood pressure and mood, followed by 76.0% who professed that the presence of trees would contribute greatly to their health. About 72.0% of respondents also strongly agreed that trees make them feel comfortable and relaxed whereas the least 12.2% of residents signified the health impacts of trees that trees make them enjoy serenity and tranquility in their environment. The result corroborates the findings of Turner-Skoff & Cavender (2019) who reposed that trees enhance health and social wellbeing by cleansing and detoxifying air pollution, reduce stress and support physical activities as well as enforcing strong family ties with relatives and friends.



Table 4: Benefits of Community Trees to Residents' Physical Health and Mental Wellbeing

Benefits of Trees	High	Moderate
Cleansing by trees intercept particulate materials	25 (30.5)	57 (69.5)
Absorption of pollutant gasses into inner leaf surfaces	35 (42.7)	47 (57.3)
Removal nitrogen dioxide, sulphureIVoxide and carbon monoxide from industries	29 (35.4)	53 (64.6)
Removal of organic pollutants from indoor air	33 (40.2)	49 (59.8)
Reduction of emotional and psychological stress	27 (32.9)	55 (67.1)
Presence of trees help individuals with stress and depression to recuperate faster.	30 (36.6)	52 (63.4)
Reduction of air pollutant and respiratory condition	35 (42.7)	47 (57.3)
Reduction of excess heat and thermal discomfort	34 (41.5)	48 (58.5)
Improve cardiovascular function	31 (37.8)	51 (62.2)
Improve immune system	38 (46.3)	44 (53.7)
Improve cognition and attention	37 (45.1)	45 (54.9)
Improve active living	33 (40.2)	49 (59.8)
Reduction in effect of ultraviolet radiation (URV)	27 (32.9)	55 (67.1)
Improve social cohesion and interaction	32 (39.0)	50 (61.0)

Note: Percentage in Parentheses; Source: Field survey, 2023

Table 5: Respondents' Perceived Effect of Trees on Mental and Physical Wellbeing

Perceived Effect of Trees	Strongly Agreed	Agreed
Trees give feeling of comfort and relaxation	59 (72.0)	23 (28.0)
Trees give serenity and tranquility in my environment	72 (87.8)	10 (12.2)
Presence of trees improve physical health and mental wellbeing	63 (76.8)	19 (23.2)
Presence of trees help in maintaining mental stability	58 (70.7)	24 (29.3)
Exposure to trees help lessen stress and relieve unnecessary tension	51 (62.2)	31 (37.8)
Spending time around trees sharpens mental articulation in handling family issues	37 (45.1)	45 (54.9)
Exposure to trees helps the body immune system and respiratory system	36 (43.9)	46 (56.1)
Relaxing in the trees estate enhances mental focus and meditation	51 (62.2)	31 (37.8)
Spending time around trees reduces stress and lower blood pressure	63 (76.8)	19 (23.2)
Trees have potential to absorb pollutant gasses in the environment	54 (65.9)	28 (34.1)
Trees provide a nutrition security for the inhabitants around them	55 (67.1)	27 (32.9)
Trees enhance a quick recovery from illness for their inhabitants	58 (70.7)	24 (29.3)

Note: Percentage in Parentheses; Source: Field survey, 2023

Hypotheses Testing

The Table presented summary of Chi-square analysis of relationship between respondents' socio-economic characteristics and perceived impact of trees on their physical health and mental wellbeing: sex ($p=0.76$), marital status ($p=0.68$), religion ($p=0.24$), education ($p=0.07$), nativity ($p=0.85$), occupation ($p=0.40$), and family size ($p=0.15$) had no significant relationship with perceived impact of trees on their physical health and mental wellbeing, while ethnicity ($p=0.05$) and land acquisition ($p=0.00$) had related with perceived impact of trees on their physical health and mental wellbeing. Result in Table 6 showed there was no significant relationship between each of sex ($\chi^2=0.09$, $p=0.76$), marital status ($\chi^2=1.473$, $p=0.68$), Religion ($\chi^2=2.139$, $p=0.24$), education ($\chi^2=7.164$, $p=0.07$) and nativity ($\chi^2=0.035$, $p=0.85$). This implies that respondents' education, Sex, marital status, education and religion do not have significant association with perceived impact of trees on residents' health. However, significant association existed between ethnicity ($\chi^2=5.109$, $p=0.05$) and land acquisition ($\chi^2=8.064$, $p=0.00$), and perceived impact of trees on residents' health. This result indicates that ethnicity in community confers presence of indigenous people and the presence of other migrants that value trees and understand the beneficial impact of community trees on the health condition of the people.

The Table presented summary of pearson product moment correlation of identified types of trees with respondents' physical health and mental wellbeing in the studied area ($r=0.259$, $p=0.19$). Result in Table 7 showed there was no significant relationship between identified type of trees and the perceived impact of trees on residents' health (r -value = 0.259, $p=0.19$). This indicates that identified types of trees do necessarily contribute to the health condition of residents especially if the people do not value and recognize the importance of trees in their environment.



Health and Mental Wellbeing

The Table presented summary of pearson product moment correlation of identified benefits of trees with respondents' physical health and mental wellbeing in the studied area ($r = 0.311$, $p = 0.004$). Further, result in Table 8 showed there was significant relationship between benefits of trees and the perceived impact of trees on residents' health in the study area. ($r = 0.311$, $p = 0.004$). This implies that benefits of trees are embraced by the residents which ultimately contribute to the health condition of residents of Oluyole forest environment.

The Table presented summary regression analysis of extant factors on residents' physical health and mental wellbeing in the studied area. This was revealed as age ($\beta = -0.323$, $p = 0.03^*$), marital status ($\beta = 0.273$, $p = 0.05^*$) and benefits of trees ($\beta = 0.314$ $p = 0.004^*$). The result of regression analysis in Table 9 revealed age ($\beta = -0.323$, $p = 0.03$), marital status ($\beta = 0.273$, $p = 0.05$) and benefits of trees ($\beta = 0.314$ $p = 0.004$) significantly influence perceived impact of trees on residents' physical health and mental wellbeing at $\alpha = 0.05$. This result implies that age, marital status and benefits of trees were major extant factors which significantly contribute to perceived impact of trees on residents' health which confers that age and marital status bring about commitment of the people to bare on importance of trees to the wellbeing and survival of the people while benefits of trees showcased the reason for its embrace and utilisation in Oluyole forest environment.

Table 6: Chi-square Analysis of Relationship between Socio-Economic Characteristics of the Respondents and Perceived Impact of Trees on Residents' Physical Health and Mental Wellbeing

Socio-Economic Variables	χ^2 -value	p-value	Decision
Sex	0.089	0.76	Not significant
Marital Status	1.473	0.68	Not significant
Religion	2.139	0.24	Not significant
Education	7.164	0.07	Not Significant
Nativity	0.035	0.85	Not significant
Occupation	5.109	0.40	Not Significant
Ethnicity	8.064	0.05	Significant
Land acquisition	29.456	0.00	Significant
Family size	3.752	0.15	Not significant

Source: Field survey, 2023

Table 7: PPMC Analysis of Relationship between Identified Type of Trees and Respondents' Physical

Variable	r-value	p-value	Decision
Identified Trees	0.259	0.19	Not Significant

Source: Field survey, 2023

Table 8: PPMC Analysis of Relationship between Benefits of Trees and Respondents' Physical Health and Mental Wellbeing

Variable	r-value	p-value	Decision
Benefits of Trees	0.311	0.004	Significant

Source: Field survey, 2023

Table 9: Regression Analysis of Extant Factors between Benefits of Trees and Perceived Impact of Trees on Residents' Physical Health and Mental Wellbeing

Model	Unstandardized Coefficients		Standardized Coefficients	t-value	Sig.
Parameters	Beta	Std. Error	Beta		
(Constant)Sex	1.398 -.026	.529 .116	-.025	2.641 -.228	.01.82
Age	-.013	.006	-.323	-2.186	.03*
Marital status	.197	.100	.273	1.980	.05*
Educational status	.077	.072	.130	1.073	.29
Nativity	-.023	.112	-.023	-.208	.84
Major occupation	-.057	.036	-.171	-1.577	.12
Farm size	-.093	.064	-.161	-1.452	.15
Ethnicity	.100	.060	.193	1.666	.10
Source of farm land acquisition	.073	.054	.149	1.343	.18
Years of residence in the environment	-.058	.051	-.137	-1.130	.26
Type of trees identified	-.126	.076	-.182	-1.659	.10
Benefits of trees	.223	.075	.314	2.961	.004*

Source: Field survey, 2023



Conclusion

In conclusion, the study showed that most household heads were male with most residents being active and productive in age. It was also observed that majority of residents identified *Adamsonia digitata*, *Azadirata indica* in their environment. Furthermore, most respondents signified that proper and sustainable management of community trees as being a vital factor that influences the impact of trees on residents' health. Based on the conclusion of this study, the following recommendations are established. The government should incentivise conservation of trees in communities in Nigeria. In addition, government should stop sharp practices among its officers and forest contractors with strong punitive measures. Further, agencies of government on environmental protection and development should educate citizens on the health benefits of trees from eco-friendly practices in both rural and urban centres. Finally, enforcement of extant laws should be enacted to stop illegal destruct of the forest estates and open grown trees in communities all over Nigeria.

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Common Skeletal Problems In Broiler Breeding And Solution Suggestions

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Abstract

A high portion of the protein need in human nutrition is met by white meat production. It is preferred for reasons such as high red meat prices, low fat level, easy access to white meat and cheap prices. A large part of white meat production is met by broiler chicken breeding which is grown intensively. As a result of intensive selection and genetic studies in commercial broiler breeding, hybrids with a slaughter weight of 42 days and 2500 g slaughter weight were obtained. As a result of this selection made as a result of various needs, the desired yield level has been achieved and rapid growth has been achieved in chickens due to intensive feeding. As a result of rapid growth, problems such as foot problems, feed eating disorder, gait disorder, difficulty in meeting water requirements are encountered in broilers. The most common problem encountered in foot problems is TD, Valgus-varus deformation. As a result of these problems, conditions such as decrease in carcass quality, decrease in live weight loss and decrease in welfare level are observed. This study focuses on the skeletal structure and the problems that arise due to intensive feeding, its effect on health protection, its effect on stress factors, and aims to contribute to the industry and the research that can be done by utilizing the important findings obtained from the existing literature and these findings.

Keywords: *Skeleton, Tibia, Valgus-varus, carcass quality, Broiler Chicken*

Etlik Piliç Yetiştiriciliğinde Sık Görülen İskelet Problemleri Ve Çözüm Önerileri

Özet

İnsan beslenmesinde protein ihtiyacının yüksek bir bölümünü beyaz et üretimi ile giderilmektedir. Kırmızı et fiyatlarının yüksek olması, yağ seviyesinin düşük olması, beyaz ete ulaşımının kolay olması ve fiyatının ucuz olması gibi nedenlerle tercih edilmektedir. Beyaz et üretiminin büyük bir kısmını entansif olarak yetiştirilen etlik piliç yetiştiriciliğiyle karşılanmaktadır. Ticari Etlik Piliç yetiştiriciliğinde yoğun seleksiyon ve genetik çalışmalar sonucunda 42 günde kesim ağırlığına ve 2500 gr kesim ağırlığına sahip hibritler elde edilmiştir. Çeşitli ihtiyaçlar sonucunda yapılan bu seleksiyon sonucunda istenilen verim düzeyine ulaşılmış olup yoğun beslemeye bağlı piliçler hızlı büyüme elde edilmiştir. Hızlı büyümenin sonucunda piliçlerde ayak problemleri, yem yeme bozukluğu, yürüme bozukluğu, su gereksinimini gidermede zorluk çekme gibi problemler ile karşılaşmaktadır. Ayak problemlerinde en sık karşılaşılan sorun ise TD, Valgus-varus deformasyonudur. Bu problemler neticesinde karkas kalitesinde azalma, canlı ağırlık kaybında düşme, refah seviyesinin düşmesi gibi durumlar görülmektedir. Bu çalışmada iskelet yapısı ve verilen yoğun yemlemeye bağlı olarak ortaya çıkan problemleri, sağlık korumaya etkisi, stres faktörü ile etkisi üzerine odaklanılarak, mevcut literatürden elde edilen önemli bulguları ve bu bulgulardan yararlanılarak endüstri koluna etkisi ve yapılabilecek araştırmalar için katkıda bulunmayı amaçlar.

Anahtar Kelimeler: *İskelet, Tibia, Valgus-varus, karkas kalitesi, Etlik Piliç*

Giriş

Etlik piliçlere daha kısa sürede, hızlı ve daha fazla et üretimi amacıyla yoğun seleksiyon programları uygulanmış ve bunun sonucunda hibrit türler elde edilmiştir. Broiler yetiştiriciliğinde genetik çalışmalar sonucunda elde edilen yeni ırklar veya hatlar sayesinde hem yetiştirme süresi kısalmış hem de yem ve diğer maliyetler kısmen azalmıştır. Yoğun seleksiyon çalışmaları ile etlik piliçlere yoğun besleme programları uygulanmış, genetik parametreler ve yoğun besleme sonucunda bacak kasların ve iskelet sisteminin gelişiminin aynı doğrultuda olmaması ve bu durumun sonucunda ayakların vücudu taşıyamaması gibi tanımlanabilen bazı problemler ortaya çıkmıştır. Etlik piliçlerin ayak kemiklerinde yaygın olarak ortaya çıkan iskelet problemleri ile göğüs kası bölgesinde yoğun şekilde görülen kas problemleri piliç etinin kalitesini negatif olarak etkileyerek, karkas kalitesini düşürmektedir (Petracci ve ark., 2014; Sözcü ve Koyuncu, 2015). Hızlı büyümeye bağlı olarak etlik piliçlerde refah seviyesinin değerlendirilmesi uygulamalarında, iskelet sistemi bozuklukları ve bacak sağlığı sorunları ile farklı korku ve stres parametreleri de kriter olarak ele alınmaktadır (Karaarslan, 2015, s. 5). Etlik piliç yetiştiriciliğinde görülen iskelet



problemleri ölüme ve piliçlerin kötü sınıflandırılmasına yol açan sorunların başında gelmektedir. İskelete bağlı ayak hastalığı kemik dokusunun histolojik yapısının tamamen gelişim göstermemesi yada meydana gelen hücresel bozulmaları sonucunda oluştuğu belirtilmektedir(Köseoğlu ve İmİK, 2022). Etlik piliçlerde hızlı kas gelişmesine bağlı olarak tibial diskondroplazi (TD), valgus-varus deformasyonu (VVD), osteodistrofi ve femur başı nekrozu gibi iskelet problemleri de meydana gelmektedir.(Sarı ve Saatcı,2020)

Tibial Dyschondroplasia

Tibial diskondroplazi hastalığı araştırmacılar Leach ve Nesham tarafından ilk kez 1965’ de, “tibiatarsus ve tarsometatarsus’un proksimal metafizlerinde oluşumu tamamen bitmemiş kondrositlerin birikmesiyle belirlenen anormal kırıkardaki gelişimi” olarak ifade etmişlerdir(Leach ve Nesheim, 1965, s. 236; Deniz, 2000). Etlik piliçlerde en yaygın görülen iskelet bozukluğu Tibial dyschondroplasia’dır (TD). TD’nin hindi ve etlik piliçlerde yumurtacılara göre daha yaygın olması bu probleme büyüme hızı ve vücut ağırlığının sebep olduğunu düşüncesini akla getirmektedir. Etlik piliçlerde büyüme dönemlerinde yoğun besleme sonucu canlı ağırlığın hızlı şekilde artması sonucu bu problemler sık görülmektedir. İlk haftalarda verilen yemlerde enerji kısıtlamasının TD’yi yarı yarıya azalttığı, rasyondaki protein kısıtlamasının ise çok az etkisi olduğu bildirilmektedir. 10-14 günlük yaştaki etlik piliçlerde kısıtlı yemleme uygulamasının yapılması TD sorununu büyük ölçüde önlediği bildirilmiştir.(Praul ve ark.,2000; Deniz ve ark. 2000)

Birçok kanatlılarda ise Tibia kemiğinin baş bölümünde küçük lezyonlar halinde bulunduğu, bazı durumlarda tibia kemiğinin baş kısmını tamamen kapladığı, bazı durumlarda ise tibianın kırıldığı veya eğildiği bildirilmektedir(Karamüftüoğlu 1998; Praul ve ark.,2000). TD, etlik piliçlerde yürüme zorluğu meydana gelmesiyle hayvanın hareketsiz kalmasına, yeme ve suya ulaşımının güçleşmesine, hayvanın göğüs üzerine yatmasına ve göğüsün altlıkla uzun süre temas sonucu göğüste ödem ve amonyak yanığı şekillenmesine, canlı ağırlık kaybına ve karkas kalitesinin bozulmasına neden olabilmektedir (Karaarslan, 2015, s. 5). Piliçlerde tibial diskondroplazi lezyonu bulunup bulunmadığı nekropsisi yapılarak ya da röntgen çekilerek saptanabilmektedir (Sevim 1999; Karaarslan, 2015, s. 5).

Yapılan çalışmalarda TD oluşumunda cinsiyetin etkisine bakıldığında erkek piliçler dişi piliçlere oranla daha fazla görüldüğü sonucuna varmışlardır(Riddel,1975; Yalçın ve ark.,1996; Yalçın ve ark.,2000) Genetik faktörlerin etkilerine bakıldığında ise yavaş gelişen hibritlerde TD problemi hızlı gelişen hibritlere göre daha az görüldüğü çeşitli çalışmalarda saptanmıştır(Lilburn 1989; .

TD oluşumunu etkileyen faktörler; genetik yapı, genetik yatkınlığa bağlı büyüme hızı, hayvanın yaşı, cinsiyeti, beslenme düzeyi, anyon- katyon oranı, kalsiyum fosfor düzeyi, yerleşim sıklığı, aydınlatma süresi, bazı çevresel faktörler, çeşitli mikotoksinler ve vitaminler, elektrolit dengesizliği, rasyon proteini ve amino asitler gibi faktörlerin etkili olduğu bildirilmiştir(Rossellot ve ark.,1994; Riddell,1997; Deniz, 2000; Praul ve ark., 2000; Pines, 2005).

İskelet Gelişimi için Dikkate Alınması Gereken Hususlar

Rasyon Proteini ve Amino Asitleri: Fazla protein artan adrenal salgısıyla birlikte strese yol açmaktadır.

Proteince zengin rasyonlar folik asit metabolizmasını bozmakta ve bacak problemlerini arttırmaktadır.

Asit-Baz Dengesi: Klorun rasyondaki düzeyinin artırılması, TD riskini artırır. Kalsiyum oranının artması ise TD riskini azaltmıştır(Bond ve ark, 1991;Mert ve ark.,2007).

Hammaddeler: Bira mayasının bazı bacak problemlerini azalttığı bildirilmektedir. Soya küspesinde Cl düzeyinin artması bacak problemlerini artırıyor. Tripsin inhibitör düzeyi ile bacak kusurları arasında ilişki olduğu bildirilmiştir. Çavdarla besleme ile de bu problem artmaktadır. Ayrıca sorgum, kanola ve kolza küspesi de içerdikleri tanenin kollagen üretimini bozmak suretiyle bacak kusurlarına neden olduğu düşünülmektedir.

Mikotoksinler: Aflatoksin ve okrotoksin vitamin D3 metabolizmasını bozarak kemik sertliğini azaltmaktadır.)

Elektrolit Dengesizliği: TD ve vitamin D3 arasında önemli bir ilişki bulunmaktadır. Yüksek düzeydeki Klor seviyesi TD problemini artırır. Rasyonlarda Na⁺, K⁺ ve Clarasındaki elektrolit dengesi oldukça önemlidir.

Vitaminler: Vitamin D3 ve pridoksin özellikle kemik gelişiminde önemlidir. Fazla miktarda alınan vitamin A ve vitamin E kemik dengesini bozmaktadır.)

Minareller: Ca, P, Mg, Zn, Cu, Mn, Fe) Etlik piliçlerde kalsiyum ve fosfor oranının artışına paralel olarak tibia kemiği direncinin arttığını belirtilmiştir(Ruff ve Hughes, 1985; . Rasyonlardaki kalsiyum, fosfor ve kalsiyum fosfor oranının optimum seviyede verilmesi kemik gelişimini artırdığını bildirmişlerdir.

Genetik: TD cinsiyete bağlı bir genle de ilişkilendirilmektedir. Bu genin resesif olduğu bildirilmektedir.)

Valgus-Varus Deformasyonu

Tibia kemiğinin alt uç kısmının ortaya doğru sapmasına valgus deformasyonu, dışarı doğru sapmasına ise varus deformasyonu adı verilir(Julian,1984; Thorp,1994; . Valgus-varus deformasyonunun, hızlı büyümenin neden olduğu büyüme plağında vasküler yapının bozulmasından kaynaklandığı belirtilmiştir(Crespo ve Shivaprasad, 2008; Balcazar, 2010; Karaarslan, 2015). Valgus defromasyonu varus deformasyonuna göre etlik piliçlerde



görülme oranı daha yüksektir(Crespo ve Shivaprasad 2008; Karaarslan, 2015). Valgus deformasyonunun etlik piliçlerde iki haftadan itibaren görüldüğü ve bunun kesime kadar daha da yükseldiği, Varus deformasyonunun ise 5-15 günlük yaşlarda iken aniden görüldüğünü belirtmişlerdir.(Leterrier ve Nys, 1992).Bu deformasyonların nedenlerine bakıldığında beslenme, genetik yapı ve yatkınlık, hareket yetersizliği gibi durumlar etkilidir. Leterrier ve Nys(1992) ‘nin yaptıkları çalışmadan aktardıklarına göre civcivlerde serbest gezenlerin(%3) kafeste yetiştirilenlere(%11) göre bu deformasyonun görülme düzeyinin daha düşük seviyede olduğunu gözlemlemişlerdir.

Tartışma Ve Sonuç

Broilerde görülmesi en muhtemel ayak problemi femur başı nekrozu ve tibial dyschondroplasia (TD) dir. Etlik piliçlerde yüksek büyüme hızı ve canlı ağırlık, beslenmeye bağlı hastalıklar, yerleşim sıklığı görülen ayak problemlerinin nedenlerinin başında gelir. Etlik piliçlerde gerçekleşen ölümlerin %16,75’ini ayak problemlerine bağlı problemlerden kaynaklandığı belirtilmiştir(Mısırlıoğlu ve ark.,2001; Karaarslan,2015). Sürülerde ayak sağlığı ile problemler devamlı tekrarlanıyorsa müdahaleli büyüme programı uygulanabilir. Ross Breeders tarafında yapılan genetik seleksiyonlar sonucunda ayak sağlığında önemli oranda düzelme gözlenmiştir. Yapılan çalışmalar sonucunda kısıtlı aydınlatma programının Tibia diskomplazması görüldüğünü olumlu yönde azalttığını bildirmişlerdir(Karaarslan,2015; Sonotra ve ark.,2002). Erken dönemde kısıtlı aydınlatmanın uygulanmasının canlı ağırlık artışı azalttığı ve hastalığa yakalanma ihtimalide azalmış olmasından kaynaklanabileceği sonucuna varılmıştır. Valgus-varus deformasyonu ile ilgili literatürde az sayıda çalışmalar mevcuttur ve nedenleri hakkında kesin bir sonuca ulaşılması güçtür. Sason gibi yavaş gelişen etlik piliçlerin kullanımı büyüme hızının hızlı gelişen genotipler gibi hızlı değil daha dengeli olabileceği kanısıyla ayak problemlerinin görülme sıklığı daha az olabileceği yorumuna varılabilir.

Hastalık Adı	Belirtiler	Görülme Zamanı	Çözüm Önerileri
Tibial diskondroplazi	Hareketsizlik, yeme ve suya ulaşımının güçleşmesi, hayvanın göğüs üzerine uzun süre yatması sonucu göğüste ödem ve amonyak yanığı görülmesi	1. haftadan itibaren başlar ve 6. Haftaya kadar şiddetlenerek artar.	Beslemenin 2. Haftasında yem kısıtlamasının yapılması, anyon-katyon dengesinin sağlanması, kalsiyum-fosfor oranının optimal düzeyde olması, yerleşim sıklığının yeterli düzeyde ayarlanması, kısıtlı aydınlatma programının uygulanması, organik madde(mineral, vitamin,protein) içeriğinin uygun oranda olması
Valgus-Varus Deformasyonu	Hızlı büyümeye bağlı vasküler yapıda bozulma, hareketsizlik, genetik yatkınlık, beslenme düzeyi, topallık	Valgus deformasyonu; 2.hafta Varus deformasyonu; 1-2 hafta	

Yavaş ve hızlı gelişen etlik piliçlerde valgus-varus, tibial diskondroplazi problemlerinin görülmesi

Hibritler	Valgus(sol)	Valgus(sağ)	Varus(sol)	Varus(sağ)	Tibial Diskondroplazi
Yavaş Gelişen	18.93	19.97	1.89	3.27	1.03
Hızlı Gelişen	29.40	27.69	1.54	5.13	2.56

Shim ve ark., 2012)

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Ön Titanyum Dioksit Uygulamasının Şekerpancarı (*Beta Vulgaris* L) Genotipinde Tuz Stresi Altında Çimlenme Ve Fide Gelişimi Üzerine Etkisi

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Özet

Yapılan birçok araştırma sonucu abiyotik stres faktörleri içerisinde yer alan tuz stresinin bitkilerin çimlenme, büyüme, gelişme ve ürün verimini önemli ölçüde sınırladığını göstermiştir. Bununla birlikte, nanopartikül uygulamalarının ise çeşitli çevresel streslerin oluşturduğu olumsuz etkilerin düzenlenmesinde; fizyolojik ve biyokimyasal mekanizmalar üzerine, hücre yapısını ve hücre fonksiyonunu olumlu yönde etkilediği ortaya konmuştur. Bu çalışmada, tuz stresi (0, 50, 100, 150 ve 200 mM) altındaki şekerpancarı (Bernache) çeşidine ait tohumlara Titanyum dioksit (TiO₂) uygulaması (600, 1200 ve 1800 mg/l) yapılmış olup, fizyolojik özellikler üzerindeki görünür etkileri incelenmiştir. Tuzluluk stresi altında titanyum dioksit (TiO₂) uygulanan şekerpancarı tohumunun farklı tepkiler verdiği belirlenmiştir. Çalışmada şekerpancarında çimlenme oranı, çimlenme süresi, çimlenme indeksi, kök - gövde uzunluğu ve kök - gövde yaş ağırlığı gibi bitkinin fizyolojik özellikler incelenmiştir. Araştırma sonucunda: 100 mM tuz konsantrasyonuna kadar sürgün uzunluğu değerinin arttığı 200 mM seviyesinde ise sürgün uzunluğunun azaldığı, en yüksek değerin, 41,33 mm ile 100 mM tuz konsantrasyonundan elde edildiği gözlemlenmiştir. En yüksek yaş gövde, yaş kök ağırlığının ve gövde uzunluğunun 100 mM NaCl dozu uygulamasından elde edilmiştir. Titanyum dioksit (TiO₂) uygulamalarının, incelenen tüm karakterler üzerinde olumlu etkilerinin olduğu ve artan konsantrasyon seviyelerine bağlı olarak bu etkinin de pek çok parametrede arttığı gözlemlenmiştir. Bu sonuçlara göre, şekerpancarı bitkisinde tuzun meydana getirdiği olumsuz etkiler Titanyum dioksit (TiO₂) uygulamasıyla azaltılabileceği görülmüştür.

Anahtar kelimeler: *Beta vulgaris* L., Nanopartikül, fide gelişimi



Impact of Extraction Solvent On the Antimicrobial Potential of the Root of *Verbascum Blattaria*

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Abstract

Different solvent extracts of the root of *Verbascum blattaria* were screened for the antimicrobial activity in the present study. Extracts of the root were prepared in different solvents and tested against fungal and bacterial species (*Klebsiella pneumoniae*, *Bacillus atrophaeus*, *Pseudomonas aeruginosa*, *Citrobacter freundii*, *Salmonella typhi*, *Agrobacterium tumefaciens*, *Alternaria solani*, *Aspergillus fumigatus*, *Candida albicans*). Antifungal and antibacterial assays were performed by well diffusion and disc diffusion methods. The screening of the different solvent extracted samples revealed that methanol extract was more effective against *B.subtillus*, *B.atrophus*, *A. tumefaciens*, *C. freundii*, *K. pneumoniae*, *A.solani*, and *A. fumigatus*. Methanol extract formed the maximum zone of inhibition of 67% ZI at 3000µg/disc against *B.atrophus* than other tested microorganism. The hexane extract produced a maximum zone of inhibition against *B.subtillus* (32% ZI), *E.coli* (54 % ZI) and *A. tumefaciens* (52% ZI) while the ethyl acetate extract reduced the growth of *P. aeruginosa* with high potential than other extracts.

Key words; Plant extract, Microorganism, Extraction solvent, Antifungal activity

Introduction

Medicinal flora has a potential health benefit and used in pharmaceutical and cosmetic industry worldwide (Chan et al., 2008). In addition to their use in conventional and traditional medicine, the medicinal plants have become part of modern and complementary medicine due to their good effect on health (Zanon et al., 1999). Different plant extracts are commonly used for the cure of infectious diseases (Rajbhandari et al., 2009). *Verbascum* is an important genus of medicinal flora and consist of 360 species which are commonly found in tropical and temperate areas (Chen et al., 2014). *Verbascum* species have been reported for different biological activities including anti-inflammatory, antioxidant, tumor suppressing, antiseptic, sedatives, expectorant and diuretic properties (Magiatis et al., 2001). Different bioactivities including antiviral, antifungal and antibacterial have also been reported from the different species of this genus (Rajbhandari et al., 2009; Sener & Dulger 2009; Magiatis et al., 2001). The plants included in this genus are the rich source of important bioactive compounds like alkaloid, saponin, flavonoids, phenolic acids, iridoids, steroids (Grigore et al., 2013). Among the reported species of *Verbascum*, *Verbascum blattaria* is very important and used in traditional and conventional medicine (Turker & Gurel, 2005). The flowers and leaves of *Verbascum blattaria* are used in folk medicine for the treatment of various respiratory disorders such as whopping cough, tuberculosis, bronchitis, whooping cough and dry cough (Magiatis, 2001). *Verbascum blattaria* also described to be mild sedative and also having anti-inflammatory property (Turker & Camper, 2002). The plant extract has also been used to cure different ailments such as migraine, congestion, fever, pneumonia, and allergies as a domestic remedy (Muhammad et al., 2006). Due to excessive used of antimicrobial reagent, resulting in the development of resistance in both plants and human pathogen. This alarming situation has encouraged the researcher to seek new sources of an antimicrobial agent, and also to develop a standardized procedure for the extraction of these active agents (Cordell, 2000). In the current study, the impact of extraction solvent was investigated on antimicrobial activities of the root of *V. blattaria*.

Material and Methods

Plant of *V. blattaria* was collected from the different places in district Malakand, and taxonomic identification was confirmed by Prof Semen Jan at the Department of Botany, University of Peshawar. Roots were cut from the aerial parts of the plant body and washed with running tap water to remove sand and dust particles. The roots were then dried in shade and then put in the grinding machine to become powder.

Solvent, Chemicals, and Equipment

Nutrient agar, nutrient broth and Dimethylsulfoxide, (DMSO), nutrient broth, nutrient agar, potato dextrose, and potato broth media were supplied by Musaji Adam & sons. Ethanol hexane and methanol (Analytical grade) were used in extraction. The solution was dried by Rotary evaporator.



Preparation of Extracts

Sixty gram (60g) of root powder was weighted and poured into each extraction flask containing 600ml of the solvent. The flasks were placed in shaking incubator for five days. The solution was decanted and filter by Whatman filter paper into label bottles. Five hundred ml of the solvent was passed three times from solid residue. The solutions in bottles were then transferred into an evaporating flask of the rotary evaporator for drying. The semisolid extracts were prepared by a rotary evaporator, which was then kept in china dish for complete drying in a water bath.

Antimicrobial Activity

Potato dextrose, nutrient agar, and nutrient broth media were prepared according to manufacturer protocols. Well diffusion and disc diffusion methods were performed for testing anti-fungal and antibacterial activity of the extracts. Briefly, prepared nutrient agar plate was streaked with 50 μ l of standardized microbial culture (McFarland standard used). Through micropipette, three different concentration (1000 μ g, 2000 μ g, and 3000 μ g) were applied to each disc. For the antifungal assay, extracts of the different concentration (4000 μ g, 5000 μ g, and 6000 μ g/well) were poured in wells. Then a block of five days old culture was placed in the center of Petri plate containing potato dextrose agar media. The same procedures were also used for the antibiotic and antifungal solution. At the end of the experiment the zone of inhibition was measured and percent zone of inhibition was measured (Khan et al., 2017).

Statistical analysis

Mean $\pm$ standard deviation of the triplicate was calculated through Microsoft Excel 2010.

Results

Methanol extract formed 67% ZI against *B.atrophus* while the other extracts were less effective at 3000 μ g /disc (34% ZI by ethyl acetate and 21% ZI by hexane extracts). At 2000 μ g /disc, the extract reduced the growth of bacterium and produced 56% ZI shadowed by ethyl acetate extract (27% ZI) and hexane extract (9% ZI). Furthermore, the data also revealed that ethyl acetate formed 17%ZI while methanol extract produced 41% ZI at 1000 μ g /disc (Fig 1). Hexane extract was inactive against bacterium at 1000 μ g/disc and formed 0% zone of inhibition. The tested extracts also reduced the growth of *B.subtillus*. In the tested samples, the methanol and n-hexane extract formed an equal zone of inhibition (32% ZI), while ethyl acetate extract produced 35% ZI at 3000 μ g /disc (Fig 2). Methanol extract formed 31% ZI while n-hexane and ethyl acetate produced 27% and 34% ZI respectively at 2000 μ g/disc. Furthermore, 1000 μ g /disc of methanol extract measured 27% ZI followed by ethyl acetate (24% ZI) and hexane extracts (18% ZI). Similarly, hexane and methanol extract formed an equal zone of inhibition (52% & 50% ZI) at 3000 and 2000 μ g/disc against *A. tumefaciens* while ethyl acetate produced 44% and 34% ZI at 2000 and 1000 μ g/disc, respectively. Furthermore, methanol and hexane extract reduced the growth of bacterium by 37% and 44% as compared to control. Against *C. freundii*, the methanol extract was effective than other extracts (29% ZI by ethyl acetate and 12% by hexane extract) and formed 41% ZI at 3000 μ g /disc. Hexane extract was not effective against *C. freundii* at 2000 μ g /disc and 3000 μ g /disc while at the same concentrations ethyl acetate extracts and methanol extracts formed 28%, 18%, 38% and 28% ZI respectively (Fig 3). The growth of *P. aerugenosa* was reduced by ethyl acetate extract and formed 57% ZI shadowed by hexane (54% ZI) and methanol extract (43% ZI) at 3000 μ g /disc (Fig 4). The tested extracts also showed activity at 2000 μ g and 1000 μ g /disc. Ethyl acetate extract produced 53%ZI while hexane and methanol extract formed 44% and 37% ZI respectively, at 2000 μ g /disc. Methanol and hexane extract formed an equal zone of inhibition (37% ZI) while ethyl acetate extract produced 44% ZI at a concentration of 1000 μ g /disc. Furthermore, hexane extract was more effective than other extracts at 3000 μ g/disc and formed 54 % ZI against *E.coli* (43% ZI ethyl acetate and methanol extract) (Fig 5). Against *K. pneumonia*, methanol and ethyl acetate extracts were effective and formed 46% and 45% ZI respectively at 3000 μ g /disc. The tested extracts also reduced the growth of bacterium at 2000 μ g and 1000 μ g /disc. Methanol extract produced 37% and 29 % zone of inhibition while ethyl acetate and hexane extract revealed 40%, 35%, 32% and 28% at 2000 μ g mg/disc and 1000 μ g /disc respectively (Fig 6).The tested extracts were inactive against *A. fumigatus* and *A. niger* at the concentrations of 1000 μ g, 2000 μ g and 3000 μ g /well. However the growth of both fungi was inhibited at 4000, 5000 and 6000 μ g /well by methanol and ethyl acetate extracts. N-hexane extract did not restrict fungal growth. Methanol and ethyl acetate extract formed 24% and 19% ZI respectively at 4000 μ g/well against *A. fumigatus* while at the same concentration the growth of *A. niger* was reduced to 38% (ZI) by methanol and 32% (ZI) by ethyl acetate extract as compared to control (Figs 7-8). The concentration, when increased to 5000 μ g/well methanol extract, produced 29% ZI and ethyl acetate extract measured 21% ZI against *A. fumigatus* while at the same concentration ethyl acetate extract and methanol extract formed 33% and 40% ZI respectively, against *A.niger*. The finding of the study revealed that methanol extract formed 34% zone of inhibition against *A. fumigatus* shadowed by ethyl acetate extract (27% ZI) extract at 6000



µg/well. On the other hand, methanol and ethyl acetate extracts reduced the growth of *A.niger* by 42% and 34% respectively at 6000 µg/well. The tested extract of the root did not affect the growth of *C.albicans* and *T. rubrum*.

Discussion

Different and numerous bioactive compounds are present in plant species at different concentration showing the bioactive nature of the natural flora (Skrovankova et al., 2015). The isolation of compounds from the plant is based on the mode of extraction and solvent extraction system (Altemimi et al., 2017), (Khan et al., 2018). The current study demonstrates the effect of extraction solvent on the antimicrobial activity of the root of *V. blataria*. Hexane, methanol and ethyl acetate solvents extracts were tested against the bacterial and fungal pathogens. Results of the study demonstrated that the root extracts showed variation in the antimicrobial property against *K.pneumoniae*, *B.atrophaeus* *P.aeruginosa*, *C.freundi*, *S.typhi*, *A.tumefaciens*, *A. solani*, *A.fumigatus*, *C.albicans*,. Our finding supports the result of the previous studies which stated that *Verbascum* species are rich of bio active compounds with antimicrobial potential such as saponins, flavonoids, neolignan glycosides, iridoid glycosides and phenylethanoid (Tatli and Akdemir, 2006), (Alper and Basaran, 2009). The screening of the different solvent extracted samples revealed that methanol extract was more effective against *B.subtillus*, *B.atrophus*, *A. tumefaciens*, *C. freundi*, *K. pneumoniae*, *A.solani*, *A. fumigatus*. Ghasemi et al. (2015) also reported that the methanol extract of *V. thapsus* flower oil was effective against the *P. aeruginosa*, and *E. coli*. Similarly, the significant antimicrobial potential was also reported in the methanol extract of leaves against *Y.pestis*, *E coli*, *S aureus* and *B. cereus* (Prakash et al., 2016). Furthermore, antifungal activity against *A. niger* and *A. fumigatus* was also found in the methanol extract of the leaf (Khan et al., 2011). On the other hand, the hexane extract produced a maximum zone of inhibition against *B.subtillus*, *E.coli* and *A. tumefaciens* while the ethyl acetate extract reduced the growth of *P. aerugenosa* with high potential than other extracts. These findings suggest that methanol is the best solvent for the optimized extraction and recovery of antimicrobial substances from the root of *V. blataria*. Similar results were also reported in the previous studies (Lin et al., 1999; Ahmad et al., 1998; Eloff, 1998). *C.albicans*, *T. rubrum* and *S.typhi* were resistant to the tested extracts. The difference in susceptibility among the microbes against the bioactive agents present in plant extract may be attributed to the difference in composition of the cell wall and/or the presence of antimicrobial resistance genes in their plasmids.

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Statement of conflict of interest.

All the authors of manuscript are unanimous in submitting the research paper to journal and there is no conflict of interest.

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The Use of Marine Collagens: Applications and Benefits

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Abstract

Collagen is an important structural protein found in the human body, functioning as a fibrous protein that provides durability, flexibility, and strength. Additionally, it serves as a fundamental building block that holds cells and tissues together, maintaining their integrity and resilience. Various types of collagen perform different functions in the body. Type I collagen is found in the skin, bones, tendons, connective tissues, and organs, providing durability and flexibility. Type II collagen, on the other hand, is located in cartilage and is essential for maintaining joint health. Type III collagen surrounds muscles, organs, and blood vessels, supporting tissue repair and elasticity. Type IV collagen is a component of the basal membranes beneath cells, providing cellular support. Marine collagens are proteins obtained from fish and other marine organisms and stand out as environmentally friendly and sustainable sources. In recent years, marine collagen has become a significant component in the health, beauty, and dietary supplement industries. It is particularly widely used in areas such as skin health, joint support products, and wound healing. Marine collagen has a smaller molecular structure compared to other animal-based collagens, making it more easily absorbed by the body and known for its higher bioavailability. These properties make marine collagen an effective supplement that provides quick results. Primarily obtained from fish and shellfish, fish are among the most common sources of this protein. Fish skin, scales, bones, and fins, often considered waste, are utilized for collagen production. Species such as cod, salmon, tuna, and tilapia are frequently preferred for this purpose. Additionally, shellfish, such as crabs and shrimp, contribute to collagen production, and some species of jellyfish are also rich in collagen. Marine collagen possesses hypoallergenic properties, meaning it has a lower risk of allergic reactions compared to animal-based collagens derived from cattle and pigs. This makes it a safer option, particularly for individuals without seafood allergies. Furthermore, marine collagen exhibits antioxidant effects, protecting the skin from damage caused by free radicals, which can help keep skin cells healthier and delay signs of aging. All these properties contribute to the growing preference for marine collagen as a key ingredient in health and beauty products.

Key Words: Marine Collagen, Protein, Salmon, Jellyfish

Deniz Kollajenlerinin Kullanımı: Uygulamalar ve Faydalar

Özet

Kollajen, insan vücudunda bulunan önemli bir yapısal proteindir ve dayanıklılık, esneklik ve güç sağlayan lifli bir protein işlevi görür. Ayrıca, hücreleri ve dokuları bir arada tutan temel bir yapı taşı olarak görev yaparak dokuların bütünlüğünü ve dayanıklılığını korur. Vücutta farklı işlevler gerçekleştiren çeşitli kollajen türleri bulunmaktadır. Tip I kollajen, cilt, kemikler, tendonlar, bağ dokuları ve organlarda bulunarak dayanıklılık ve esneklik sağlar. Tip II kollajen ise kırıkta yer alır ve eklem sağlığının korunmasında hayati öneme sahiptir. Tip III kollajen, kasların, organların ve kan damarlarının etrafında bulunarak doku onarımını ve esnekliği destekler. Tip IV kollajen ise hücrelerin altında bulunan bazal membranların bir bileşenidir ve hücresel destek sağlar. Deniz kollajenleri, balık ve diğer deniz organizmalarından elde edilen proteinlerdir ve çevre dostu ve sürdürülebilir kaynaklar olarak öne çıkmaktadır. Son yıllarda, deniz kollajeni sağlık, güzellik ve diyet takviyeleri endüstrilerinde önemli bir bileşen haline gelmiştir. Özellikle cilt sağlığı, eklem destek ürünleri ve yara iyileşmesi gibi alanlarda yaygın olarak kullanılmaktadır. Deniz kollajeni, diğer hayvan kaynaklı kollajenlere kıyasla daha küçük bir moleküler yapıya sahiptir. Bu nedenle, vücut tarafından daha kolay emilir ve daha yüksek biyoyararlanıma sahip olduğu bilinmektedir. Bu özellikler, deniz kollajenini etkili bir takviye haline getirir ve hızlı sonuçlar sağlar. Deniz kollajeni esas olarak balıklardan ve kabuklulardan elde edilmektedir. Balıklar, bu tür proteinlerin en yaygın kaynaklarından biridir. Balıkların deri, pul, kemik ve yüzgeçleri, genellikle atık olarak kabul edilen parçalar, kollajen üretiminde kullanılmaktadır. Cod, somon, ton balığı ve tilapia gibi türler bu amaçla sıkça tercih edilmektedir. Ayrıca, kabuklular, örneğin yengeçler ve karidesler, kollajen üretiminde kullanılmakta ve bazı denizanası türleri de zengin kollajen kaynakları arasında yer almaktadır. Deniz kollajeni, hipoalerjenik özelliklere sahiptir; bu da, sığır ve domuzlardan elde edilen hayvan kaynaklı kollajenlere göre alerjik reaksiyon riski daha düşük olduğu anlamına gelir. Bu, deniz ürünlerine alerjisi olmayan bireyler için daha güvenli bir seçenek haline getirir. Ayrıca, deniz kollajeninin serbest radikallerin neden olduğu hasara karşı cildi koruyan antioksidan etkileri olduğu bilinmektedir. Bu, cilt hücrelerini daha sağlıklı tutmaya yardımcı olabilir ve yaşlanma belirtilerinin gecikmesini sağlayabilir. Tüm bu özellikler, deniz kollajeninin sağlık ve güzellik ürünlerinde anahtar bir bileşen olarak artan tercih edilmesine katkıda bulunmaktadır.

Anahtar Kelimeler: Deniz Kollajeni, Protein, Somon, Denizanası



ID: 540

Antifungal Potential of Some Volatile Oils Against *Saprolegnia parasitica*

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Abstract

Aromatic plants containing volatile oils are used in various fields due to their phytochemical properties. In aquaculture, they have the potential to be used as anesthetics, antifungals, antiseptics, and ectoparasiticides as alternatives to various synthetic chemicals. This study investigates the effects of lavender oil, thyme oil, marjoram oil, rosemary oil, and eucalyptus oil on the fungal species *Saprolegnia parasitica*, which causes diseases and deaths in fish and fish eggs during incubation, under *in vitro* conditions. The agar dilution method was applied as a quantitative susceptibility test, and the fungus was inoculated onto Sabouraud Maltose Agar (SMA), which was kept at 20°C for 5 days. Lavender, thyme, rosemary, and eucalyptus oils were added to the SMA at concentrations of 1, 5, 25, and 125 µL/L, while marjoram oil was added at concentrations of 2, 10, 50, and 250 µL/L, all oils were dissolved in 96% ethanol at a 1:1 ratio. The negative effects of these oils at different concentrations on the growth of *Saprolegnia parasitica* were examined in triplicate and compared with a control group. The MIC values were determined as 25 µL/L for rosemary oil, over 25 µL/L for eucalyptus oil, over 50 µL/L for marjoram oil, and 125 µL/L for lavender oil, while thyme oil showed no effect at the tested concentrations. As a result of the relatively low concentrations showing positive effects, it is suggested that rosemary oil and eucalyptus oil may also be tested on incubating eggs and fish frequently experiencing fungal infections.

Key Words: *Saprolegnia*, Aquaculture, Volatile oils, Rosemary, Eucalyptus

Saprolegnia parasitica Üzerine Bazı Farklı Uçucu Yağların Antifungal Potansiyeli

Özet

Uçucu yağlara sahip aromatik bitkiler, fitokimyasal özellikleri nedeniyle birçok alanda kullanılmaktadır. Su ürünleri yetiştiriciliğinde ise çeşitli sentetik kimyasallara alternatif olarak anestetik, antifungal, antiseptik ve ektoparazitisit özellikleriyle kullanım potansiyeli taşımaktadırlar. Bu çalışmada, su ürünleri yetiştiriciliğinde balıklarda ve kuluçkalanan balık yumurtalarında hastalıklara ve ölümlere neden olan mantar türlerinden *Saprolegnia parasitica* üzerinde lavanta yağı, kekik yağı, ıtır yağı, biberiye yağı ve okaliptüs yağının etkileri *in vitro* şartlarda incelenmiştir. Çalışmada, kantitatif duyarlılık testi olarak agar dilüsyon yöntemi uygulanmış ve Sabouraud Maltose Agar (SMA)'a mantarın ekimi yapılarak, 5 gün süreyle 20°C'de tutulmuştur. SMA içerisine 1, 5, 25 ve 125 µL/L konsantrasyonlarında lavanta, kekik, biberiye ve okaliptüs yağları, 2, 10, 50 ve 250 µL/L konsantrasyonlarında ıtır yağı 1/1 oranında %96'lık etil alkol ile çözündürülerek eklenmiş ve farklı konsantrasyonlardaki bu yağların *Saprolegnia parasitica*'nın üremesi üzerindeki negatif etkileri, kontrol grubu ile kıyaslanarak 3 tekerrürlü olarak incelenmiştir. MIC değerleri, biberiye yağı için 25 µL/L, okaliptüs yağı için 25 µL/L üzeri, ıtır yağı için 50 µL/L üzeri, lavanta yağı için 125 µL/L olarak tespit edilmiş, kekik yağının ise, denenen konsantrasyonlarda etki edemediği görülmüştür. Çalışma sonunda, görece düşük konsantrasyonlardaki olumlu etkileri nedeniyle, biberiye yağı ve okaliptüs yağının, kuluçkalanan yumurtalar ve sıklıkla mantar enfeksiyonları görülen balıklar üzerinde de denenebileceği düşünülmektedir.

Anahtar Kelimeler: *Saprolegnia*, Akuakültür, Uçucu yağlar, Biberiye, Okaliptüs





ID: 542

An Economic Study On Shifting Boro Rice to Maize Production in Northern Region of Bangladesh

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Abstract

This study investigates the shift from Boro rice to maize cultivation in northern Bangladesh, specifically in the Lalmonirhat and Dinajpur districts, focusing on profitability, production efficiency, and sustainability. Data were gathered from 300 farmers and agricultural laborers using surveys, focus group discussions (FGDs), and key informant interviews (KIIs). The research analyzed factors influencing farmers' decisions to switch to maize, including education, profitability, credit availability, high demand, training, land type, and seed access. Probit regression and SWOT analyses were used to evaluate the findings. The results show that maize farming is considerably more profitable than Boro rice. The total cost of maize cultivation was lower (Tk. 111,649.9/ha) compared to Boro rice (Tk. 128,726.3/ha). The average net return for maize was Tk. 32,824.33/ha, much higher than Boro rice's Tk. 9,516.60/ha. Farmers in Dinajpur achieved greater profits than those in Lalmonirhat. Maize's Benefit-Cost Ratio (BCR) was 2.06, surpassing Boro rice's 1.60, reflecting higher profitability due to lower costs and higher demand. Despite the profitability, maize farmers were operating below their maximum production capacity, with potential production increases of 41.9%. The technical efficiency was below optimal, but the economic incentives continue to drive the shift toward maize. While the transition offers significant economic benefits, it may also impact food security, especially for poorer communities. The study suggests that public interventions are needed to mitigate negative consequences and ensure that vulnerable populations are not adversely affected by this agricultural transformation.

Keywords: Boro rice, profitability, production efficiency, maize cultivation, technical efficiency, sustainability



ID: 543

Examination of The City Parks in terms of Landscape Design Criteria

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Abstract

Urban parks, which ensure the sustainability of cities and create quality and comfortable living spaces for urban people, affect the users they address in line with their landscape design features. Both positive and negative aspects of compliance with design criteria concern not only the urban park but also its users and the city as a whole. Spaces without any recreational activities, without comfort, without a green texture do not add anything positive to the city and do not create physical, social and cultural interaction for the people of the environment in which they are located, and will cause stagnation and restlessness on the psychology of the city people. However, the urban park applied within the scope of landscape design criteria will provide quality, comfort and tranquility to the user it addresses. Urban parks that are intertwined with nature, include active and passive recreational activities, are in harmony with their surroundings, create a safe environment, appeal to all age groups and meet the wishes and needs of users increase the level of satisfaction by affecting the living standards of the city. In this study, firstly, it was planned to observe, identify and analyze the current conditions of 5 urban parks in the central district of Niğde. The aim of the study is to determine the suitability of some parks that provide services at the urban scale within the borders of Niğde; landscape design criteria (accessibility, suitability for all age groups, equipment elements, water elements, parking, barrier-free space use, year-round usability, climate suitability, security, night use, vegetative design, space use, size, contribution to urban aesthetics and harmony with the environment. In this context, it is planned to determine the suitability of the parks in terms of landscape design according to the landscape design criteria determined and to make evaluations to analyze the current situation of the parks. As a result of the evaluation, solutions will be proposed for the problem of the current situation in accordance with the landscape design criteria.

Key Words: Landscape Design, Urban Design, Sustainable Design, Urban Parks, Niğde

Kent Parklarının Peyzaj Tasarım Kriterleri Açısından İncelenmesi

Özet

Kentlerin sürdürülebilirliğini sağlayan, kent insanı için kaliteli ve konforlu yaşam alanı oluşturan kent parkları, sahip olduğu peyzaj tasarım özellikleri doğrultusunda hitap ettiği kullanıcıları etkilemektedir. Tasarım kriterlerine uygunluğun hem olumlu hem olumsuz yönleri yalnız kent parkını değil kullanıcısı ve kentin tümünü ilgilendirmektedir. İçerisinde hiçbir rekreasyonel aktivitesi bulunmayan, konforsuz, yeşil bir dokusu olmayan mekânlar kente olumlu anlamda bir şey katmadığı gibi bulunduğu çevrenin insanı için de fiziksel, sosyal ve kültürel anlamda bir etkileşim yaratmadığı için kent insanı psikolojisi üzerinde durağanlık ve huzursuzluğa neden olacaktır. Ancak peyzaj tasarım kriterleri kapsamında uygulanan kent parkı hitap ettiği kullanıcıya kalite, konfor ve huzur sağlayacaktır. Doğayla iç içe, aktif ve pasif rekreasyonel aktiviteleri bünyesinde bulunduran, çevresiyle uyumlu, güvenli bir ortam oluşturan, her yaş grubuna hitap eden ve kullanıcıların istek ve ihtiyaçlarını karşılayan kent parkları kentin yaşam standartlarını etkileyerek memnuniyet seviyesini de arttırmaktadırlar. Bu çalışmada ilk olarak Niğde ili Merkez ilçesinde bulunan 5 kent parkının yerinde gözlem, tespit ve mevcut durumlarının analiz edilmesi planlanmıştır. Çalışmanın amacı, Niğde İli sınırları içerisinde kent ölçeğinde hizmet sağlayan bazı parkların; peyzaj tasarım kriterleri (ulaşılabilirlik, her yaş grubuna uygunluk, donatı elemanları, su ögesi, otopark, engelsiz mekân kullanımı, yıl boyu kullanılabilirlik, iklim uygunluk, güvenlik, gece kullanımı, bitkisel tasarım, alan kullanımı, büyüklük, kent estetiğine katkı ve çevreyle olan uyum kapsamında peyzaj tasarım kriterlerine uygunluğunun tespit edilmesidir. Bu bağlamda belirlenen peyzaj tasarım kriterlerine göre parkların peyzaj tasarımı açısından uygunlukları tespit edilip, parkların mevcut durumlarının analiz edilmesine yönelik değerlendirmeler yapılması planlanmaktadır. Değerlendirme sonucunda mevcut durumun sorununa yönelik peyzaj tasarım kriterlerine uygun olacak şekilde çözüm önerileri sunulacaktır.

Anahtar Kelimeler: Peyzaj Tasarımı, Kentsel Tasarım, Sürdürülebilir Tasarım, Kent Parkları, Niğde



ID: 545

Effect of Different Planting Times on Pod Characteristics of Pea Varieties

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Abstract

The pea plant has an important place in human nutrition and culinary culture. The pod characteristics of the pea determine its purpose of use. Therefore, pod characteristics of Elena, Deren and Irmak 01 pea varieties grown in Kahramanmaraş conditions with five different planting times were investigated. In the research, pea varieties were planted at five different times, one month apart from November to March, taking into account climate and soil conditions. In the study, pea varieties were planted at five different times, starting from November and including March, once a month, taking into account the climate and soil conditions. First pod height, pod number, pod length, pod width, grain number per pod, pod weight and pod grain weight of the pea varieties used were examined. At the end of the research, first pod height, pod length, pod width, number of grains per pod, and pod grain weight showed statistically significant differences according to the pea varieties used. The effect of planting times on the other traits, except pod width, was found as significant. As a result of the study, it was recorded that the first pod height varied between 21,4-79,33 cm, pod number varied between 3-14,2 pieces, pod length varied between 5,48-7,38 cm, pod width varied between 8,99-11,49 mm, grain number varied between 4,86-6,98 pieces per pod and grain weight varied between 0,64-1,26 g. It was determined that higher pod weight was achieved in Deren and Irmak 01 varieties, and pod weight was higher in December, January and February plantings than in other planting times.

Key words: pea, pod characters, grain weight of pod

Farklı Ekim Zamanlarının Bezelye Çeşitlerinin Bakla Özelliklerine Etkisi

Özet

İnsan beslenmesi yönünden mutfak kültüründe bezelye bitkisi önemli bir yere sahiptir. Bezelyenin bakla özellikleri kullanım amacına yön vermektedir. Bu nedenle, Kahramanmaraş koşullarında beş farklı ekim zamanı uygulanarak yetiştirilen, Elena, Deren ve Irmak 01 bezelye çeşitlerinin bakla özellikleri incelenmiştir. Araştırmada iklim ve toprak şartları dikkate alınarak Kasım ayından itibaren ayda bir kez olmak üzere, Mart ayı dahil beş farklı zamanda bezelye çeşitlerinin ekimi yapılmıştır. Kullanılan bezelye çeşitlerinin, ilk bakla yüksekliği, bakla sayısı, bakla boyu, bakla eni, baklada tane sayısı, bakla ağırlığı, baklada tane ağırlığı incelenmiştir. Araştırma sonunda ilk bakla yüksekliği, bakla boyu, bakla eni, baklada tane sayısı, baklada tane ağırlığı kullanılan bezelye çeşitlerine göre istatistiki önemli farklılıklar göstermiştir. İncelenen özelliklerden bakla eni hariç, diğer özellikler üzerine ekim zamanlarının etkisi önemli bulunmuştur. Yürütülen çalışma sonucunda, ilk bakla yüksekliği 21,4-79,33 cm, bakla sayısı 3-14,2 adet, bakla boyu 5,48-7,38 cm, bakla eni 8,99-11,49 mm, baklada tane sayısı 4,86-6,98 adet, baklada tane ağırlığı 0,64-1,26 g arasında değiştiği kaydedilmiştir. Deren ve Irmak 01 çeşitlerinde daha yüksek bakla tane ağırlığına ulaşıldığı, Aralık, Ocak ve Şubat aylarındaki ekimlerinden baklada tane ağırlığının diğer ekim zamanlarına göre daha yüksek olduğu belirlenmiştir.

Anahtar kelimeler: bezelye, bakla özellikleri, baklada tane ağırlığı

GİRİŞ

Yemeklik tane baklagiller ülkemizde tarım alanlarının yaklaşık %10'unu kapsar ve azot bağlama özelliklerinden dolayı ekim nöbeti için aranan bitkilerdendir (Yılmaz ve Kılınç, 2018). Yemeklik tane baklagillerin bileşiminde %18-31,6 oranında protein bulunur. Ayrıca insan vücudunda sentezlenemeyen aminoasitler, mineraller, vitaminler (özellikle A,B,C ve D), kalsiyum, fosfor, karbonhidrat ve özellikle demir yönünden, diğer besin maddelerini içinde yemeklik baklagiller önemli bir yere sahiptir (Demirci ve Ünver, 2005). Yemeklik baklagiller arasında önemli bir baklagil bitkisi olan bezelye, yüksek protein oranı vitamin yönünden zengin olması dolayısıyla, bezelye taneleri yeşil sebze ve kuru tane olarak kullanılmaktadır. Bezelye, dondurulmuş gıda sanayisinde kullanımı ve konserve olarak kullanılması ile önem kazanmıştır (Demirci ve Ünver, 2005). Dünyada bezelye ekim alanı, yemeklik baklagiller arasında fasülye, nohut ve mercimekten sonra dördüncü sırada yer alır (Çiftçi ve ark., 2020). Ülkemizde, bezelye (*Pisum sativum* L.), 781 ha ekim alanına sahiptir. Türkiye'de 2021 yılı verilerine göre 2.193



ton bezelye üretimi yapılmıştır. Bezelye bitkisinin verimi ve kalitesi üzerine kullanılan çeşitlerin ve yetiştirme yöntemlerinin etkisi olduğu bilinmektedir. Yetiştirilen çeşitlerin verim miktarı ve kalitesi üzerinde ekim zamanı, gübreleme, ekim sıklığı gibi birçok faktörün etkisi vardır (Demirci ve Ünver, 2005). Bezelye bitkisinin ekim zamanı bölgelere göre değişiklik göstermektedir. Ekimin yapılacağı bölgenin iklim özellikleri ve bu iklime uygun olan ekim zamanının belirlenmesi gerekmektedir. Ekim zamanlarına bağlı olarak bitkinin gelişim hızı da farklılık göstermektedir. Kullanılan çeşitler, ekimin yapıldığı tarih birçok bitkide olduğu gibi bezelyede de kaliteyi ve verimi etkilemektedir. Bezelyede tane verimi miktarını ve kaliteyi, bitkide bulunan baklaların sayısı, baklaların boyutları, bakla içerisindeki tanelerin kalitesi belirlemektedir. Bu çalışmada farklı ekim zamanlarının ve çeşitlerin, bezelye bitkisindeki baklalara ve tanelerin verimine, kalitesine olan etkisi ortaya koyulmaya çalışılmıştır.

Materyal Ve Metot

Araştırmada Elena, Deren ve Irmak 01 bezelye çeşitleri materyal olarak kullanılmıştır. Materyal olarak bezelye çeşitleri Türkiye’de tescil edilmiş yerli çeşitlerdir. Deneme; Kahramanmaraş koşullarında Kasım 2022-Temmuz 2023 tarihleri arasında yürütülmüştür. Araştırmada Kasım, Aralık, Ocak, Şubat ve Mart ayları olmak üzere 5 farklı ekim zamanı kullanılmıştır. Deneme, ana parsellerde ekim zamanları, alt parsellerde ise çeşitler olacak şekilde bölünmüş parseller deneme desenine göre 3 tekerrürlü olarak kurulmuştur. Bitkiler 50 cm sıra arası ve 8 cm sıra üzeri mesafede, 5 metre uzunluğundaki her bir parselde 4 sıra olacak şekilde, önceden çapa makinesi ile açılan çizilere elle ekilmiştir. Ekim sırasında 18-46 DAP gübresi dekara 13 kg düşecek şekilde, Azotlu gübre dekara 8 kg düşecek şekilde bitki 10-15 cm iken üst gübre olarak uygulanıp toprağa karıştırılmıştır. Beş farklı ekim zamanının uygulandığı çalışmada ilk ekim toprak hazırlığından hemen sonra ekildiği için çıkıştan sonra oluşan yabancı otlar el çapası ile kontrol altına alınmıştır. Sonraki ekimlerde önce yabancı otlar el çapasıyla uzaklaştırdıktan sonra ekim yapılmıştır. Çıkıştan sonrada yine el çapasıyla ot uzaklaştırma yapılmıştır. Mildiyö hastalığına ve beyaz sineğe karşı ilaçlama yapılmıştır. Bezelye çeşitlerinin Kasım, Aralık ve Ocak ayları ekimlerinde toprak tavı dikkate alınarak ekildiğinden sulama ihtiyaç duyulmamıştır. Şubat ve Mart aylarındaki bezelye çeşitlerinin ekiminden hemen sonra sulama uygulaması yapılmıştır. Bezelye çeşitlerinin baklalarının kuruma başlangıcına kadar bitkinin su ihtiyacı karşılanmıştır. Çeşitlerin baklalarının tamamen kuruduğu ve bakla tanelerinin bakla içinde hareketinin gerçekleşmesiyle hasat yapılmıştır. Yürütülen araştırmada elde edilen verilerin analizinde JMP 13 paket programı, ortalamaların karşılaştırılmasında DUNCAN çoklu karşılaştırma kullanılmıştır (JMP, 2013)

Bulgular Ve Tartışma

Kahramanmaraş koşullarında bezelye çeşitleri ile yürütülen çalışmada bakla boyu ve bakla enine ait özelliklerin ortalamaları ve oluşan grupları Çizelge 1’de verilmiştir.

Çizelge 1. Bezelye çeşitlerinin ekim zamanlarına göre bakla boyu ve bakla eni değerleri.

Ekim zamanları	Bakla boyu (cm)				Bakla eni (mm)			
	Elena	Deren	Irmak 01	Ort.	Elena	Deren	Irmak 01	Ort.
Kasım	5,86	7,22	6,12	6,40abc	8,99	10,67	11,45	10,37
Aralık	6,00	7,38	6,52	6,63 a	9,12	10,78	11,45	10,45
Ocak	5,72	7,32	6,42	6,49 ab	9,19	10,97	11,49	10,55
Şubat	5,70	7,00	6,02	6,24 bc	9,31	10,65	11,21	10,39
Mart	5,48	6,71	6,02	6,07 c	9,06	10,33	11,14	10,18
Ortalama	5,75 b	7,13a	6,22b		9,13 c	10,68 b	11,35 a	

Farklı ekim zamanları uygulanan bezelye çeşitlerinde bakla boyları 5,75-7,13 cm arasında değişmekte olup, en uzun bakla boyuna sahip çeşit Deren olmuştur ve diğer iki çeşitten farklı grupta yer almıştır. En kısa bakla boyuna sahip çeşit ise 5,75 cm ile Elena olarak kaydedilirken, Irmak 01 çeşidi ile aynı istatistiksel grupta yer almıştır. Ekim zamanları incelendiğinde bakla boyu değerlerinin 6,07-6,63 arasında değiştiği görülmektedir. En uzun bakla boyu Aralık ayında yapılan ekiminden elde edildiği, Kasım ve Ocak ayında yapılan ekimler hariç diğer ekim zamanlarından farklı istatistiksel grupta yer almıştır. En kısa bakla boyu ise Mart ayında yapılan ekimlerde ölçülmüştür ve Şubat ayında yapılan ekimler hariç diğer ekim zamanlarına göre farklılık oluşturmuştur. Çeşit x ekim zamanları interaksiyonlarında bakla boyları 5,48-7,38 cm arasında değişmekte olup istatistiksel olarak önemli bir fark oluşturmamışlardır.

Karayel (2006), Samsun koşullarında yürütülen çalışmada bakla boyunun 4,9-9,9 cm arasında değiştiğini belirtmiştir. Shaukat ve ark. (2012), Pakistan’ın Kashmir bölgesinde 4 sıra arası ve mesafe ve 4 farklı ekim zamanı uygulanarak yapılan araştırmada, 50 cm sıra aralığı uygulanan bitkilerin bakla uzunluklarının diğer sıra arası mesafelere göre daha iyi sonuç verdiğini kaydetmişlerdir. Khan ve ark. (2013), Pakistan’ın İslamabad bölgesinde 15 bezelye kültürü ile yapılan araştırmada bakla boyunun 4,38-9,33 cm arasında olduğunu arasında değiştiğini



kaydetmişlerdir. Kılınç (2017), Giresun şartlarında yetiştirilen yerel bezelye çeşitlerinin bakla boylarının 5-13 cm arasında olduğunu belirtmiştir. Özaktan ve ark. (2022), Kayseri ekolojik koşullarında bezelye bitkisinde sulamanın etkisinin araştırıldığı çalışmada bakla boyunun 7,53-8,86 cm arasında değiştiği kaydedilmiştir. Bezelye bitkisinde bakla boyu özelliğinin uygulanan faktörlere, iklim koşullarına ve çeşitlere göre değişkenlik gösterdiği daha önceki çalışmalardan da görülmektedir. Yürütülen çalışmada elde edilen bakla boyu verileri, önceki çalışmalarda elde edilen değerlerle paralellik göstermekle birlikte, sıcaklığın artması ve vejetasyon süresinin kısalması ile bakla boyu azalmıştır.

Denemede kullanılan bezelye çeşitlerinin bakla enleri üç farklı istatistiksel grup oluşturmuştur. En yüksek bakla eni 11,35 mm ile Irmak 01 çeşidinde ölçülmüş olup, onu ikinci sırada 10,68 mm ile Deren çeşidi izlemiştir. En düşük bakla eni ise 9,13 mm ile Elena çeşidinde kaydedilmiştir. Bakla enleri açısından ekim zamanları arasında önemli bir fark bulunamamıştır. Ekim zamanlarında en yüksek bakla eni 10,55 mm ile Ocak ayında, en düşük bakla eni ise Mart ayında yapılan ekimlerde kaydedilmiştir. Çeşit x ekim zamanları interaksiyonları, bakla eni özelliği için istatistiksel olarak önemli bir fark oluşturmamış olup, 8,99-11,49 mm arasında değişen değerlere sahip olmuşlardır.

Kılınç (2017), Giresun ekolojik şartlarında yerel bezelye çeşitleri ile yapılan çalışmada bakla genişliğinin 8,92-25,73 mm arasında olduğu kaydedilmiştir. Özaktan ve ark. (2022), Kayseri’de bezelye bitkisinde sulamanın etkisinin araştırıldığı denemede, bakla genişliğinin 15,49-17,17 mm arasında değiştiğini belirlemişlerdir. Bakla enine baklanın içerisindeki tanelerin büyüklüğü etki etmektedir. Bakla enine genetik faktörlerin etkisi yanı sıra çevresel faktörlerden de etkilendiği yürütülen çalışmalarda görülmektedir.

Bezelye çeşitleri ile yürütülen çalışmada bakla sayısı ve bakla ağırlığı ait özelliklerin ortalamaları ve oluşan grupları Çizelge 2’de verilmiştir.

Çizelge 2. Bezelye çeşitlerinin ekim zamanlarına göre bakla sayısı ve bakla ağırlığı değerleri.

Ekim zamanları	Bakla sayısı (adet)				Bakla ağırlığı (g)			
	Elena	Deren	Irmak 01	Ort.	Elena	Deren	Irmak 01	Ort.
Kasım	11,73	13,93	13,20	12,95 a	0,81	1,10	1,26	1,08 bc
Aralık	12,46	12,00	14,20	12,88 a	0,99	1,38	1,55	1,30 a
Ocak	12,00	8,46	9,86	10,11 b	0,90	1,49	1,35	1,25 a
Şubat	8,66	6,26	10,46	8,46 b	1,00	1,34	1,28	1,21 ab
Mart	5,20	3,00	4,20	4,13 c	0,82	1,00	1,06	0,96 c
Ortalama	10,01	8,73	10,38		0,90	1,28	1,30	

Araştırmada kullanılan bezelye çeşitleri arasında bakla sayısı özelliği bakımından önemli bir farklılık oluşmadığı, en fazla bakla sayısının Irmak 01 çeşidinde, en az bakla sayısının Deren çeşidinde kaydedildiği Çizelge 2’den görülmektedir. Uygulanan ekim zamanlarında 12,95 ve 12,88 adet ile Kasım ve Aralık aylarında yapılan ekimlerin en fazla bakla sayılarına sahip oldukları ve aynı grupta yer aldıkları belirlenmiştir. Mart ayında yapılan ekimlerde ise 4,13 adet ile en az bakla sayısı görülmüştür. Çeşit x ekim zamanları interaksiyonları, bakla sayısı özelliği için istatistiksel olarak önemli bir fark oluşturmamış olup, 3,00-14,20 adet arasında değişen bakla sayılarına sahip olmuşlardır.

Alan (1989), Erzurum bölgesinde üç farklı ekim zamanı (3 Mayıs, 29 Mayıs, 25 Haziran) ve iki bezelye çeşidi kullanılarak yapılan çalışmada ekim zamanı ilerledikçe bakla sayısının azaldığını (21,6-20,7-20,4 adet) belirlemişlerdir. Gülümser ve ark. (1994), Samsun şartlarında 10 bezelye çeşidi ve 2 ekim zamanı ile yapılan araştırmada kışlık ekimlerin verimlerinin daha fazla olduğunu ve bakla sayısının 10-16,3 adet arasında değiştiğini kaydetmişlerdir. Ishtiaq ve ark. (2001), Pakistan’ın Swat ve Mingora bölgelerinde 4 farklı ekim zamanı ve 4 bezelye çeşidi kullanarak yaptıkları araştırmada çeşitlerin ortalaması olarak bitkide en fazla bakla sayısının 45 adet olduğunu belirtmişlerdir. Ceyhan ve ark. (2005), Konya şartlarında 6 yerli bezelye çeşidi ve 20 egzotik kökenli bezelye çeşitlerinde bakla sayısının 18-38 adet arasında olduğunu, Karayel (2006), Samsun koşullarında yürütülen çalışmada bakla sayısının 10,6-43 adet arasında değiştiğini kaydetmişlerdir. Toğaç ve ark. (2006), Van ekolojik koşullarında 2 bezelye çeşidi kullanılarak yapılan araştırmada bakla sayısının 7,2-8,2 adet arasında değiştiğini, Shaukat ve ark. (2012), Pakistan’ın Kashmir bölgesinde 4 farklı sıra arası mesafe ve 4 farklı ekim zamanı ile yapılan araştırmada, bitkide bakla sayısı özelliği için en iyi sonucun 50 cm sıra arası mesafede elde edildiğini kaydetmişlerdir. Khan ve ark. (2013), Pakistan’ın Islamabad bölgesinde 15 bezelye genotipi ile yürütülen çalışmada bitkide bakla sayısının 14,25-60,40 arasında olduğu, Kılınç (2017), Giresun bölgesinde yerel bezelye çeşitleri ile yapılan araştırmada bakla sayısının 7-35 adet arasında olduğu belirtilmiştir. Haq ve Ahmed (2021), Bangladeş’te 13 Kasım, 28 Kasım ve 13 Aralık olmak üzere 3 farklı ekim zamanı kullanılarak yapılan araştırmada, en yüksek bakla sayısı 28 Kasım tarihinde yapılan ekimlerde elde edilmiştir. Özaktan ve ark. (2022), Kayseri şartlarında bezelye bitkisine sulamanın etkisinin araştırıldığı denemede bitkide bakla sayısı 3,86-11,06 adet olarak belirtilmiştir. Sayed ve Ouis (2022), Kahire’de biyolojik ve ticari gübreler uygulanarak yapılan araştırmada bakla sayısının 5,7-23,5 adet arasında değiştiğini kaydetmişlerdir. Daha önce yapılan çalışmalardan da bakla sayısının çeşitlere, uygulanan faktörlere ve çevreye göre değişkenlik gösterebileceği anlaşılmaktadır. Yürütülen çalışmada



da bezelye bitkisinin ılıman iklim bitkisi olması, hava sıcaklığının artmasıyla vejetasyon süresinin kısalması ve bunun sonucunda bakla sayısının azaldığı kaydedilmiştir.

Yapılan çalışmada çeşitler, bakla ağırlığı özelliğinde istatistiksel olarak farklılık göstermemiş olup, en fazla bakla ağırlığına sahip çeşidin Irmak 01, en düşük bakla ağırlığına sahip çeşidin Elena olduğu belirlenmiştir. Bakla ağırlığı bakımından denemede uygulanan ekim zamanları arasında istatistiksel olarak önemli farklılıklar oluşmuştur. Aralık ve Ocak aylarında yapılan ekimlerde elde edilen baklalar 1,30 ve 1,25 g ile en yüksek bakla ağırlığına sahip olduğu görülmüştür. Aralık, Ocak ve Şubat ayı ekimleri bakla ağırlığı yönünden kendi aralarında istatistiksel farklılık oluşturmamıştır. Mart ayında yapılan ekimlerde elde edilen baklalar 0,96 g ile en az bakla ağırlığına sahip çeşit olarak diğer ekim zamanlarından farklı bir istatistiksel grupta yer almıştır. Çeşit x ekim zamanları interaksyonları, bakla ağırlığı özelliğinde istatistiksel olarak önemli olmamıştır ve 0,81-1,55 g arasında değişen bakla ağırlıklarına sahip olmuşlardır.

Prusinski ve Borowska (2022), Polanda’da yürütülen çalışmada yağışın az olduğu ve havanın sıcak olduğunda bakla ağırlığının arttığını, yağışta oluşan düzensizlik bakla ağırlığını azalttığı belirmişlerdir. Bakla ağırlığının çevresel faktörlerden etkilendiği daha önce yapılan çalışmadan da anlaşılmaktadır.

Bezelye çeşitleri ile yürütülen çalışmada bakla tane sayısı ve ilk bakla yüksekliklerine ait özelliklerin ortalamaları ve oluşan grupları Çizelge 3’de verilmiştir.

Çizelge 3. Bezelye çeşitlerinin ekim zamanlarına göre baklada tane sayısı ve baklada tane ağırlığı değerleri.

Ekim zamanları	Baklada tane sayısı (adet)				İlk Bakla Yüksekliği (cm)			
	Elena	Deren	Irmak 01	Ort.	Elena	Deren	Irmak 01	Ort.
Kasım	5,04	6,02	4,86	5.30 bc	45,13 c	33,00 d	79,33 a	52,48 a
Aralık	5,46	6,27	5,92	5,88 a	28,40 de	30,23 d	55,10 b	37,91 b
Ocak	5,22	6,52	5,41	5.72 ab	27,73 de	28,40 de	50,20 bc	35,44 bc
Şubat	5,54	6,98	5,60	6.04 a	28,06 de	27,26 de	42,40 c	32,57 cd
Mart	4,90	5,08	4,93	4.97 c	25,53 de	21,40 e	42,33 c	29,75 d
Ortalama	5,23 b	6,17 a	5,34 b		30,97 b	28,06 b	53,87 a	

Yürütülen araştırmada kullanılan çeşitler baklada tane sayısı bakımından istatistiksel olarak iki grup oluşturmuştur. Baklada en fazla tane sayısı 6,17 adet ile Deren çeşidinde kaydedilmiştir ve istatistiksel olarak diğer iki çeşitten farklı grupta yer almıştır. Baklada en az tane sayısı 5,23 adet ile Elena çeşidinde kaydedilirken, Irmak 01 çeşidi ile aynı istatistiksel grupta yer almıştır. Ekim zamanlarına göre baklada tane sayısı 4,97-6,04 adet arasında değişmekte olup, baklada en fazla tane sayısı Şubat ayında yapılan ekimlerde, baklada en az tane sayısı ise Mart ayında yapılan ekimlerde görülmüştür. Baklada tane sayısı yönünden Şubat, Aralık ve Ocak ayı ekimleri arasında istatistiksel farklılığın olmadığı belirlenmiştir. Kasım ve Ocak ayı ekimleri arasında da baklada tane sayısı yönünden istatistiksel farklılığın olmadığı görülmüştür. Çeşit x ekim zamanları interaksyonları arasında önemli farklılık bulunmamakla beraber, baklada en fazla tane sayısı 6,98 adet ile Deren çeşidinin Şubat ayında yapılan ekiminde, baklada en az tane sayısı ise 4,86 adet ile Irmak 01 çeşidinin Kasım ayında yapılan ekiminde kaydedilmiştir.

Alan(1989), Erzurum ekolojik şartlarında üç farklı ekim zamanı (3 Mayıs, 29 Mayıs ve 25 Haziran) ve iki bezelye çeşidi ile yürütülen çalışmada ekim zamanı geciktikçe baklada tane sayısının azaldığını (5,6-5,4-4,9 adet) belirtmişlerdir. Gülümser ve ark. (1994), Samsun ekolojik koşullarında 10 bezelye çeşidi ve 2 farklı ekim zamanı ile yürütülen çalışmada baklada tane sayısının 4-6,9 adet arasında değiştiğini ve kışlık olarak yapılan ekimlerde verimin daha yüksek olduğunu kaydetmişlerdir. Ishtiaq ve ark. (2001), Pakistan’ın Mingora ve Swat bölgelerinde 4 farklı ekim zamanı ve 4 bezelye çeşidi ile yürütülen araştırmada çeşitlerin ortalaması olarak baklada en fazla tane sayısının 6,17 adet olduğunu belirtmişlerdir. Karayel (2006), Samsun şartlarında yürütülen araştırmada baklada tane sayısının 4-7,6 arasında olduğunu, Shaukat ve ark. (2012), Pakistan’ın Kashmir bölgesinde 4 farklı sıra arası mesafe ve 4 ekim zamanı kullanarak yaptıkları araştırmada en fazla baklada tane sayısının 50 cm sıra arası mesafedeki bitkilerden elde ettiklerini bildirmişlerdir. Khan ve ark. (2013), Pakistan’ın Islamabad bölgesinde 15 bezelye genotipi ile yapılan araştırmada baklada tane sayısının 3,66-8,26 adet arasında değiştiğini, Kılınç (2017), Giresun bölgesinde yerel bezelye çeşitleri ile yürütülen araştırmada baklada tane sayısının 3-11 adet arasında olduğunu belirtmişlerdir. Haq ve Ahmed (2021), Bangladeş’te 13 Kasım, 28 Kasım ve 13 Aralık olmak üzere üç farklı ekim zamanı uygulanarak yürütülen araştırmada baklada en fazla tane sayısının 28 Kasım tarihinde yapılan ekimlerde elde edildiğini belirtmişlerdir. Sayed ve Ouis (2022), Kahire’de biyolojik ve ticari gübreler uygulanan araştırmada bakladaki tane sayısının 4,7-12 adet arasında değiştiğini belirtmişlerdir. Luthra ve ark. (2024), Hindistan’da 25 bezelye çeşidi kullanılarak yapılan araştırmada bakladaki tane sayısının 5,43-7,93 adet arasında



değiştiğini belirtmişlerdir. Önceki çalışmalardan da bakladaki tohum sayısının çok değişken olduğu görülmektedir. Baklada tohum sayısı, verimi belirleyen bir özellik olduğu için, genetik faktörlerle birlikte tüm çevresel faktörlerden etkilenmektedir. En az tohum sayısının Mart ayında yapılan ekimlerden elde edilmesi, hava sıcaklığının artması ve döllenme oranının düşmesi ile açıklanmaktadır.

Yapılan araştırmada ilk bakla yükseklikleri çeşitler arasında önemli farklılıklar göstermiş olup 28,06-53,87 cm arasında ölçülmüştür. En yüksek ilk bakla yüksekliğine sahip çeşit 53,87 cm ile Irmak 01 olurken, en düşük ilk bakla yüksekliğine sahip çeşitler Deren ve Elena; 28,06 ve 30,97 cm ile aynı istatistiksel grupta yer almışlardır. Çalışmada ekim zamanları, ilk bakla yüksekliği özelliğinde istatistiksel olarak önemli farklılık oluşturmuştur. En yüksek ilk bakla yüksekliği 52,48 cm ile Kasım ayında yapılan ekimlerde görülmüş olup diğer ekim zamanlarından farklı istatistiksel grupta yer alırken, en düşük ilk bakla yüksekliği ise 29,75 cm ile Mart ayında yapılan ekimlerde kaydedilmiştir. Mart ayında elde edilen bakla yükseklik değerleri, Şubat ayında elde edilen değerlerden istatistiksel önemli farklılıklar oluşturmadığı belirlenmiştir. Çeşit x ekim zamanları interaksyonları istatistiksel olarak önemli fark oluşturmuş olup, en yüksek ilk bakla yüksekliği 79,33 cm ile Irmak çeşidinin Kasım ayı ekiminde görülürken, en düşük ilk bakla yüksekliği ise 21,40 cm ile Deren çeşidinin Mart ayında yapılan ekiminde kaydedilmiştir. Diğer interaksyonlarda ilk bakla yüksekliği değerleri 55,10-25,53 cm arasında değişim gösterdiği tespit edilmiştir.

Kılınç (2017), Giresun bölgesinde yerel bezelye çeşitleri ile yürütülen araştırmada, ilk bakla yüksekliğinin 5-72 cm arasında olduğu belirlenmiştir. Özaktan ve ark. (2022), Kayseri ekolojik koşullarında bezelye bitkisine sulamanın etkisinin belirlenmesi amacıyla yürütülen denemede, ilk bakla yüksekliğinin 24,05-27,86 cm arasında değiştiği kaydedilmiştir. İlk bakla yüksekliği özelliğine kullanılan çeşidin genetik yapısının etkisi olduğu gibi, çevresel faktörlerin de etkisinin olduğu yürütülen araştırmada ve daha önce yapılan çalışmalarda da görülmektedir. Bezelye çeşitleri ile yürütülen çalışmada baklada tane ağırlığına ait özelliklerin ortalamaları ve oluşan grupları Çizelge 4’de verilmiştir

Çizelge 4. Bezelye çeşitlerinin ekim zamanlarına göre baklada tane ağırlığı değerleri.

Ekim zamanları	Baklada Tane Ağırlığı (g)			
	Elena	Deren	Irmak 01	Ort.
Kasım	0,64	0,92	0,99	0,85 b
Aralık	0,78	1,12	1,26	1,05 a
Ocak	0,71	1,18	1,03	0,98 a
Şubat	0,81	1,06	1,04	0,97 a
Mart	0,66	0,79	0,86	0,77 b
Ortalama	0,72 b	1,01 a	1,04 a	

Çalışmada kullanılan bezelye çeşitleri, baklada tane ağırlıkları bakımından iki farklı istatistiksel grup oluşturmuştur. Irmak 01 ve Deren çeşitleri 1,04 ve 1,01 g ile baklada tane ağırlığı bakımından aynı istatistiksel grupta yer almışlardır. Elena çeşidi ise 0,72 g baklada tane ağırlığı ile diğer iki çeşidin gerisinde kalarak farklı bir istatistiksel grupta yer almıştır. Ekim zamanlarına göre baklada tane ağırlıkları iki farklı grup oluşturmuş olup, Aralık, Ocak ve Şubat aylarında yapılan ekimlerin baklada tane ağırlıkları diğer iki ekim zamanına göre daha fazladır. Baklada tane ağırlığı 0,77 g olan Mart ayı ekimi ve 0,85 g ile Kasım ayı ekimi aynı istatistiksel grupta yer alarak en düşük baklada tane ağırlığı elde edilen ekim zamanını oluşturmuştur. Çeşit x ekim zamanı interaksyonları baklada tane ağırlığı özelliğinde önemli bir fark oluşturmamış olup, en fazla baklada tane ağırlığı 1,26 g ile Irmak 01 çeşidinin Aralık ayı ekiminde, en düşük baklada tane ağırlığı ise 0,64 g ile Elena çeşidinin Kasım ayı ekiminde elde edilmiştir

Kılınç (2017), Giresun ekolojik koşullarında yerel bezelye çeşitleri kullanılarak yürütülen araştırmada bakladaki kuru tanelerin 0,90-2,70 g ağırlığında olduğunu belirtmiştir. Yürütülen araştırmada da erken ve geç ekimin bakladaki tane ağırlığını etkilediği görülmektedir

Sonuç

Kahramanmaraş koşullarında üç yerel bezelye çeşidine, beş farklı ekim zamanı uygulanarak, çeşitlerin ekim zamanlarına göre kuru baklaları incelenmiştir. Araştırmada kullanılan bezelye çeşitlerinden en fazla bakla boyu ve bakla tane sayısı Deren çeşidinde elde edilirken, en fazla bakla ağırlığı ve baklada tane ağırlığı Irmak 01 çeşidinde elde edilmiştir. İncelene özelliklerden bakla boyu, bakla ağırlığı, baklada tane ağırlığında en yüksek değerler Aralık ayı ekimlerinde elde edilmiştir. Kasım ayından Mart ayına kadar yapılan beş farklı ekimde, Mart ayında yapılan ekimlerde incelenen bakla değerlerinin düştüğü görülmüştür. Akdeniz iklimine sahip bölgelerde bezelye bitkisinin baklalarının bahar aylarındaki sıcaklık artışlarından etkilenebileceği dikkate alınarak ekimlerinin kış aylarında yapılabilmesinin daha uygun olabileceği sonucuna varılmıştır.



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Evaluation of Linear Type Traits of Simmental (Fleckvieh) Cattle in a Private Farm in Karacabey District of Bursa Province

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Abstract

In this study, linear type traits of Simmental (SIM) cattle of Austrian and German origin, raised in a disease-free private cattle farm with the capacity of 550 heads in Karacabey District of Bursa Province, were evaluated. The overall means of linear type traits for body structure, rump height (RH), rump length (RL), rump angle (RA), rump width (RW), back length (BL), body depth (BD), chest length (CL), muscularity (M); for udder structure, fore udder attachment (FUA), teat length (TL), teat thickness (TT), front teat placement (FTP), fore udder length (FUL), rear udder length (RUL), udder depth (UD), central ligament (CL), rear teat angle (RTA), rear teat attitude (RTA), rear teat placement (RTP), rear udder height (RUH); for foot-leg structure, hock angularity (HA), hock development (HD), hoof angle (HFA), hoof height (HH) and ankle angle (AA) were determined as 142.73±0.207 cm, 43.66±0.164 cm, 5.13±0.039, 20.02±0.114, 85.15±0.384 cm, 75.31±0.194 cm, 5.76±0.033, 5.41±0.038, 5.23±0.055, 5.47±0.060 cm, 3.49±0.025 cm, 4.01±0.043, 5.44±0.043, 5.11±0.041, 3.40±0.059, 4.66±0.066, 4.49±0.045, 4.62±0.048, 4.80±0.057, 5.60±0.049, 4.89±0.041, 4.94±0.050, 4.29±0.033, 4.31±0.32 cm ve 5.57±0.035, respectively. In this study, the averages calculated in terms of linear type traits were similar to the results obtained in many studies, and it was determined that there were significant differences between the BD, TT, UD, HA, HH, and HFA characteristics and the literature, and that these differences were due to the farm. Since there are not enough studies on the evaluation of the SIM breed cattle according to linear type traits, it is thought that this study will contribute to the literature.

Key Words: Simmental, Linear type traits, Body structure, Foot-leg structure, Udder structure

Bursa İli Karacabey İlçesinde Özel Bir İşletmede Yetiştirilen Simmental (Fleckvieh)ırkı Sığırların Dış Görünüş Özelliklerinin Değerlendirilmesi

Özet

Bu çalışmada Bursa ili Karacabey ilçesinde hastalıklardan arı 550 baş sağmal kapasiteye sahip özel bir işletmede yetiştirilen Almanya ve Avusturya orijinli 495 baş Simmental (SİM) ırkı sığırın dış görünüş özellikleri değerlendirilmiştir. Dış görünüş özelliklerinden beden yapısına ait Sağrı yüksekliği (SY), Sağrı uzunluğu (SU), Sağrı eğimi (SE), Sağrı genişliği (SG), Omuz-bel uzunluğu (OBU), Beden derinliği (BD), Göğüs genişliği (GG) ve Kaslılık (K), meme yapısına ait Ön meme bağlantısı (ÖMB), Ön meme başı uzunluğu (ÖMBU), Ön meme başı kalınlığı (ÖBK), Ön meme başı yerleşimi (ÖMBY), Memenin önden görünümü (MÖG), Memenin baldırdan görünümü (MBG), Meme taban yüksekliği (MTY), Meme merkez bağı (MMB), Meme başı yönü (MBY), Arka meme başı pozisyonu (AMP), Arka meme başı yerleşimi (AMBY), Arka meme yüksekliği (AMYU), ayak bacak yapısına ait olarak da Arka bacak açısı (ABA), Diz yapısı (DY), Tırnak açısı (TA), Tırnak taban yüksekliği (TY) ve Bilek açısı (BAÇ) özelliklerine ait genel ortalamalar sırasıyla 142.73±0.207 cm, 43.66±0.164 cm, 5.13±0.039, 20.02±0.114, 85.15±0.384 cm, 75.31±0.194 cm, 5.76±0.033, 5.41±0.038, 5.23±0.055, 5.47±0.060 cm, 3.49±0.025 cm, 4.01±0.043, 5.44±0.043, 5.11±0.041, 3.40±0.059, 4.66±0.066, 4.49±0.045, 4.62±0.048, 4.80±0.057, 5.60±0.049, 4.89±0.041, 4.94±0.050, 4.29±0.033, 4.31±0.32 cm ve 5.57±0.035 olarak belirlenmiştir.

Bu çalışmada dış görünüş özellikleri açısından hesaplanan ortalamalar bir çok araştırmada elde edilen sonuçlarla benzerlik göstermiş, BD, ÖBK, MTY, ABA, TTY, ve TA özellikleri açısından literatürle aralarında önemli farklılıklar bulunduğu, bu farklılıkların işletmeden kaynaklandığı belirlenmiştir. SİM ırkı sığırlarda dış görünüşe göre değerlendirme üzerine yeterince çalışma bulunmadığından bu çalışmanın literatüre katkı sağlayacağı düşünülmektedir.

Anahtar Kelimeler: Simmental, dış görünüş özellikleri, Beden yapısı, Ayak-bacak yapısı, Meme yapısı

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ID: 549

Effects of Adding Organic and Inorganic Form of Copper at Different Levels to Diets of Breeding Quail on Performance and Hatching Parameters

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Abstract

This study was conducted to evaluate the effects of diets supplemented with different levels of inorganic and organic copper sources on the performance and hatchability of breeding Japanese quails. In the study, a total of 360 Japanese quails (female: male ratio, 2:1) aged 7 weeks were fed with diets supplemented with copper in inorganic ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) or organic form (Cu-amino acid chelate) at levels of 0, 10, 20, 40 and 80 mg/kg for 5 periods of 28 days. Ten treatments consisting of two copper sources and 5 copper levels were used in a 2x5 factorial experimental plan. Each treatment had 6 replications, each replication consisting of 4 female and 2 male quails. The study lasted 140 days and feed and water were provided ad libitum to the quails throughout the experiment. According to the study results, feed intake and feed conversion ratio were lower in the group fed with organic Cu than in the group fed with inorganic Cu ($P < 0.05$). The effect of different Cu sources on other performance parameters and hatchability characteristics was similar. The effect of dietary Cu levels on performance and hatchability characteristics was statistically insignificant ($P > 0.05$). Copper source x levels interaction had a significant effect on egg weight and chick weight of hatchability ($P < 0.05$). Other measured performance and hatchability characteristics were not affected by the interactions.

The study results show that the use of organic Cu sources in breeder quail diets reduced feed intake and improved feed efficiency. It can be said that adding 20 mg/kg of Cu to the diet may improve performance, but it does not cause a significant difference in hatchability parameters.

Key Words: Breeder, Copper, Hatching, Quail, Performance

Damızlık Bildircin Rasyonlarına Farklı Seviyelerde Organik ve İnorganik Formda Bakır İlavesinin Performans ve Kuluçka Parametrelerine Etkisi

Özet

Bu çalışma, farklı seviyelerde inorganik ve organik bakır kaynakları ilave edilen rasyonların damızlık Japon bildircinlerinin performans ve kuluçka özelliklerine etkisini değerlendirmek için yapıldı. Çalışmada 7 haftalık yaşta toplam 360 adet Japon bildircini (dişi:erkek oranı, 2:1), 28 günlük 5 dönem boyunca, inorganik ($\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) veya organik formda (Cu-amino acid chelate), 0, 10, 20, 40 and 80 mg/kg seviyelerinde bakır ilave edilmiş rasyonlarla beslendi. İki bakır kaynağı ve 5 bakır seviyesinden oluşan 10 muamele, 2x5 faktöryel deneme planında kullanıldı. Her muamele 6 tekerrürlü olup her bir tekerrür 4 dişi ve 2 erkek bildircinden ibaretti. Çalışma 140 sürdü ve deneme süresince bildircinlere yem ve su ad-libitum olarak sağlandı.

Çalışma sonuçlarına göre organik Cu ile beslenen grupta yem tüketimi ve yem değerlendirme katsayısı inorganik Cu ile beslenen gruptan daha düşük olmuştur ($P < 0.05$). Diğer performans parametreleri ve kuluçka özellikleri üzerine farklı Cu kaynaklarının etkisi benzer olmuştur. Rasyon Cu seviyelerinin performans ve kuluçka özelliklerine etkisi istatistik olarak önemsiz olmuştur ($P > 0.05$). Bakır kaynakxseviye interaksyonunun yumurta ağırlığı ve civciv çıkış ağırlığına önemli etkisi vardı ($P < 0.05$). Ölçülen diğer performans ve kuluçka özellikleri interaksyonlardan etkilenmedi.

Çalışma sonuçları damızlık bildircin rasyonlarında organik Cu kaynaklarının kullanımı yem tüketimini azaltmış ve yem değerlendirmeyi iyileştirmiştir. Rasyona 20 mg/kg seviyesinde Cu ilavesinin performansı iyileştirebileceği, fakat kuluçka parametrelerinde önemli seviyede bir farklılığa sebep olmadığı söylenebilir.

Anahtar Kelimeler: Bakır, Bildircin, Damızlık, Kuluçka, Performans





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Effects of iodine on visual color quality of sweet pepper under salinity stress

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Abstract

The quality of the pepper's color was assessed by examining the intensity and consistency of its outer pigmentation, which reflects the ripeness and overall marketability of the fruit. This study investigated how three different doses of iodine (0, 50, and 100 μM) affected the visual color quality of peppers under varying levels of salinity stress (2, 4, 6, and 8 dS m^{-1}). The L^* value ranged from 40.6 to 52.2, the a^* value varied between -17.1 and 23.8, the b^* value fluctuated between 18.5 and 32.5, and the chroma value shifted between 44.6 and 57.3. The application of foliar iodine had a significant impact on the L^* , a^* , b^* , and chroma values of pepper fruits. However, the L^* , a^* , and b^* values decreased with higher salt stress, with the highest values observed at a salinity level of 2 dS m^{-1} . The chroma value of pepper fruit decreased with foliar iodine application and further reduced with increasing salinity stress. The best visual color quality was achieved with a foliar application of 100 μM iodine and a salinity stress level of 2 dS m^{-1} . Under salinity conditions of 6 and 8 dS m^{-1} , foliar iodine did not significantly improve the visual color quality of pepper fruits. Therefore, foliar iodine is recommended for use under low soil salinity conditions. In future studies, iodine could be combined with different regulators to enhance the quality of pepper fruits under high salinity stress.

Key Words: Fruit quality , *Capsicum annum*, Color parameters, Iodine, Salinity.



Chemicals That Enhance Food Flavor

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Abstract

Flavor enhancement is a crucial aspect of culinary arts, contributing significantly to the enjoyment and palatability of foods. This paper aims to provide a comprehensive review of substances and chemicals commonly used to enhance food flavors. Beginning with an overview of the importance of flavor in food perception, the paper explores various categories of flavor enhancers, including monosodium glutamate (MSG), salt, sucrose, nucleotides, maltol, ethyl maltol and cyclamate. Each section examines the chemical properties, mechanisms of action, culinary applications, and potential health implications of these flavor enhancers. Additionally, the paper discusses emerging trends and innovations in flavor enhancement, highlighting the ongoing research efforts in this field. Through this review, readers will gain a deeper understanding of the science behind flavor enhancement and its multifaceted role in culinary creativity and consumer satisfaction.

Key Words: *Gastronomy, Food Chemicals, Flavor Enhancement*

Gıda Lezzetini Arttıran Kimyasallar

Özet

Lezzet artırma, mutfak sanatlarının önemli bir yönüdür ve gıdaların keyif ve lezzetine önemli ölçüde katkıda bulunur. Bu çalışma, gıda aromalarını geliştirmek için yaygın olarak kullanılan maddeler ve kimyasallar hakkında kapsamlı bir inceleme sunmayı amaçlamaktadır. Gıda algısında lezzetin önemine genel bir bakışla başlayan makale, monosodyum glutamat (MSG), tuz, şükroz, nükleotidler, maltol, etil maltol ve siklomat dahil olmak üzere çeşitli lezzet arttırıcı kategorilerini incelemektedir. Her bölümde bu lezzet arttırıcıların kimyasal özellikleri, etki mekanizmaları, mutfak uygulamaları ve potansiyel sağlık etkileri incelenmektedir. Ayrıca, bu alanda devam eden araştırma çabalarını vurgulayarak, lezzet artırma konusunda ortaya çıkan eğilimleri ve yenilikleri tartışmaktadır. Bu derleme sayesinde okuyucular, lezzet arttırmanın ardındaki bilimi ve lezzet arttırmanın mutfak yaratıcılığı ve tüketici memnuniyetindeki çok yönlü rolünü daha iyi anlayacaklardır.

Anahtar Kelimeler: *Gastronomi, Gıda Kimyasalları, Lezzet Artırma*

Giriş

Gıda ürünleri, koku ve tatlarına katkıda bulunan birçok bileşen içermektedir. Bunlar, tüketici tercihlerini etkileyen ana faktörlerden önemli iki bileşeni temsil etmektedir. Bu nedenle, gıda aromasının kimyası, ürünlerin ticari başarısını etkileme potansiyeli nedeniyle gıda araştırmalarında büyük ilgi gören bir konudur. Bu durum, gıda araştırmaları ve ürün geliştirme projelerinde kimyasal tanımlama ve duyuşal değerlendirmeyi önemli kılmaktadır. Analitik tekniklerdeki son gelişmeler ve farklı kimyasal-duyuşal yaklaşımları birleştirme yeteneği, aroma kimyası, duyuşal profiller ve gıda tüketici tercihleri arasındaki ilişkileri araştıran heyecan verici bir araştırma çizgisine yol açmıştır. Şimdiye kadar, gıdalardaki bileşenleri tanımlamak için çok sayıda teknik uygulanmıştır (Sanstis, 2024). İki önemli bileşenden biri olan Lezzet; tat, aroma ve ağız hissini kapsayan çok boyutlu bir duyuşal deneyimdir ve gıdaların kabulü ve keyif alınmasında önemli bir rol oynamaktadır. Doğal bileşenler gıdaların içsel lezzetine katkıda bulunurken, şefler ve gıda üreticileri tarafından lezzet profillerini geliştirmek ve yoğunlaştırmak için genellikle çeşitli maddeler ve kimyasallar kullanılmaktadır. Bu lezzet arttırıcılar tat reseptörleri, koku reseptörleri ve diğer duyuşal mekanizmalarla etkileşime girerek tat ve aroma algısını artırır. Lezzet arttırmanın altında yatan ilkeleri anlamak mutfak profesyonelleri, gıda bilimcileri ve tüketiciler için çok önemlidir. (Spence, 2015). Maddelerin ve kimyasalların kullanımı yoluyla gıda lezzetlerinin artırılması, dünya çapında mutfak geleneklerine derinlemesine yerleşmiş çok yönlü bir uygulamadır. Baharat ve ot kullanan eski uygarlıklardan sentetik bileşiklerden yararlanan modern gıda endüstrilerine kadar, tatları yoğunlaştırma, değiştirme veya tamamlama arayışı gastronomide itici bir güç olmuştur. Bu arayış, yalnızca geliştirilmiş tatlardan elde edilen duyuşal zevkten değil, aynı zamanda gıda üretimi ve tüketiminin kültürel, ekonomik ve teknolojik boyutlarından da kaynaklanmaktadır (Doğan & Özdemir, 2022).



Lezzet artırma, özünde kimyasal bileşim, duyuşsal algı ve kültürel tercihler arasındaki karmaşık bir etkileşimi içermektedir. Lezzet artırıcı maddelerin ve kimyasalların tat reseptörlerimiz ve koku alma sistemimizle etkileşime girdiği mekanizmaları anlamak, mutfak simyasının inceliklerini çözmek için gereklidir. Dahası, bu uygulamaların ortaya çıktığı tarihi ve kültürel bağlamları keşfetmek, mutfak geleneklerinin ve beslenme alışkanlıklarının evrimi hakkında değerli bilgiler sağlar (Mouritsen, 2015).

Son yıllarda, gıda bilimi ve teknolojisindeki gelişmeler, yeni aroma bileşiklerinin ve katkı maddelerinin geliştirilmesine yol açarak şeflerin ve gıda üreticilerinin kullanabileceği araç repertuarını genişletmiştir (Keast & Brestlin, 2002). Ancak bu yeniliklerin yanı sıra güvenlik, düzenleme ve tüketici algısı ile ilgili zorluklar da ortaya çıkmıştır. Lezzet artırıcı maddelerin sorumlu bir şekilde kullanılması, potansiyel sağlık etkilerinin incelikli bir şekilde anlaşılmasını ve şeffaflık ve bilinçli tüketici seçimine ilişkin etik hususları gerektirir (Thomas et al., 2022). Lezzet artırmanın bilimsel, tarihi ve sosyo-kültürel boyutlarının incelenmesi, gıda ve lezzetin sürekli gelişen manzarasında gelenek ve yenilik arasındaki karmaşık etkileşimin aydınlatılması adına önem arz etmektedir. Buradan hareketle bu çalışma, gıda aromalarını geliştiren ve lezzet artırmada yaygın olarak kullanılan temel maddeler ve kimyasalların derinlemesine incelenmesini sağlayarak bunların etki mekanizmalarına, mutfak uygulamalarına ve insan sağlığı üzerindeki potansiyel etkilerine kimya ve gastronomi alanlarındaki görüşlerden yararlanarak, kapsamlı bir genel bakış sağlamayı amaçlamaktadır.

Monosodyum Glutamat (MSG)

MSG, güvenliğini ve etkinliğini çevreleyen yanlış anlamalar nedeniyle önemli tartışmalara yol açan bir lezzet arttırıcıdır. Glutamik asit bir sodyum tuzudur ve bu tuz monosodyum glutamattır. Doğada, genellikle glutamik asit olarak adlandırılan glutamat tipik bir amino asittir. Neredeyse tüm dokularda bulunabilir ve çok sayıda protein ve peptidin yapı taşıdır. Ticari olarak pekmezin fermente edilmesiyle elde edilir, ayrıca diğer fermente protein ürünlerinin yanı sıra soya sosu ve hidrolize bitkisel proteinde de bulunur. Vücut ayrıca insan metabolizması için gerekli olan glutamati da üretir. (Kurihara, 2009).

Kimyasal olarak MSG, umami tat algısındaki rolüyle bilinen bir amino asit olan glutamik asidin sodyum tuzudur. MSG ilk olarak 1908 yılında Japon mutfağında et suyu (dashi) olarak kullanılan yenilebilir bir deniz yosunu olan kombu'nun tuzlu tadını izole etmeye ve çoğaltmaya çalışan Japon biyokimyacı Kikunae Ikeda tarafından hazırlanmıştır. MSG diğer tatların algılanmasını dengelemekte, bu lezzetleri karıştırmakta ve yuvarlamaktadır. MSG, disodyum ribonükleotidlerle birlikte stok (bulyon) küplerinde, çorbalarda, ramenlerde, et suyunda, güveçlerde, çeşnilerde, tuzlu atıştırmalıklarda vb. çeşit yemeklerde yaygın olarak kullanılmakta ve bulunmaktadır. (Yoshida & Ninomiya, 2023).

Monosodyum glutamat (MSG) genel olarak gıdalara eklendiğinde yemeklerin lezzetini artırarak yemekleri daha lezzetli ve doyurucu hale getirir. Başta Asya mutfağı olmak üzere dünya çapında çeşitli yemeklerde kullanılan yaygın bir lezzet arttırıcı olan MSG, çeşitli dünya mutfaklarında farklı yemek ve uygulamalarda kullanılmaktadır. Çin mutfağında kızartmalar, çorbalar ve soslar da dahil olmak üzere yemeklerin tuzlu tatlarını yoğunlaştırmak için yaygın olarak kullanılmaktadır. Japon mutfağında Miso çorbası, ramen ve suşi pilavı gibi birçok Japon yemeği MSG ilavesinden faydalanarak umami lezzet profillerini geliştirir. Kore mutfağında kimchi ve kimchi jjigae gibi çeşitli güveçlerde MSG kullanılmaktadır. Tayland mutfağında MSG, köriler, tavada kızartmalar ve Pad Thai gibi erişte yemekleri gibi Tayland yemeklerinde yaygın olarak bulunmakta ve bu yemeklerin zengin ve lezzetli tatlarına katkıda bulunmaktadır.

Genel olarak bakıldığında MSG, farklı mutfak geleneklerindeki çorbalar ve et sularında tuzlu notalarını güçlendirmek için sıklıkla eklenmektedir. Bunun yanı sıra atıştırmalık gıdalarda özellikle aromalı cipsler, hazır eriştelere ve diğer tuzlu ikramlar gibi işlenmiş atıştırmalıklarda, bunların tatlarını ve çekiciliklerini artırmak için genellikle MSG kullanılmaktadır (Schaich, 2018).

Konserve ve paketlenmiş gıdalar da MSG içermekte, özellikle birçok konserve çorba, sos ve paketlenmiş yemekte lezzet arttırıcı olarak MSG kullanımı sayesinde bu ürünlerde daha güçlü lezzet profillerine sahip olunabilmektedir. (Marti et al., 2017).

Bu örnekler, MSG'nin dünya çapında mutfak kültürlerindeki çeşitli uygulamalarını göstermekte ve çeşitli yemeklerin lezzet deneyimini yükseltmedeki rolünü ortaya koymaktadır. Geleneksel Çin besinlerinin tüketimi sonrasında ani gelişen; baş ağrısı, halsizlik, karın ağrısı, yüzde kızarma ve göğüste sıkışma hissi gibi semptomlara verilen genel rahatsızlık adı olan "Çin Restoranı Sendromu" ile ilişkisi konusundaki endişelere rağmen, çok sayıda bilimsel çalışma, makul miktarlarda tüketildiği takdirde MSG'nin güvenli olduğunu göstermiştir (Fernstrom, 2020).

Tuz (Sodyum Klorür)

Günümüzde hemen hemen tüm toplumların nispeten yüksek denilebilecek düzeyde tuz kullanımının yaygınlaşmasının, günümüzden 5.000-10.000 yıl öncesine dayanmakta olduğunu düşünüyor olması göz önüne alındığında tuz, insanlık tarihinin en eski ve en yaygın bileşenlerinden biridir. Gastronomide sadece lezzet arttırıcı bir baharat olarak lezzeti arttırmada temel bir kimyasal ajan olarak değil, gıdaları koruma kabiliyetiyle de yüz yıllardır önemli bir rol oynamaktadır. Tuzun gıda bileşenleriyle etkileşime girdiği çok yönlü yollardan söz etmek



mümkündür. Kimyasal özellikleri ve tat algısı üzerindeki etkisi nedeniyle tuz, gastronomideki tarihsel önemi ve fizyolojik etkileriyle günümüz modern uygulamalarında da önemini korumaktadır (NIH, 2010).

Bilimsel olarak kimyada sodyum klorür (NaCl) olarak bilinen tuz, kültürler ve medeniyetler arasında gastronomi ve mutfak uygulamalarına derinlemesine yerleşmiş bir mineral bileşiktir. Gıdalardaki çeşitli kimyasal ve fizyolojik süreçleri etkilediği için rolü sadece tat geliştirmenin ötesindedir. Kimyasal olarak tuz, tuzluluk algısını arttırmak için dildeki tat reseptörleri ile etkileşime giren sodyum ve klorür iyonlarından oluşur. Ayrıca tuz, tat hücreleriyle karmaşık etkileşimler yoluyla tatlılık ve acılık gibi diğer tatların algılanmasını da modüle edebilmektedir. Moleküler düzeyde tuz, mutfak etkinliğini destekleyen ayırt edici kimyasal özellikler sergilemektedir. Sodyum iyonları (Na⁺) ve klorür iyonları (Cl⁻) sulu çözeltilerde ayrılarak gıda bileşenleri üzerinde çeşitli etkiler göstermektedir. Sodyum iyonları tat reseptörlerinin aktivitesini modüle ederek tatlılık algısını artırırken, klorür iyonları tuzlu bir tat hissi şeklinde katkıda bulunmaktadır. Ayrıca tuz, su aktivitesini azaltarak koruyucu görevi görür ve böylece mikrobiyal büyümeyi ve enzimatik reaksiyonları da engellemektedir. Bu koruma mekanizması, tarih boyunca gıda muhafazasında çok önemli olmuştur (Prescott, 1999).

Lezzet açısından ele alındığında tuz, genel gıda lezzetine tuz tadından daha fazlasını vermektedir. Çeşitli gıdalar üzerinde (çorbalar, pirinç, yumurta ve patates cipsi) yapılan çalışmalarda, tuzun ürün kalınlığı algısını iyileştirdiği, tatlılığı artırdığı, metalik veya kimyasal kötü kokuları maskeleyiği ve lezzet yoğunluğunu artırırken genel lezzeti tamamladığı görülmüştür. Bu nedenle tuzun genel manada gıdalardaki fonksiyonları olarak lezzet dışında doku ve kalite kriterlerine etkisi ile mikrobiyolojik açıdan sağladığı güvenlik konuları da önem arz etmektedir (Akgün et al., 2018).

Bir gıda koruyucusu, bir doku geliştirici, bir lezzet artırıcı olması gibi temel kullanım özelliklerinin yanı sıra tuz aynı zamanda bir bağlayıcıdır. Diğer bir ifade ile tuz, protein jelleri oluşturmaya yardımcı olduğu için bağlayıcı bir madde olarak kullanılabilir. Sosis veya diğer işlenmiş etler gibi gıdalara tuz eklendiğinde, proteinlerin jellatlenmesine neden olur ve bu da ürünü bir arada tutmaktadır. Diğer yandan tuz aynı zamanda bir renk geliştiricidir. Jambon veya sosisli sandviç gibi birçok işlenmiş et türünün canlı rengi kısmen tuzdan kaynaklanmaktadır. Tuzun varlığı rengin gelişmesine ve korunmasına yardımcı olur ve griye dönüşmesini önler. Tuz, ayrıca ekmek kabuğundaki karamelizasyonu artırarak altın rengini almasına da yardımcı olan maddedir. Elbette gıda içerisinde etkisi anlamında sayılan bunca özelliğine son olarak tuzun önemli bir besin kaynağı oluşu da eklenmelidir. Saf sofraya tuzu yaklaşık yüzde 40 sodyum ve yüzde 60 klorürden oluşur. Dünya genelinde çoğu insan gereğinden çok fazla sodyum tüketiyor olsa da sodyum hayatta kalmak için gerekli olan bir besin maddesidir. Sodyum, kasların gevşemesine ve kasılmasına yardımcı olmak, sinir uyarılarını iletmek ve vücuttaki mineral ve su dengesini korumak için gereklidir. Hatta Amerika Birleşik Devletleri'ndeki sofraya tuzlarının çoğuna, guatr da dahil olmak üzere tiroit bozukluklarına neden olabilen iyot eksikliklerini önlemek için iyot da eklenmiştir (Moncel, 2022).

Çağdaş gastronomide tuz, günümüzde yeni keşfedilen birçok mutfak teknikleri ve uygulamalarına rağmen, temel bir bileşen olmaya devam etmektedir. Şefler yemeklere farklı dokular ve tatlar kazandırmak için koşer tuzu, deniz tuzu ve aromalı tuzlar gibi çeşitli tuz türlerini kullanmaktadır. Dahası, moleküler gastronominin ortaya çıkışı, lezzet ve dokuyu geliştirmek için tuzla kürlleme, tuzla fırınlama ve tuzla yaşlandırma gibi tuzun yenilikçi kullanımlarını kolaylaştırmıştır. Fakat bu gelişmelerin sağladığı imkanlarla birlikte, sodyum içeriği yüksek işlenmiş gıdaların da yaygınlaşması, aşırı tuz tüketimini kolaylaştırmakta ve sağlık üzerindeki olumsuz etkileri konusunda endişelere yol açmaktadır.

Tuzun gastronomide yaygın kullanımı, etik ve sağlık üzerindeki etkilerinin incelikli bir şekilde anlaşılmasını gerektirmektedir. Tuz, lezzet dengesi ve mutfak gelişimi için gerekli olsa da aşırı tuz alımı hipertansiyon ve kardiyovasküler hastalık gibi sağlık sorunlarıyla ilişkilendirilmiştir (Sun et al., 2022).

Dünya Sağlık Örgütü (DSÖ) kalp-damar hastalıklarının önlenmesi için bireylerin günde 5 gramdan daha az tuz tüketmesini önermektedir. Ancak dünya çapında tuz tüketiminin günlük 9-12 gram olduğunu belirten DSÖ, tuz tüketiminin önerilen miktara düşürülmesinin kan basıncı ve kalp-damar hastalıkları üzerinde büyük bir etkisinin olabileceğini ifade etmektedir (WHO, 2024). Bu bağlamda, ulusal ve uluslararası düzeyde yetkili kurumlar tarafından tuz azaltma programları hayata geçirilerek dünya çapında tuz tüketiminin azaltılması amaçlanmıştır. Bu doğrultuda, şefler ve gıda üreticileri tuzu tariflere dahil ederken dikkatli olmakta ve sağlık sonuçlarından ödün vermeden lezzet optimizasyonuna öncelik vermektedirler. Ayrıca, tüketicileri aşırı tuz alımının zararlı etkileri konusunda eğitime çabaları, daha sağlıklı beslenme alışkanlıklarını teşvik etmek için gereklidir. Buradan hareketle şefler ve tüketiciler, tuz yerine geçen çeşitli maddeler ve lezzet artırıcılar da kullanılabilir. Yemeklerle birlikte alınan sodyum seviyesini düşürmek amacıyla yapılan tercihlerden biri NaCl bileşeni yerine geçebilecek maddeler, yani kişiye tuz lezzetini sağlayan ama sodyum ihtiva etmeyen maddelerdir. Bunlara örnek olarak magnezyum klorür, potasyum klorür, potasyum laktat, kalsiyum klorür, amonyum klorür ve benzeri mineral tuzları ile bazı dipeptitler veya lizin, arjinin gibi aminoasitler, alternatifler olarak kullanılabilir. Fakat bu gibi alternatif maddeler, nihai gıdada acılık, metalimsi veya buruk tatlar şeklinde arzu edilmeyen tatlara neden olabilmektedir (Akgün et al., 2018).



Sonuç olarak tuz, lezzet, muhafaza ve tat algısı üzerinde önemli etkiler yaratarak gastronominin en önemli kimyasal maddelerinden biri olarak hizmet vermektedir. Tarihsel önemi, karmaşık kimyası ile birleştiğinde, dünya çapında mutfak uygulamalarındaki vazgeçilmezliği ortaya çıkmaktadır. Bununla birlikte, aşırı tuz alımıyla ilişkili olumsuz sağlık etkilerini azaltmak için bilinçli tüketim ve etik hususlar çok önemlidir. Şefler ve tüketiciler, tuzu makul ve sorumlu bir şekilde benimseyerek, halk sağlığını koruyucu tedbirler alabilmektedir.

Sükroz (Sofra Şekeri)

Genellikle sofras şeker olarak bilinen sükroz, gıda ve gastronomi alanlarında çok yönlü bir rol oynamaktadır. Genellikle şeker kamışı veya şeker pancarından elde edilen tatlandırıcı bir madde olarak birincil işlevinin ötesinde sükroz, çeşitli mutfak kreasyonlarının dokusuna, lezzetine ve genel duysal deneyimine katkıda bulunmaktadır. Sükrozun gıda hazırlamadaki çeşitli uygulamalarını, gastronomideki önemini, kimyasal özelliklerinin, mutfakta kullanımının ve kültürel etkilerinin anlaşılması, sükrozun dünya çapında mutfak geleneklerini şekillendirmedeki rolünün de anlaşılması için önemlidir (Clark, 1995; Godshall, 1995).

Glikoz ve fruktoz moleküllerinden oluşan bir disakkarit olan sükroz, mutfak dünyasında her yerde bulunmaktadır. Tatlı tat profili, onu tatlılardan tuzlu yemeklere kadar çok sayıda tarife temel bir bileşen haline getirmektedir. Bununla birlikte, sükrozun rolü sadece tatlılığın ötesine uzanmakta, onun kimyasal özellikleri gıda dokusunu, stabilitesini ve karamelizasyonunu etkilemektedir (Clark, 1995). Dahası, sükroz genellikle misafirperverliği, kutlamayı ve hoşgörüyü simgeleyen kültürel bir öneme de sahiptir.

Lezzet artırma açısından sükroz, birçok gıdanın lezzetini artırabilen çok yönlü bir tatlandırıcıdır. Sadece tatlılık katmakla kalmayarak aynı zamanda gıdaların dokusuna ve ağızda bıraktığı hisse de katkıda bulunmaktadır. Sükroz, hoş olmayan tatları maskeleyebilmekte ve bazı gıdaların asitliğini dengeleyerek onları daha lezzetli hale getirebilmektedir. Örneğin, domates bazlı ürünlerde sükroz domatesin ekşiliğini ve acılığını azaltmaya ve genel lezzeti arttırmaya yardımcı olabilmektedir. Ayrıca sükroz, baharat ve otların lezzetini de tamamlayarak daha belirgin ve keyifli hale getirebilmektedir. Lezzet arttırıcılığının yanı sıra sükrozun gastronomide çeşitli başka kullanım amaçları da mevcuttur ve bunlar arasında muhafaza özelliğinden de istifade edilmektedir. Sükroz, bozulmayı önleme ve raf ömrünü uzatma özelliği nedeniyle gıda muhafazasında sıklıkla kullanılmaktadır. Gıdalara eklendiğinde, su molekülleriyle bağlanıp gıdaların su aktivitesini düşürerek bakterilerin ve diğer mikroorganizmaların büyümesini ve çoğalmasını zorlaştırmaktadır. Bu sayede koruyucu olarak da işlevselliğe sahip olan sükroz kullanımı ile bakteri, maya ve küf oluşumu önlenilebilmekte ve gıdalar daha uzun süre taze tutabilmektedir. Bu özelliği nedeniyle sükroz, reçel, jöle ve konserve gibi bozulmaya eğilimli gıdalarda önem arz etmektedir. Piyasada çok sayıda ve çeşitte bulunan tatlandırıcılarla kıyaslandığında sükroz, benzersiz özellikleri nedeniyle gıda üreticileri için popüler bir seçim olmaya devam etmektedir. Örneğin, aspartam ve sakarin gibi yapay tatlandırıcılar genellikle şeker ikamesi olarak kullanılmakta, ancak sükroz ile aynı lezzet ve dokuyu sağlayamamaktadırlar (FasterCapital, 2024).

Ayrıca, bazı yapay tatlandırıcılar kilo alımı ve diyabet riskinin artması gibi sağlık sorunlarıyla ilişkilendirilmiştir. Öte yandan, bal ve akçaağaç şurubu gibi doğal tatlandırıcılar da oldukça pahalı olabilmekte ve sükroz ile aynı düzeyde koruma ve lezzet artışı sağlayamayabilmektedir. Sükroz kullanım alanları ve sükrozun en iyi uygulamalarının konuşulması kadar sükroz açısından öncelikle ele alınması gereken, sükrozun etkili bir koruyucu ve lezzet arttırıcı olsa da ölçülü kullanılması gerektiğidir. Aşırı sükroz tüketimi obezite, diyabet ve kalp hastalığı da dahil olmak üzere bir dizi sağlık sorunlarıyla ilişkilendirilmiştir. Ayrıca, gıda muhafazasında sükroz kullanılırken, kontaminasyonu önlemek için gıdanın uygun şekilde saklandığından ve işlendiğinden emin olmak önem arz etmektedir. Son olarak, yemek pişirmede sükroz kullanırken, uygun miktarın kullanıldığından ve yiyeceğin uygun sıcaklıkta pişirildiğinden emin olmak için tarifi dikkatlice takip etmek de çok önemlidir (FasterCapital, 2024).

Gıdalarda lezzet arttırması, tatlılık katması ya da acı hissi alması gibi lezzetleri dengelemesi, ürünleri muhafaza özellikleri dışında sükroz, yüksek lifli gıdaların tadını iyileştirilmesine, unlu mamullerde yumuşak yapının ve dondurulmuş süt ürünlerinde pürüzsüzlüğün sağlanmasına da yardımcı olarak gıdaların dokularına ve tüketicilerin ağız hislerine de etki etmektedir. Aynı zamanda farklı ürünlere hacim katarak uzun, kabarık veya yumuşak olmalarını sağlayabilmektedir. Ayrıca ısı ile (karamelizasyon) veya ısı ve proteinlerle (Maillard reaksiyonu) reaksiyona girerek unlu mamullerde ve soslarda altın kahverengi bir renk oluşturarak gıdalara renk de verebilmektedir (CSI, 2024).

Sonuç olarak sükroz, gıdaların korunmasında ve lezzetinin artırılmasında hayati bir rol oynamaktadır. Su molekülleriyle bağlanma ve su aktivitesini azaltma kabiliyeti onu etkili bir koruyucu haline getirirken, tatlı tadı ve dokusu onu birçok gıdada çok yönlü bir bileşen haline getirmektedir. Birçok tatlandırıcı mevcut olsa da sükroz bu benzersiz özellikleri nedeniyle popüler bir seçim olmaya devam etmektedir. Sükroz kullanırken, mümkün olan en iyi sonuçları elde etmek için ölçülü kullanmak ve uygun gıda güvenliği ve pişirme uygulamalarını takip etmek önem arz etmektedir.



Nükleotidler

Nükleotidler, azot içeren bazlar (sitozin, timin, guanin, adenin ve urasil), fosfat ve şeker (riboz veya deoksiriboz) içeren protein olmayan azotlu bileşiklerdir (Ding vd., 2021). Deoksiribonükleik asit (DNA) ve ribonükleik asit (RNA) gibi yaşamsal öneme sahip moleküllerin temel yapıtaşı olmalarının yanı sıra, proteinlerin ve fosfolipidlerin sentezlenmesinde ve şekerlerin dönüşümünde önemli bir rol oynarlar ve ayrıca metabolizmanın düzenlenmesinde de rol oynarlar (Ding et al., 2021; Lane & Fan, 2015). Ek olarak, çalışmalar bu bileşiklerin bağışıklık sistemi işlevini, ince bağırsağın yenilenmesini ve işlevini desteklemek ve sağlıklı yara iyileşmesini desteklemek için gerekli olduğunu göstermiştir (Carver et al., 2002).

Nükleotidler ayrıca hematopoetik sistemi indükler ve korur, trombosit agregasyonunu destekler ve güçlü anti-enflamatuar ve antiviral özelliklere sahiptir. Biyolojik aktiviteleri nedeniyle, bebekler için modifiye süt bileşeni olarak bir uygulama alanı bulmuşlardır. İlaç endüstrisinde, en yaygın olanları 5'-monofosfat üridin (UMP) ve sitidin 5'-monofosfat (CMP) olmak üzere, gıda takviyelerinde diyet nükleotidleri olarak bulunurlar. Vücudun hızlı bir restorasyona ihtiyacı olduğunda nükleotidler içeren gıda preparatlarıyla takviyeler önerilebilmektedir (Dancey et al., 2006).

Nükleotidler, et, balık ve mantar gibi gıdalarda bulunan ve umami tat algısını arttırmak için kullanılan glutamat ile sinerjik olarak çalışan bileşiklerdir. Kimyasal olarak, inozin monofosfat (IMP), guanozin monofosfat (GMP) ve ksantozin monofosfat (XMP) gibi nükleotidler, tat tomurcukları üzerindeki belirli reseptörlere bağlanarak lezzet artırıcı olarak işlev görebilmekte ve böylece lezzetli tatların algılanmasını güçlendirebilmektedir. 5'-nükleotidler RNA'nın yıkımı ile elde edilmektedir. 5'-nükleotidler *Penicillium* ve *Streptomyces* türlerinden elde edilen enzim kullanımıyla maya RNA'larından ticari olarak elde edilmektedir. Mutfak uygulamalarında nükleotidler, tuzlu yemeklerin karmaşıklığını ve zenginliğini arttırmak için genellikle glutamat bakımından zengin bileşenler veya MSG ile birlikte kullanılmaktadır (Seo et al., 2018; Yamaguchi ve Ninomiya, 2000).

Maltol

Maltol (3-hidroksi-2-metil-4-piron) gıda ve kozmetik takviyesi olarak yaygın bir şekilde kullanılmaktadır ve antioksidan ve anti-inflamatuar aktivitelere sahiptir. Doğal bir organik bileşik olan maltol, pamuk şeker ve karamel kokusuna sahiptir. Kozmetik ve ilaç endüstrilerinin yanı sıra gıda endüstrisinde de lezzet artırıcı olarak yaygın bir şekilde kullanılmaktadır. Maltol kavrulmuş malta bulunur ve Kore kırmızı ginsenginin ısıtılması sırasında Maillard reaksiyonu ile maltoz ve amino asitlerden sentezlenir. Maltol, iyi bilinen bir bitkisel ilaç olan Kore kırmızı ginsenginin anti-enflamatuar etkinliğini sergileyen bir molekül olarak gündemde olmuştur. Kore ve Çin de dahil olmak üzere Kuzeydoğu Asya'da uzun süredir çeşitli insan sağlığı sorunlarını iyileştirmek için de tüketilmektedir. Kore kırmızı ginsenginin ısıtılması sırasında maltol içeriği artmaktadır. Serbest radikal temizleme aktivitesi de artan maltol içeriğine bağlı olarak artmaktadır. Maltol, sinir sistemi, karaciğer, böbrek ve diyabetin çeşitli hastalıklarını iyileştirdiği bildirilen güçlü bir antioksidandır. Maltol, ginsenglerin saponin olmayan fraksiyonlarının önemli ve etkili bir bileşenidir. Kore kırmızı ginsenginin bileşimine bağlı olarak inflamazom aktivasyonunu inhibe eder veya uyarır (Ahn et al., 2022).

Güçlü bir antioksidatif ajan olan maltol tipik olarak gıdaları tatlandırması ve koruması yanında sağlık açısından da olumlu etkileri, diyabetik periferik nöropatiyi (DPN) önleme üzerine hayvanlar üzerinde yapılan çalışmalarda ortaya konulmuştur. Nan ve arkadaşları 2018 yılında yaptıkları bir çalışmada, maltolun diyabetik hayvanlarda H₂O₂ hasarını azaltmış, DPN'yi geliştirmiş olduğu ve hayvanların metabolik mekanizmalarını arttırmış olduğu sonucuna ulaşarak, maltolun DPN tedavisinde alternatif sağlayabileceği yönünde bulgular elde etmişlerdir (Nan et al., 2018).

Gıdalar içerisindeki maltol kaynakları arasında kahve ve içecekler, pişmiş tahıllar, ekmek kabukları, karamelize gıdalar ve sükröz pirolizi veya nişastanın ısıtılması yoluyla elde edilmiş ürünler bulunmaktadır. Yüksek oranda konsantrasyonları veya diğer bileşenlerle etkileşimlerinin bir sonucu olarak maltol, gıda ürünlerinin lezzetini değiştirebilmekte ve/veya artırabilmektedir. Lezzet artırıcı olarak yaygın bir şekilde kullanılmakta olan maltolun en geniş kapsamlı kullanım örnekleri olarak ekmekler, kekler, malt içecekleri, çikolata ve şekerlemeler, dondurma, instant kahve ve çay, biralar, likörler ve çikolata süt gibi ürünler gösterilebilir (Altunay et al., 2017; Seo et al., 2018).

Ticari olarak fermentasyon yöntemi ile elde edilen maltol 50-250 mg/kg konsantrasyonlarında kullanılmaktadır (Seo et al., 2018). Bununla birlikte, maltol doza bağlı bir toksisite sergilmektedir. Ayrıca, maltol, alüminyumun vücuttaki oral biyo yararlanımını stabil bir alüminyum oluşumu nedeniyle büyük ölçüde artırabilmektedir. Bu nedenle Avrupa Birliği (AB) mevzuatına göre, insanlarca tüketilebilir gıdalardaki maltol bulunabilirliği 50 ila 200 mg/kg arasında değişen konsantrasyonlarda olmak şartıyla izin verilmiş, maksimum sınır 200 mg/kg olarak belirlenmiştir (Altunay et al., 2017).

Gıda ve Tarım Örgütü (FAO) ve Dünya Sağlık Örgütü (WHO) tarafından ise insan tüketimi için en fazla günde vücut ağırlığı başına 2 mg/kg kabul edilmektedir. Bu değerin üzerindeki alımlar insanlar için zararlı olabilmekte ve baş ağrısı, bulantı, kusma ve nörotoksik etkilere neden olabilmektedir. Ancak, kimyasal reaktivitesi ve matris etkileri nedeniyle maltol, çözelti içinde kolayca belirlenemez. Bu nedenle gıda ürünlerinde maltolün doğru ve



güvenilir bir şekilde belirlenmesi açısından basit, düşük maliyetli, hassas ve seçici ayırma/ön konsantrasyon yöntemleri geliştirilmesi önem arz etmektedir (Altunay et al., 2017).

Etil Maltol

Etil maltol, maltol bir metil grubu yerine bir etil grubunun dahil edilmesiyle elde edilebilmektedir. Etil maltolün moleküler yapısındaki bu küçük değişiklik, maltolden üç ila sekiz kat daha fazla aroma artışına neden olmaktadır (Anitha ve Srinivasan, 2024). Genellikle beyazımsı kristal toz görünümünde olan etil maltol yapay bir tatlandırıcı sanılsa da aslında gıdanın aromasını tatlandırır ve böylece koku duyusu yoluyla gıdanın lezzetini artırır. Bu nedenle, şeker ikamelerinin aksine, etil maltol bileşiği vücuda alındığında kan şekerini arttırmaz. Maltol molekülünden sentetik olarak üretilen bir ürün olmasına rağmen, bu bileşik Amerikan Gıda ve İlaç İdaresi (FDA) tarafından genel olarak güvenli (GRAS) olarak kabul edilmektedir. Bu nedenle, fırıncılıkta, yiyecek ve içecek üretiminde ve parfümeride güvenli ve etkili bir şekilde kullanılabilir (NutriAvenue, 2021; Anitha & Srinivasan, 2024).

Etil maltolün gıdalarda kullanımı açısından özellikleri, yoğun lezzet, diğer hammaddelerle kolay koordine edilebilirlik ve uygulanan gıdanın orijinal lezzetinin artırılması şeklinde sayılabilir. Etil maltol, şekerler, bisküvi ve fırıncılık, dondurmalar, salamura sebzeler, marinat, fındık, süt ürünleri ve soslar olma üzere geniş bir gıda yelpazesinde kullanılabilir (AIPU, 2024).

Etil maltol, karamelize şeker veya pişmiş meyve olarak tanımlanabilecek tatlı kokuya ve hafif tatlı aroma olarak tanımlanabilecek lezzete sahip bir maddedir ve genellikle gıda ürünlerinin raf ömrünü uzatmak için de genellikle şarap, dondurma, şekerleme, çikolata, bisküvi, ekmek, konserve gıda, işlenmiş et vb. ürünlerde kullanılmaktadır. Uygun maliyetli bir lezzet arttırıcıdır çünkü sadece küçük bir kullanımla (genellikle %0.01-0.1) gıdanın orijinal kokusunu önemli ölçüde arttırabilir. Ayrıca, bazı yüksek konsantrasyonlu et ürünlerinin veya baharatların kokusunu örtmeye de yardımcı olabilmektedir (AIPU, 2024; NutriAvenue, 2021).

Etil maltol kullanımı genellikle yan etkilerle ilişkili değildir. Bununla birlikte, yüksek dozlarda kullanıldığında veya aşırı miktarlarda alındığında, uzmanlar bileşiğin hafif ila şiddetli formlar arasında değişebilen olumsuz etkilere neden olabileceğini söylemektedir. Artan etil maltol kullanımının yaygın yan etkileri mide bulantısı, kusma ve mide tahrişini içermektedir. Çoğu araştırmada, etil maltol için Kabul Edilebilir Günlük Alım Miktarı (ADI) maksimum 2 mg/kg vücut ağırlığıdır. Bununla birlikte, belirli tıbbi durumlardan muzdarip olan bireyler için etil maltol için ADI, bir doktorun değerlendirmesine bağlı olarak değişebilmektedir. Yaş, kilo ve genel fiziksel durum gibi faktörler de bir bireyin etil maltol için ADI değerinin belirlenmesinde dikkate alınabilmektedir (Li et al., 2017; NutriAvenue, 2021).

Siklamik Asit (Siklamat)

Siklamat, yapay tatlandırıcı siklamik asit (sikloheksilsülfamik asit) ve bunun kalsiyum veya sodyum tuzlarına verilen isimdir. Siklamat, 1937 yılında Illinois Üniversitesi'nde, bir sigaraya kazara sikloheksilamin türevinin bulaşmasını takiben keşfedilmiştir. DuPont 1940 yılında siklamat üretimi için bir patent almış ve 1950 yılında tüketicilerin kullanımına sunmuştur. Siklamat tüketimi, sakarin/siklamat karışımının deneysel laboratuvar sıçanlarında kansere neden olduğu gösterilerek potansiyel kanserojenliği ile ilgili güvenlik endişeleri nedeniyle ABD'de ve diğer ülkelerde yasaklandığı 1969 yılına kadar istikrarlı bir şekilde artmıştır. Ancak, son çalışmalar önceki çalışmalarla çelişmektedir ve siklamat birçok ülkede kullanılmaya devam edilmektedir. Siklamat insan vücudu tarafından metabolize edilmez, diğer bir ifade ile sıfır kaloridir, bu nedenle günlük diyetle enerji katkısı yoktur ve besleyici olmayan bir tatlandırıcı olarak kabul edilir (Lawrence, 2003).

Siklamat sükrözden 30-50 kat daha tatlıdır. Ağızda acı bir tat bırakır ancak sakarin ile iyi bir tatlılık sinerjisine sahiptir (Aydın et al., 2022). FAO/WHO Gıda Katkı Maddeleri Ortak Uzman Komitesi (JECFA) ve Gıda Bilimsel Komitesi (SCF) tarafından onaylanmıştır ve dünya çapında 50'den fazla ülke tarafından kullanılmaktadır. JECFA, siklamat için günde 11 mg/kg vücut ağırlığı olarak bir ADI belirlemiştir. Siklamat genellikle sodyum siklamat ve kalsiyum siklamat formlarındadır. Siklamat dişlere zararlı değildir, şeker hastaları için uygundur ve en ucuz tatlandırıcılardan biridir. Siklamat ısıya dayanıklıdır ve uzun bir raf ömrüne sahiptir; depolanması kolaydır, su içermez, havadan emilir ve fermente olmaz. Bu nedenle, gıda endüstrisinde ve tıp endüstrisinde takviye ürünlerinde de kullanılmaktadır (Thi et al., 2020).

Sonuç

Gastronomi, gıda, çeşitli tiplerde yiyecek ve içecekler ile genel gıda ürünleri söz konusu olduğunda lezzet artırma oldukça önemli bir konudur. Lezzet arttırıcılar mutfak sanatlarının önemli bir parçası olup gıdaların keyif ve lezzetine önemli ölçüde katkıda bulunmaktadır. Gıdaların hem daha kolay hem de daha keyifle tüketilmesi amacıyla tat ve koku açısından yemeklerde ve gıda takviyelerinde iyileştirmeler sağlayan ve bu makalede konu edilen monosodyum glutamat (MSG), tuz, sükröz, nükleotidler, maltol, etil maltol ve siklamat gibi çeşitli kimyasallar kullanılmakta olup, bunların kullanım dozları insan sağlığı açısından da önem arz etmektedir.



Lezzet bilimi gelişmeye devam ederken süregelen araştırmalar, lezzet artırma mekanizmalarına ilişkin yeni bilgiler ortaya çıkarmaya ve mutfakta yenilik ve tüketici memnuniyeti için yenilikçi çözümler geliştirmeye devam etmektedir. Sonuç olarak, lezzet artırma, gıdalarda tat ve aromayı optimize etmek için maddelerin ve kimyasalların stratejik kullanımını içeren çok yönlü bir çabadır. Monosodyum glutamat, tuz, sükröz, glutamik asit, nükleotidler, maltol, etil maltol ve siklomatın ele alındığı bu çalışmada, her bir lezzet arttırıcının benzersiz özellikleri ve mutfak uygulamaları ele alınmış olup, bununla birlikte lezzet optimizasyonunun insan sağlığı ve diyet tercihlerine yönelik hususlarla dengelemenin esas alınmasının gerekliliğinin altı çizilmiştir.

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Usability of pea, rice and soy proteins in the production of protein-rich pasta

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Abstract

Proteins are special components that contain the building blocks of life. Therefore, it is necessary to take them at a certain level with the daily diet. According to different authorities, the amount of protein that should be consumed daily depending on age and health status is between 20 and 50 g. Animal foods are seen as the main source of protein by many consumers. However, according to the evaluations made in our country, the main source of protein for a large part of the society is cereal products such as bread and pasta. These products contain an average of 10 g/100 g of protein. However, in addition to their protein content, their high carbohydrate content is a significant disadvantage. Considering the social consumption habits, it does not seem possible to give up these products. Therefore, it is important to make these products more nutritious by enriching them with proteins. For these reasons, the aim of this project is to enrich pasta with vegetable proteins. For this purpose, pea, rice and soy proteins were used. As a result of the project, pasta with high sensory acceptability and at least 20 g/100 g protein was produced. The use of vegetable proteins was preferred within the scope of the project for economic reasons. In fact, vegetable proteins are much more economical than animal proteins. Thus, it was evaluated that the competitive advantage of the products produced would be high. Therefore, a product that is beneficial for both food producers and society has been produced.

Keywords: Pasta, protein, pea seed isolate, rice protein isolate, soy protein isolate

Proteinçe zengin makarna üretiminde bezelye, pirinç ve soya proteinlerinin kullanılabilirliği

Özet

Proteinler yaşamın yapıtaşlarını içeren özel bileşenlerdir. Bu nedenle günlük diyetle birlikte belirli düzeyde alınması zorunludur. Farklı otoritelere göre yaş ve sağlık durumuna göre günlük tüketilmesi gereken protein miktarı 20 ile 50 g arasındadır. Hayvansal gıdalar birçok tüketici tarafından ana protein kaynağı olarak görülmektedir. Ancak ülkemizde yapılan değerlendirmelere göre toplumun büyük kesimi için ana protein kaynağı ekmek ve makarna gibi tahıl ürünleridir. Bu ürünler ortalama olarak 10 g/100 g protein içermektedir. Ancak protein içeriğinin yanında yüksek karbonhidrat içeriği önemli bir dezavantajdır. Toplumsal tüketim alışkanlıkları göz önüne alındığında, bu ürünlerden vazgeçilmesi mümkün gözükmemektedir. Bu nedenle bu ürünleri proteinlerce zenginleştirilerek daha besleyici hale getirilmesi önem arz etmektedir. Sayılan bu nedenlerden ötürü bu projenin amacı makarnanın bitkisel proteinlerce zenginleştirilmiştir. Bu amaçla bezelye, pirinç ve soya proteinleri kullanılmıştır. Proje sonucunda duyuusal kabul edilebilirliği yüksek ve en az 20 g/100g protein içeren makarnaların üretilmiştir. Proje kapsamında bitkisel proteinlerin kullanılması ekonomik nedenlerle tercih edilmiştir. Nitekim, bitkisel proteinler hayvansal proteinlere göre çok daha ekonomiktir. Böylece üretilen ürünlerin rekabet avantajının yüksek olacağı değerlendirilmiştir. Dolayısıyla hem gıda üreticileri hem de toplum için yararlı bir ürün üretilmiştir.

Anahtar Kelimeler: Makarna, protein, bezelye tohumu izolatu, pirinç protein izolatu, soya protein izolatu

Giriş

Makarna, düşük maliyeti, besleyici bileşimi, hazırlama kolaylığı, nakliyesi ve daha uzun raf ömrü nedeniyle market raflarında bulunan en popüler tüketim ürünlerdendir (Nilusha ve ark., 2019). Dünya’da makarna üretimi 2018’de 14.3 milyon tona ulaşmıştır (Kaur ve ark., 2012). Makarna geleneksel olarak nişasta ve ardından protein, yağ, vitaminler, mineraller ve biyoaktif bileşikler içeren irmikten hazırlanmaktadır (Gull ve ark., 2018). Makarna, düşük glisemik indeksli yüksek kompleks karbonhidrat içeriğinin yanı sıra protein de içermektedir. Protein kalitesi, çoğunlukla esansiyel amino asitlerdeki bileşimi ve sindirilebilirliği ile ilgilidir. Yüksek kaliteli proteinler, FAO/WHO/UN ’in referans amino asit modeline eşit veya bundan daha yüksek seviyelerde tüm esansiyel amino asitleri içermektedir. Aksine, beslenme açısından eksik veya düşük biyolojik değeri olan proteinler, bir veya daha fazla esansiyel amino asitte eksik olan proteinlerdir. Kollajen hariç tüm hayvansal proteinler tam protein olarak kabul edilirken, bitkisel proteinler, birkaç istisna dışında, bazı esansiyel amino asitlerde bir eksikliğe sahiptir. Sınırlayıcı amino asit, bir proteinde en düşük miktarda bulunan esansiyel amino asittir, bu nedenle, kazein için



sınırlayıcı amino asit arginin, balık ve yumurta proteinleri için metionin ve özellikle tahıllar ve makarna gibi tahıl bazlı gıdalar için sınırlayıcı aminoasit lizindir. Bu bağlamda, kimyasal skor, diyet proteininin uygun miktarda esansiyel amino asit sağlama potansiyeli açısından proteinlerin kalitesini tanımlamak için kullanılan parametredir. 100'e yakın veya 100'e eşit bir kimyasal skora sahip proteinler, besinsel olarak daha iyi olarak kabul edilir ve bu nedenle insan ihtiyaçlarını yeterince karşılayabilir (Messia ve ark., 2021).

Sporcular ve diyetlerinde daha fazla miktarda protein bulunması gereken kişiler tarafından protein takviyelerine olan ilgi gün geçtikçe artmaktadır. Yetişkinlerin protein gereksinimi, LARN'de (Liveli di Assunzione di Riferimento di Nutrienti ed energia) belirtilen 0.8 g/kg (protein/kg vücut ağırlığı) referans değerinden başlayarak, sportif aktivite ile önemli ölçüde artmaktadır. Ayrıca, sporculardan bağımsız olarak, tüketici tercihinin et bazlı gıdalardan bitki bazlı gıdalara kademeli olarak kaymasıyla, potansiyel bitki bazlı proteinlere rağbet bulunmaktadır. Bu amaçla, düşük proteinli diyetleri tamamlayan iyi dengelenmiş esansiyel amino asit içerdiklerinden, tahıllar potansiyel bir protein kaynağı olarak tercih edilmektedir. Bunun yanında, hayvansal kaynakları elde etmek bitki bazlı olanlardan daha maliyetlidir (Ranganathan, 2020). Bu bakımdan nüfus artışıyla başa çıkarken yüksek kaliteli gıda üretimi sağlayabilen diğer sürdürülebilir ve etkili kaynaklara yönelmek ilgi çekici olmuştur.

Belirli beslenme ihtiyaçları ve aynı zamanda gıda trendleri arasına giren yüksek proteinli makarnanın ticari segmenti son yıllarda büyümektedir. İrmiğin alternatif bileşenlerle değiştirilmesi de dahil olmak üzere yeni makarna formülasyonları geliştirilmektedir ve bu formülasyonlarda protein ikamesi olarak soya fasulyesi, bezelye, fasulye, nohut unları veya izolatları, ayrıca peynir altı suyu proteinleri, kazein ve süt tozu gibi süt ürünleri kullanılabilir (Verardo ve ark., 2011; Marconi ve Messia., 2012; Foschia ve ark., 2017). Özellikle, baklagiller zengin bir besin kaynağı (protein, mineraller, lif) (Asif ve ark., 2013) olarak tercih edilmektedir ve karbon ve su ayak izini azaltarak çevresel olarak sürdürülebilir ürünler geliştirmek amacıyla kullanılmaktadır (Boukid ve ark., 2019). Bu nedenlerle baklagillerin gıda üretimine entegre edilmesine artan bir ilgi vardır. Baklagillerin proteinleri kükürt amino asitleri ve triptofan bakımından nispeten düşük olmasına rağmen, yüksek lizin içeriğine sahiptirler. Sonuç olarak, baklagiller ve tahıllar besinsel olarak tamamlayıcıdır. Makarnanın hazırlanmasında irmiğin kısmen baklagil unları ile değiştirilmesi, protein biyolojik değerinin ve amino asit CS'nin iyileştirilmesini sağlamaktadır (Messia ve ark., 2021).

Hosta (2012), çalışmasında pirinç ununa farklı oranlarda bezelye, nohut ve kırmızı mercimek unu ile hazırladığı erişte örneklerinde tat açısından en beğenilen ürünün mercimek unu katkılı erişte olduğunu belirlemiştir. Makarnanın esansiyel aminoasit içeriğini arttırmak amacıyla et ürünleri, baklagil (*Leguminosae* L.) unu ve bitkisel protein izolatları kullanıldığında katkı maddelerinin optimum miktarları et için ağırlıkça %15, %10 bezelye ve mercimek unu, %7.5 soya unu olarak bulunmuştur. Makarna hamuruna eklenen zenginleştirici bileşenlerin makarna kalitesi üzerinde olumlu etkisi olduğu tespit edilmiştir. Makarnaların protein içeriğini %1.59-8.19, biyolojik değeri %6-16, amino asit bileşiminin fayda katsayısını 0.2-0.26, protein sindirilebilirliğini %11-24 ve günlük protein alım seviyesini %31.4-12.5 artırdığı belirlenmiştir (Galina ve ark., 2019). Yapılan bir çalışmada protein miktarı artırılmış makarna için optimum formülasyon %45.41 irmik, %24 bezelye proteini izolatu, %18 yulaf unu, %5 soya proteini izolatu, %5 peynir altı suyu proteini izolatu ve %2 gluten olarak bulunmuştur. Optimize edilmiş formülasyonda, protein içeriği, kontrole kıyasla 2.9 kattan fazla arttığı tespit edilmiştir (Rousta ve ark., 2020).

Materyal ve Yöntem

Materyal

Çalışma kapsamında protein kaynağı olarak izole bezelye proteini (Fuwell, İstanbul), pirinç protein tozu (Naturiga, İstanbul) ve soya proteini (Protein Ocean, İstanbul) kullanılmıştır. Makarnalık irmik Konya'da faaliyet gösteren bir fabrikadan temin edilmiştir. Analizlerde kullanılacak olan kimyasallar analitik saflıkta seçilmiştir.

Yöntem

Makarna Üretimi

Kontrol makarna örnekleri Brennan ve Tudorica (2008)'nin belirttiği metoda göre yaklaşık 100:30 irmik/su oranı kullanılarak hazırlanmıştır. İrmik ile yer değiştirme esasına göre %20 protein ilavesi (soya protein izolatu, bezelye protein izolatu, pirinç protein izolatu) gerçekleştirilmiştir. Makarna üretimi laboratuvar ölçekli makarna cihazı ile gerçekleştirilmiş olup, kısa kesme makarnalar üretilmiştir. Makarna ingredientleri (1500 g kuru miks + ~ 500 mL su), irmiğin su hidrasyonu sağlanana kadar (yaklaşık 15 dk) pilot makarna ünitesinin (La Monferrina P3) yoğurucu kısmında karıştırılarak daha ekstrüde edilip kesilmiştir. Makarnalar daha sonra makarna kurutma makinesinde kurutulmuştur.

Renk Ölçümü

Ham madde ile pişmiş ve pişmemiş makarna örneklerinin renk değerleri Minolta CR-400 (Konica Minolta, Inc., Osaka, Japonya) cihazı kullanılarak belirlenmiştir. Makarna örneklerinde toplam renk farklılıklarının belirlenmesi için aşağıdaki formül kullanılmıştır (Zardetto ve Rosa, 2009):

$$\Delta E = (\Delta L^2 + \Delta a^2 + \Delta b^2)^{1/2}$$



Ağırlık ve Hacim Artışı

Ağırlık artışının belirlenmesi için 20 gr makarna 250 mL kaynayan saf su içerisinde optimum pişme süresince pişirilecek ve çiğ ve pişmiş örneklerdeki ağırlık farkı % olarak belirlenmiştir. Hacim artışının belirlenmesi için örnekler aynı ağırlık artışı testinde olduğu gibi pişirilip süzülecek ve 2 dk bekletildikten sonra içerisinde saf su bulunan ölçü silindire koyulup taşırdıkları suyun hacmi belirlenmiştir (Özkaya ve Kahveci, 1990).

Suya Geçen Kuru Madde

20 g makarna 250 mL saf su içerisinde optimum pişme süresince pişirilip süzümüştür. Süzüntü suyu kurutma dolabında 135°C’de kurutulurak, suya geçen kuru madde miktarı (%) hesaplanmıştır (Kahveci ve Özkaya, 1989).

İstatistiksel Analiz

Çalışma tesadüf parseller deneme desenine göre yürütülmüştür, elde edilen veriler varyans analizine tabi tutularak önemli bulunan farklılıklar Duncan Çoklu Karşılaştırma Testi ile belirlenmiştir. İstatistik hesaplamalar SAS paket programları ile gerçekleştirilmiştir.

Bulgular ve Tartışma

Ham Madde ve Makarna Örneklerinin Renk Değerleri

Makarna örneklerinin üretiminde kullanılan hammaddelere ait renk değerleri Çizelge 1’de verilmiştir. Makarna örneklerinde verildiği gibi bezelye protein izolatının b* değeri diğer protein izolatlarından yüksek bulunmuştur. İrmik ve pirinç protein izolatlarının parlaklık değerleri istatistiksel olarak benzer bulunurken pişirme sonrası pirinç protein izolatı ilaveli makarnaların parlaklık değeri daha koyu bulunmuştur.

Çizelge 1. Hammaddelerin renk değerleri ¹

² Protein çeşidi	L*	a*	b*	Ton açısı	Doygunluk
İrmik	89.01±0.1a	-2.41±0.33b	23.06±0.26b	23.19±0.22b	264.01±0.1b
Soya	86.87±0.04b	0.26±0.01a	16.28±0.14c	16.28±0.14c	90.95±0.04a
Bezelye	83.6±0.14c	0.27±0.02a	25.67±0.61a	25.67±0.61a	90.59±0.14a
Pirinç	88.48±0.7a	-0.09±0.01a	10.45±0.23d	10.45±0.23d	269.47±0.7c

¹Aynı satırdaki farklı harfler ortalamaların P<0.05 seviyesinde farklı olduğunu gösterir. ²Her bir protein çeşidi %20 oranında ilave edilmiştir.

Çeşitli protein izolatları ilaveli makarna örneklerinin renk değerleri Çizelge 2’de verilmiştir. Hue angle a* ve b* değerlerinden hesaplanmaktadır. Bu nedenle a* ve b* değerlerini etkileyen herhangi bir faktör aynı zamanda hue angle değerini de etkilemektedir. Hue angle (ton açısı) değerindeki değişiklikler enzimatik olmayan esmerleşme reaksiyonlarıyla ilgilidir (Sacchetti et al. , 2016). Soya ve pirinç protein izolatları chroma değerini (doygunluk) etkilememiş ancak bezelye protein izolatı kullanan makarna örneklerinin chroma değerinin diğerlerine göre daha yüksek olduğu görülmüştür. Bezelye protein izolatı ilavesiyle en yüksek b* değeri belirlenmiştir dolayısıyla C* (doygunluk) ve H^o (ton açısı) değerleride yüksek bulunmuştur.

Çizelge 2. Makarna örneklerinin renk değerleri¹

² Protein çeşidi	L*	a*	b*	Ton açısı	Doygunluk
Kontrol	58.08±0.75b	-2.45±0.11c	11.09±0.35c	11.36±0.36c	11.36±0.36c
Soya	58.08±0.75b	-1.24±0.06b	14.41±0.22b	14.46±0.21b	14.46±0.21b
Bezelye	62.12±0.96a	-0.94±0.01ab	17.58±1a	17.61±1.01a	17.61±1.01a
Pirinç	54.8±0.8c	-0.78±0.12a	15.87±0.48ab	15.88±0.48ab	15.88±0.48ab

¹Aynı satırdaki farklı harfler ortalamaların P<0.05 seviyesinde farklı olduğunu gösterir. ²Her bir protein çeşidi %20 oranında ilave edilmiştir.

Makarna ağırlık artışı değerleri %138.7 ile %173.53 arasında değişmiş olup ortalama %157.20 olarak belirlenmiştir (Çizelge 3).Farklı protein çeşitleri ile ağırlık artışları kontrol grubuna göre bir miktar azalmış bu azalma nişasta granülüne su girişinin sınırlandıran bir protein ağı oluşumundan kaynaklanmış olabilir (Liu ve ark., 2016). Bunun yanı sıra, makarna örneklerindeki ağırlık artışı değerlerindeki azalmanın proteinden kaynaklı nişasta-lipit kompleksi oluşumu ile ilişkilendirildiği bilinmektedir (Desai ve ark., 2019). Protein izolatlarından soya protein izolatı en fazla ağırlık artışı sağlamıştır.

Makarna örneklerinin hacim artışı değerleri %139.26-165.81 arasında değişim göstermiştir (Çizelge 3). Makarnaların hacim artış değerlerine protein çeşidine göre değerlendirildiğinde %20 soya protein izolatı ilaveli makarna örneklerinin hacim artışı değeri (%165.81), %20 pirinç protein izolatı ilaveli makarna örneklerinin hacim artışı değerlerinden (%139.26) daha yüksek bulunmuştur. Soya protein izolatı en fazla hacim artışı sağlarken en düşük hacim artışını pirinç protein izolatı sağlamıştır. Ancak bu değişim istatistiksel olarak anlamlı bulunmamıştır (P>0.05). Makarnanın iyi bir pişme kalitesi, nişastanın tutulumunu sağlayan protein miktar ve kalitesi ile ilişkilendirilmektedir (Chillo ve ark., 2010).



Çizelge 3. Makarna örneklerinin pişme testi ve sıklık değerine ait sonuçlar¹

² Protein çeşidi	Ağırlık artışı (%)	Hacim artışı (%)	SGMM (%)	Sıklık
Kontrol	173.53±6.93a	161.76±6.93a	5.9±0.12b	1506.88±2.2b
Soya	165.36±0.92ab	165.81±12.65a	7.73±0.3a	1559.1±26b
Bezelye	138.7±2.4c	158.18±2.57a	6.43±0.05b	2208.57±17.2a
Pirinç	151.23±4.56bc	139.26±13.09a	8.2±0.41a	1784.18±12.08b

¹Aynı satırdaki farklı harfler ortalamaların P<0.05 seviyesinde farklı olduğunu gösterir. ² Her bir protein çeşidi %20 oranında ilave edilmiştir.

Çizelge 3'te yaş makarna örneklerine ait suya geçen kuru madde miktarı (SGMM) değerlerinin %5.9-8.2 arasında değiştiği gösterilmiştir. Örneklerin protein izolatu çeşitleri olarak değerlendirildiğinde %20 pirinç proteini izolatu ilaveli makarna örneklerinin SGKM (%8.2), %20 bezelye proteini izolatu ilaveli makarna örneklerinin SGKM değerinden (%6.3) daha yüksek bulunmuştur. Bezelye tohum izolatu diğer izolatlara göre düşük bir SGKM değeri verse de istatistiksel olarak kontrol örneği ile benzer niteliktedir. Kaliteli bir makarna için SGMM değerlerinin, makarnanın kuru ağırlığının %8'ini geçmemesi gerektiği (Lacko-Bartošová, 2014) soya ve bezelye protein izolatları ilaveli makarna örneklerinin de sınırlar içerisinde olduğu görülmektedir (Çizelge 3). Bu sebeple, soya ve bezelye protein izolatları ilavesi ile elde edilen makarnaların pişme özelliklerinin olumsuz etkilemediği sonucuna varılmıştır.

Makarna örneklerine ait sıklık değerleri 1506.88-2208.57 g arasında değişim göstermiştir (Çizelge 3). Kontrol grubu yaş makarna örneklerine göre soya ve pirinç protein izolatları ilavesi sıklık değerleri üzerinde kontrol örneğine benzer değerler gösterirken sıklık değerlerini çok fazla artırmamıştır. Ayrıca belirlenen artış değerleri istatistiksel olarak önemli bulunmamıştır (P>0.05). Lu ve ark. (2009) tarafından belirtildiği gibi serbest lipidlerin veya bunların belirli bir içerikte alt bölümlerinin eklenmesiyle pişirme sırasında nişasta-lipit komplekslerinin oluşmasıyla makarna sıklık değerlerini arttırmasına sebep olmaktadır. %20 Bezelye protein izolatının eklenmesiyle elde edilen yaş makarna örneklerinin sıklık değerinin artması nişasta-lipit komplekslerinin oluşumuna bağlanabilir.

Sonuçlar

Çalışmada, soya, bezelye ve pirinç protein izolatları % 20 oranlarında kullanılmıştır. İzolatlar kuru madde üzerinden irmik oranları azaltılarak eklenmiştir. Kontrol örneklerine göre ağırlık artışları çok az düşüş göstermiştir. Soya protein izolatu ilaveli makarna örneklerinde küçük bir hacim artışı görülmesine karşın suya geçen kuru madde miktarı sadece bezelye protein izolatu ilaveli örnekte en yüksek bulunmuştur. Protein izolatları ilaveli makarna örneklerindeki hacim artış miktarları ise istatistiksel olarak benzer bulunmuştur. Suya geçen kuru madde miktarları baz alındığında soya ve bezelye protein izolatları kaliteli makarna üretim için uygun özellik gösterirken, pirinç protein izolatu ile elde edilen makarnaların suya geçen kuru madde miktarının kuru ağırlığın %8'i geçmesi sebebiyle kaliteli makarna üretimi için arzu edilen kriterlere uymayabilir. Makarna örneklerine ait L*, b*, doygunluk indeksi ve ton açısı değerleri bezelye protein izolatu ilavesi ile daha yüksek belirlenirken, a* değerleri ise kontrol örneğinde ile daha yüksek tespit edilmiştir. Bezelye protein izolatu ilaveli makarna örneklerinin parlaklık değeri hem kontrol örneğine göre hem de soya ve pirinç protein izolatu ilaveli makarna örneklerinden daha parlak olarak belirlenmiştir. Dolayısıyla, bezelye protein izolatu makarnaların satın alınabilirliğini arttırabilmektedir.

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ID: 554

A Case Study For The University Efforts To Reduce Carbon Footprint - Dokuz Eylül University Tınaztepe Campus İn İzmir, Türkiye

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Abstract

This study aims to calculate the carbon footprint of Tınaztepe Campus, the central and largest campus of Dokuz Eylül University, and to comprehensively evaluate the environmental impacts of the campus during this process. The study provides a detailed analysis of carbon emissions resulting from the campus's energy consumption, transportation, water usage, and other resources. In this regard, carbon emissions were determined by using data on fuel consumption for transportation and heating (gasoline, diesel, and natural gas), electricity consumption, and water usage at the university. Additionally, the contribution of the university's solar energy system, used as a renewable energy source, to reducing carbon emissions, as well as the carbon sequestration capacity of the university's forested land, were also taken into account to calculate the total carbon footprint of the campus. The calculations were carried out using the United Nations' IPCC Model Tier 1 approach. As a result of the calculations, the annual total carbon footprint of Tınaztepe Campus was found to be 2,669.83 tons of CO₂. Moreover, the annual per capita carbon footprint was calculated to be 0.064 tons of carbon. According to the findings of the study, the largest share of carbon emissions comes from natural gas consumption, while the smallest share originates from water consumption. Based on this data, various strategic recommendations were developed to reduce the campus's carbon footprint. These recommendations include increasing energy efficiency, adopting more sustainable transportation methods, and reducing water consumption. The results of this study provide valuable insights that universities can consider when developing their sustainability policies.

Key Words: Carboon foot print, University campus, Energy, Transportation, Fuel

Üniversitelerde Karbon Ayak İzini Azaltmaya Yönelik Örnek Çalışma - Dokuz Eylül Üniversitesi Tınaztepe Kampüsü (İzmir, Türkiye)

Özet

Bu çalışma, Dokuz Eylül Üniversitesinin merkezi ve en büyük kampüsü olan Tınaztepe Kampüsü'nün karbon ayak izini hesaplamayı ve bu süreçte kampüsün çevresel etkilerini kapsamlı bir şekilde değerlendirmeyi amaçlamaktadır. Çalışmada, kampüsün enerji tüketimi, ulaşım, su kullanımı ve diğer kaynaklardan kaynaklanan karbon emisyonları ayrıntılı olarak analiz edilmiştir. Bu doğrultuda üniversitede ulaşım ve ısınma amaçlı yakıt kullanımı (benzin, motorin ve doğal gaz kullanımı), elektrik tüketimi, su tüketimi verileri kullanılarak oluşan karbon emisyonları belirlenmiştir. Bunun yanı sıra, üniversitenin yenilenebilir enerji kaynağı olarak kullanılan güneş enerji sisteminin karbon emisyonunu azaltmaya katkısı, bunun yanı sıra, üniversitenin ormanlık arazisinin karbon yutak kapasitesi de dikkate alınarak, kampüsün toplam karbon ayak izi belirlenmiştir. Çalışmada Birleşmiş Milletler'in IPCC Modeli Tier 1 yaklaşımı kullanılarak hesaplamalar gerçekleştirilmiştir. Yapılan hesaplamalar sonucunda, Tınaztepe Kampüsü'nün yıllık toplam karbon ayak izi 2669,83 ton CO₂ olarak tespit edilmiştir. Ayrıca, kişi başına düşen yıllık karbon ayak izi 0.064 ton karbon olarak hesaplanmıştır. Çalışmada elde edilen bulgulara göre, karbon emisyonlarının en büyük kısmı doğalgaz tüketiminden, en küçük kısmı ise su tüketiminden kaynaklanmaktadır. Bu veriler ışığında, kampüsün karbon ayak izini azaltmaya yönelik çeşitli stratejik öneriler geliştirilmiştir. Öneriler arasında enerji verimliliğinin artırılması, ulaşımında daha sürdürülebilir yöntemlerin benimsenmesi ve su tüketiminin azaltılması gibi önlemler bulunmaktadır. Bu çalışmanın sonuçları, üniversitelerin sürdürülebilirlik politikalarını geliştirirken dikkate alabilecekleri önemli bilgiler sunmaktadır.

Anahtar Kelimeler: Karbon ayak İzi, Üniversite Kampüsü, Enerji, Ulaşım, Yakıt





ID: 555

Antimicrobial Activities, Proximate and Mineral Analysis of Selenium Enriched Functional Food (Cheese)

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Abstract

Functional foods are foods that offer additional health benefits that extend beyond their nutritional values. Cheese a nutritious dairy product; have garnered significant attention due to their nutrient-rich profiles, including high-quality protein, essential vitamins and minerals. *Lactobacillus paracasei* is a lactic acid bacterium that plays a crucial role in cheese production. Selenium deficiency can lead to various health issues, and optimal intake appears to have protective effects against certain diseases. This study aimed at enriching cheese with selenium, investigating the nutritional values and the antioxidant potential of the cheese produced. Cheese samples were produced with *L. paracasei* and enriched with selenium using standard procedures. Viability tests were done using pour plate method. Proximate and mineral content were analysed. Antioxidant activity measured using DPPH assay. *L. paracasei* remained viable in 4 mM concentration of selenium and cheese was produced. Proximate analysis revealed variations in moisture, crude protein, fat, ash, crude fiber, and carbohydrate content among the cheese samples. Selenium enriched cheese had higher content of ash (0.70%), crude fiber (16.13%), protein (22.40%) and moisture content (26.75%). Mineral analysis showed significant differences in selenium, calcium, iron, potassium, and sodium levels, with selenium-enriched cheese. Antioxidant activity demonstrated a concentration-dependent increase in scavenging capacity. The cheese enriched with Selenium demonstrated improved nutritional composition and extended shelf life.

Keywords: Functional food, Cheese, Selenium, *Lactobacillus paracasei*, Nutritional values.





ID: 556

Occurrence of *Fusarium* sp. and *Lasiodiplodia* sp. Causing Root Rot in Grapevine (*Vitis vinifera* L.) in Sri Lanka

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Abstract

A decline of various grapevines (*Vitis vinifera* L.) associated with root rot symptoms was observed during a field survey conducted from January to March 2024 in vineyards in the Jaffna district, Northern Province, Sri Lanka. Despite the significance of identifying the causative agents for effective disease management, no prior reports exist on the pathogens responsible for grapevine root rot in Sri Lanka. In this study, based on morphological characterization, we identified *Fusarium* sp. and *Lasiodiplodia* sp. as potential causal agents of grapevine root rot. Koch's postulates were confirmed by the successful re-isolation of both pathogens from healthy plants inoculated with the conidial suspensions under controlled conditions. To the best of our knowledge, this is the first report of *Fusarium* sp. and *Lasiodiplodia* sp. causing grapevine root rot in Sri Lanka. This study highlights the need for species-level identification using molecular data and lays the foundation for future research aimed at developing sustainable disease management strategies.

Key Words: Fungal diseases, Pathogenicity, Sordariomycetes, Botryosphaeriaceae

Introduction

Grapevine (*Vitis vinifera* L.) is an economically significant crop worldwide, cultivated for fresh fruit, wine production, and other value-added products (Perestrelo et al., 2014; Parihar & Sharma, 2021). Global grape production spans about 7.9 million hectares, with 51.42% of the total coming from China (12.85%), Italy (11.5%), the USA (9.24%), Spain (9.07%), and France (8.69%) (Kulwijila et al., 2018). In Sri Lanka, grapes are primarily grown for fresh consumption on about 100 hectares (Champa, 2015), mainly in the Dry Zone areas of the Northern and Eastern regions (Champa, 2015; Ramanathan & Sivapalan, 1988). During a survey of the vineyards in the Jaffna district, Northern Province, Sri Lanka, a widespread vine declining was noted with root rot symptoms. Root rot is primarily caused by soil-borne pathogens and is particularly challenging to manage because initial symptoms develop below ground, becoming visible only after significant damage has occurred, which compromises yield and jeopardizes plant survival (Bodah, 2017; Williamson-Benavides & Dhingra, 2021). Among the root rot causing pathogens, *Fusarium* spp. are common (Alves et al., 2023; Bodah, 2017; Williamson-Benavides & Dhingra, 2021), and *Lasiodiplodia* spp. are also frequently associated with root rot in various crops (El-Ganainy et al., 2022; Gnanesh et al., 2022; Latha et al., 2009; Xie et al., 2014). The genus *Fusarium* belongs to the phylum Ascomycota, class Sordariomycetes, order hypocreales, and family Nectriaceae (Crous et al., 2021). *Fusarium* spp. are characterized by aerial phialides or sporodochial conidiophores and conidiogenous cells; aerial microconidia produced on long, narrow phialides; mesoconidia; thick-walled septated macroconidia with blunt, rounded apical cells and inconspicuous foot-shaped basal cells; and chlamydospores (Leslie & Summerell, 2006; Crous et al., 2021). The genus *Lasiodiplodia* belongs to the phylum Ascomycota, class Dothideomycetes, order Botryosphaeriales, and family Botryosphaeriaceae (Phillips et al., 2013). *Lasiodiplodia* spp. are characterized by subglobose or oval, smooth, thick-walled conidia that are initially hyaline, and become dark brown and striated upon maturity (Phillips et al., 2013). *Lasiodiplodia* spp. are distinguished from related genera by the presence of pycnidial paraphyses and longitudinal striations on mature conidia (Abdollahzadeh et al., 2010). *Fusarium* spp. and *Lasiodiplodia* spp. have been reported to cause grapevine root rot disease in various parts of the world, including China (Li et al., 2023; Zhang et al., 2023), Egypt (El-Ganainy et al., 2022; El-Mohamedy et al., 2010; Hemida et al., 2017, 2024), Iraq (Abdullah et al., 2015), South Africa (Marais, 1979), and Turkey (Akgül et al., 2024). Despite their global significance, there has been no documented evidence of these pathogens affecting grapevines in Sri Lanka. Studying new occurrences of fungal pathogens in various hosts offers valuable insights into host-pathogen interactions and helps expand knowledge of their geographical distribution. This study presents the first report of *Fusarium* sp. and *Lasiodiplodia* sp. causing root rot in grapevines in Sri Lanka. The findings contribute to the existing knowledge on grapevine root rot and highlight the need for integrated disease management strategies to ensure sustainable grape production in the region.



Material and Methods

Sample collection and isolation of pathogens

Samples were collected from the grapes fields at Jaffna district from January to March 2024. Infected roots were collected from the grape vines showing disease symptoms. The root samples were thoroughly washed with tap water to remove adhered soil and surface dirt. Then the diseased root tissues were cut into small sections and surface sterilized using 1% sodium hypochlorite solution for 2 minutes. After washing three times in sterile distilled water, the sections were dried using sterile blotting papers. The sections were then placed on potato dextrose agar (PDA) medium and incubated at 28 °C. After 2-3 days, mycelium tips of resulting fungi were transferred into fresh PDA in order to obtain pure cultures.

Identification of pathogens

Fusarium sp. and *Lasiodiplodia* sp. isolates were identified based on the morphology of fungal colonies and conidia described by Crous et al. (2021) and Phillips et al. (2013), respectively. Morphological characters were observed and documented using a compound microscope (Olympus BH-2, Japan), equipped with a Canon EOS 600D (Japan) digital camera. Measurements were made using Image Focus Plus Version 2.0, and the photographs were processed with Adobe Photoshop Version 22.0.

Pathogenicity test

The isolated *Fusarium* sp. and *Lasiodiplodia* sp. were tested for pathogenicity following Koch's postulates. Healthy grapevines were transplanted in sterilized pots filled with sterilized soil and maintained in a greenhouse at the University of Jaffna. Two methods, such as wounded and unwounded were followed to assess the infection ability and the virulence of the isolates on grapevine roots. In wounded method, soil at the crown area was removed carefully, cleared the prominent roots and a small wound was created by using a sterile needle. Then, a 5 ml conidial suspension was applied into the root zone of each wounded and unwounded plants. Control tests were done by applying 5 ml of sterilized distilled water. The inoculated plants were observed daily for disease symptom development. After appearing the symptoms, the pathogen was re-isolated and confirmed by morphological characterization.

Results and Discussion

Identification of pathogens

Two pathogenic fungi were isolated from diseased grapevine root tissues and identified as *Fusarium* sp. and *Lasiodiplodia* sp. based on their morphological characteristics. *Fusarium* sp. colonies on PDA were moderately dense with whitish mycelium and a yellowish reverse, reaching 90 mm in diameter after 3 days at 25°C. The macroconidia were slightly curved to straight, elongated, tapering at both ends with 2-4 septa, measuring 22.7-39.10 × 4.93-5.9 µm. The microconidia were oval to fusiform, hyaline, smooth, and either aseptate or septate, measuring 10.9-15.4 × 3.13-4.19 µm (Figure 1).

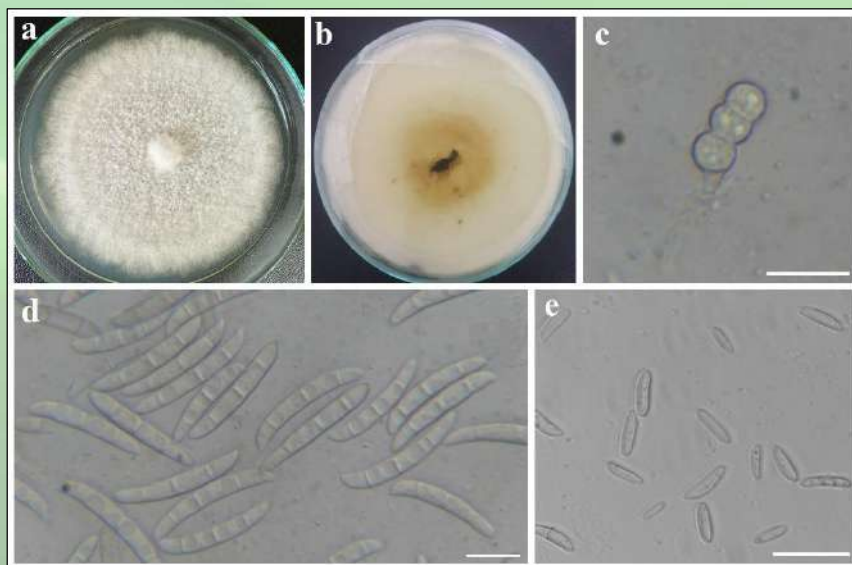


Figure 1: Morphological characters of *Fusarium* sp. (a, b) Colony morphology on potato dextrose agar (PDA) (c) chlamydospore (d) macroconidia (e) microconidia. Scale bars: 10 µm.



Lasiodiplodia sp. colonies were initially whitish, later becoming dark olivaceous with a yellowish reverse, and reached 90 mm in diameter after 3 days at 25°C. The conidia were initially hyaline, becoming dark brown with one septum and longitudinal striations upon maturity, measuring $14.94\text{--}19.36 \times 10.21\text{--}12.53 \mu\text{m}$ (Figure 2).

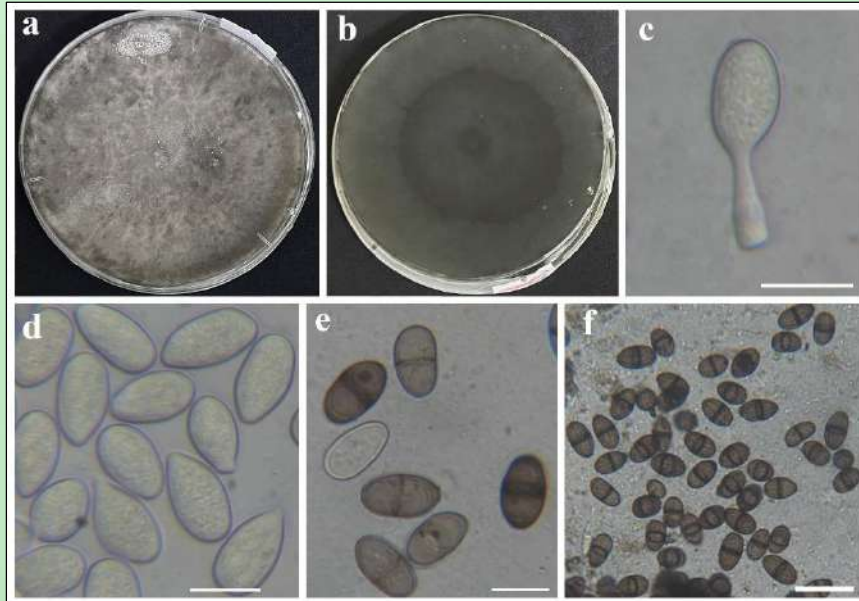


Figure 2: Morphological characters of *Lasiodiplodia* sp. (a, b) Colony morphology on potato dextrose agar (PDA) (c) a conidium developing on a conidiogenous cell (d) hyaline, immature conidia (e, f) mature conidia in two different magnifications to show the longitudinal striations. Scale bars: 10 μm (c-e); 20 μm (f).

This is the first report of *Fusarium* sp. and *Lasiodiplodia* sp. as root rot pathogens of grapevines in Sri Lanka. However, in other regions, various *Fusarium* species have been documented to cause grapevine root rot, including *F. oxysporum* (Hight & Nair 2008; Ziedan 2003; Ziedan et al., 2020), *F. solani* (Hemida et al., 2024; Ziedan 2003; Ziedan et al., 2020), *F. avenaceum* (Ziedan et al., 2020), *F. commune* (Zhang et al., 2023), *F. brachygibbosum*, *F. chlamydosporum*, and *F. ipomoeae* (Hemida et al., 2024). Similarly, though less frequent than *Fusarium* spp., *Lasiodiplodia* spp., such as *L. theobromae* (Hemida et al., 2024; Ziedan et al., 2020) and *L. exigua* (Hemida et al., 2024), have also been reported to cause grapevine root rot. Beyond root rot, *Fusarium* spp. are implicated in other grapevine diseases like vine decline (Bustamante et al., 2024; Reveglia et al., 2018), vascular wilt (Ziedan et al., 2011), basal rot, and wood cankers (Akgül et al., 2024). Likewise, *Lasiodiplodia* spp. can cause vine decline (Aroca et al., 2008) and dieback (Correia et al., 2016; Rangel Montoya et al., 2021) in addition to root rot.

Pathogenicity test

Grapevine plants inoculated with spore suspensions of *Fusarium* sp. and *Lasiodiplodia* sp. developed root rot symptoms approximately after 3-4 weeks and 2 weeks, respectively. No symptoms were observed in control plants. *Fusarium* sp. primarily caused leaf necrosis along the length of the shoot, while *Lasiodiplodia* sp. led to chlorosis of the bottom-to-top leaves in grapevine plants, eventually causing wilting and plant death (Figure 3).

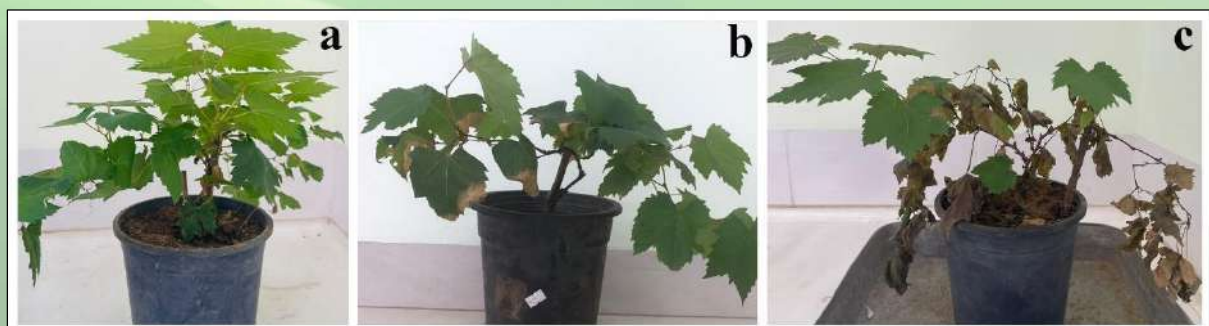


Figure 3: Disease symptoms of grapevine root rot on the shoot system, under soil inoculated with *Fusarium* sp. (c) and *Lasiodiplodia* sp. (b), compared to the control (a).



Both pathogens caused rotting of the secondary and feeder roots, with brown discoloration observed and also negatively impacted overall root system growth (Figure 4). These symptoms align with previous studies (Hemida et al., 2024; Zhang et al., 2023).

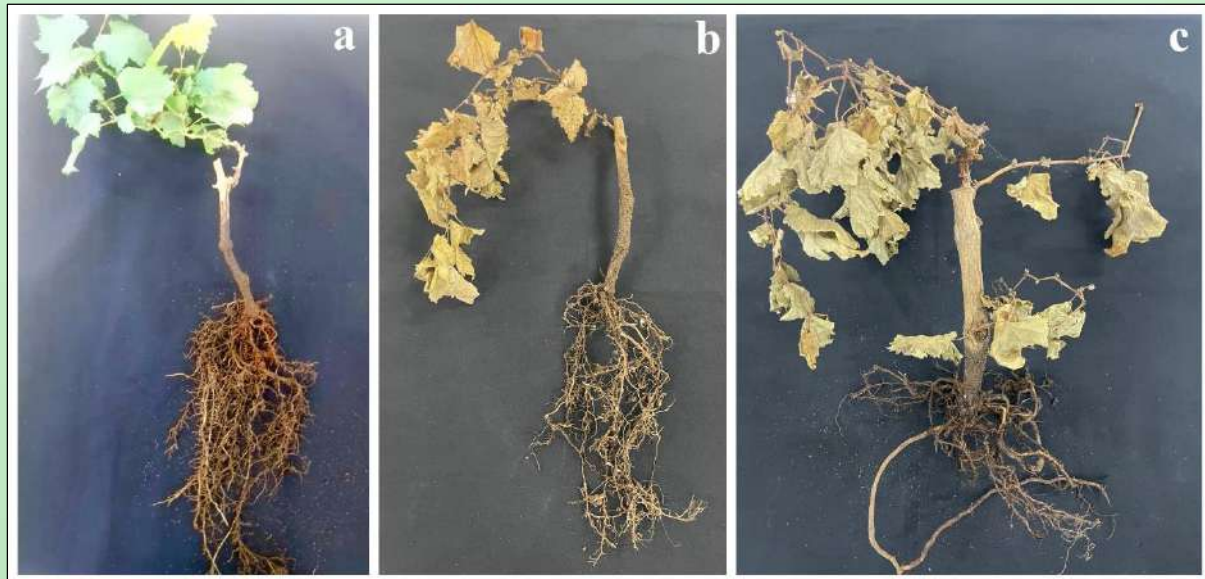


Figure 4: Disease symptoms of grapevine root rot on the root system, under soil inoculated with *Fusarium* sp. (c) and *Lasiodiplodia* sp. (b), compared to the control (a).

Therefore, it is evident that these two pathogens are among the causative agents of grapevine root rot, a serious threat to grapevine cultivation in Sri Lanka. This finding highlights the need for species-level identification using molecular data and provides a foundation for future studies aimed at managing this disease. Given the significant threat posed to grapevine cultivation, implementing integrated disease management strategies, including biological control measures, will be vital to safeguarding vineyards in the region. This study contributes to the growing knowledge base and calls for continued research to mitigate the impact of grapevine root rot in Sri Lanka.

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ID: 557

Research on Feeding Dynamics and Ecological-Economic Control of *Lobesia botrana* ([Denis & Schiffermüller, 1775]) (Lepidoptera: Tortricidae) Species

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Abstract

Lobesia botrana ([Denis & Schiffermüller, 1775 (Lepidoptera: Tortricidae) species is commonly called “Grass Moth”. Although its main host is grapevine; *L. botrana* is a polyphagous species that also meets its nutritional needs with plants such as laurel, jujube, blackberry. This study, which is based on the determination and control process of the feeding dynamics of *L. botrana*; was carried out in two different vineyard areas where Emir and Parmak grape varieties were located in 2021-2022. Delta type traps were used to follow the biological process of the taxon. The traps were hung on the vines determined before the flowering period and after the temperature reached 12 degrees. The study was carried out in thermohygrographic values were taken from the observation trench in the vineyard area and these values were compared with the phenological values of the grapevine. As a result, it was seen that the nutrition and economic-ecological control of *L. botrana* are directly related to plant phenology and ecology. Here, it was also determined that the control process of the species varies according to the years and that grapes, which are considered as the main food of *L. botrana*, are effective on the development and density of the moth in the context of changes in plant biology caused by ecological factors such as temperature, disease and precipitation during the year.

Key Words: *Lobesia botrana*, Phenology, Ecology, Econmy, Control, Grape

Lobesia botrana ([Denis & Schiffermüller, 1775]) (Lepidoptera: Tortricidae) Türünün Beslenme Dinamikleri ve Ekolojik-Ekonomik Kontrolü Üzerine Araştırma

Özet

Lobesia botrana ([Denis & Schiffermüller, 1775 (Lepidoptera: Tortricidae) türü yaygın söylemle, “Salkım güvesi” olarak adlandırılmaktadır. *L. botrana*, temel konukçusu asma olmasına rağmen; defne, hünnap, böğürtlen gibi bitkiler ile de beslenme ihtiyacını karşılayan, polifag bir türdür. *L. botrana* ’nın beslenme dinamiklerinin tespiti ve kontrol sürecini esas alan bu çalışma; 2021-2022 yıllarında Emir ve Parmak üzüm çeşitlerinin bulunduğu iki farklı bağ alanında yürütülmüştür. Taksonun, biyolojik sürecinin takibinde delta tipi tuzaklar kullanılmıştır. Tuzaklar, çiçeklenme döneminden önce ve sıcaklığın 12 dereceye ulaşmasından sonra belirlenen omcalara asılmıştır. Çalışmanın yürütüldüğü bağ alanında bulunan rasat siperinden termohigrografik değerler alınmış ve bu değerler, asmanın fenolojik değerleri ile kıyaslanmıştır. Sonuç olarak, *L. botrana*’nın beslenmesi ve ekonomik-ekolojik kontrolünün, bitki fenolojisi ve ekolojisi ile de doğrudan ilişkili olduğu görülmüştür. Burada aynı zamanda türün kontrol sürecinin yıllara göre değişkenlik gösterdiği ve *L. botrana*’nın ana besini olarak ele alınan üzümün, yıl içerisindeki sıcaklık, hastalık ve yağış gibi ekolojik faktörlerin bitki biyolojisinde yarattığı değişiklikler bağlamında, güvenin gelişimi ve yoğunluğu üzerinde etkili olduğu tespit edilmiştir.

Anahtar Kelimeler: *Lobesia botrana*, Fenoloji, Ekoloji, Kontrol, Üzüm



ID: 558

Microbial diversity of fruit and vegetable market dumpsite soils in Yola, Adamawa State, Nigeria

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Abstract

A study was conducted to study the bacterial and fungal biodiversity in fruit and vegetable dumpsite soils of the main fruit and vegetable market in Yola, Adamawa State Nigeria. The dumpsites were chosen based on their significant contribution to the local waste disposal system in the market. The biological properties of the dumpsite soils were assessed by investigating microbial abundance and diversity of bacteria and fungi only. Plate count was carried out to quantify their population in the samples and statistical analysis using Dunnett's test revealed that there were significant ($P < 0.05$) differences in bacterial and fungal counts between the fruit and vegetable dumpsite soils. Bacterial count in the fruit dumpsite soil was 7.23×10^5 Cfug while in the vegetable dumpsite it was 5.63×10^5 Cfug and 1.50×10^5 Cfug in the control pot. The fungal count was 5.14×10^5 Cfug, 4.14×10^5 Cfug and 1.40×10^5 Cfug for fruit dumpsite soil, and vegetable dumpsite soil and control respectively. Based on the combination of biochemical characteristics, different isolates of bacteria were identified such as *Escherichia coli*, *Klebsiella sp.*, *Pseudomonas sp.* and *Proteus sp* while some fungal isolates such as *Aspergillus niger*, *Mucor species*, *Aspergillus flavus*, *Penicillium species*, *Aspergillus fumigates* and *Fusarium species* were identified in both of the dumpsites. The present study has revealed some of the bacteria and fungi that thrive in the market dumpsite known to be associated with organic waste degradation however, the presence of potential pathogens like *Escherichia coli* and *Aspergillus flavus* raises concern for more caution in organic waste disposition especially near waterways and its subsequent use in Nigeria.

Keywords: Fruit, vegetable, bacteria, fungi, dumpsite soil

Introduction

A dumpsite soil is soil found in areas designated for the deposition of waste materials, which can include household, industrial, market and/or institutional refuse. These sites may be open or covered with soil and can significantly impact the surrounding environment, particularly through groundwater contamination and soil pollution due to leachate from the waste (Igboama et al., 2022). The composition of dumpsite soil is often altered by the types of waste deposited, leading to changes in microbial communities and soil properties, such as increased heavy metal concentrations and variations in pH and electrical conductivity (Halász et al., 2022; Ramaswamy et al., 2021; Agbeshie et al., 2020). Like most developing economies, Nigeria wastes are disposed of on open dumpsites with no regard for suitable waste management techniques (Adewumi et al., 2019). Research indicates that soil in and around dumpsites can exhibit distinct characteristics, including a predominance of certain bacterial phyla, which may have implications for bioremediation efforts (Selvarajan et al., 2022).

The diversity of bacteria and fungi in fruit and vegetable dumpsite soils is notably rich and varied, as evidenced by studies. Research indicates that dumpsite soils are predominantly enriched with bacterial phyla such as Actinobacteria, Proteobacteria, and Firmicutes, with specific genera like Nocardioidees, Bacillus, and Pseudomonas frequently isolated (Selvarajan et al., 2022; Varier, 2019). Fungal diversity is also significant in dumpsite soils, with common genera including Aspergillus, Mucor, and Fusarium identified in these environments (Mgbeze and Osazee, 2014). The microbial communities in these soils exhibit distinct functional potentials, particularly in biodegradation, which can be harnessed for bioremediation efforts (Selvarajan, 2022; Bassey et al., 2021). However, the presence of potential pathogens, such as Escherichia and Klebsiella, raises concerns regarding food safety and the health implications of utilizing such soils for agricultural purposes (Bassey et al., 2021). While the microbial diversity in dumpsite soils presents opportunities for ecological applications, careful management is essential to mitigate health risks associated with pathogenic organisms.

The diversity of bacteria and fungi in fruit and vegetable dumpsite soils in Nigeria is notably influenced by the specific environmental conditions and waste composition at these sites. Research indicates that dumpsites in Ondo and Lagos states exhibit significant microbial populations, with Epe dumpsite showing higher bacterial (122.0×10^6 cfu/ml) and fungal counts (25.5×10^6 cfu/ml) compared to Laje dumpsite (Simon-Oke et al., 2023) because



of the differences in the types of wastes being deposited in those dumpsites. Similarly, a study in Lagos identified various fungal species, including *Penicillium chrysogenum* and *Aspergillus flavus*, indicating a rich fungal diversity in the soil (Ewekeye et al., 2023). In Ogun State, a predominance of keratinophilic fungi was noted, with a Shannon index of diversity around 1.98, suggesting a diverse fungal community (Thomas et al., 2021).

Materials and Methods

Dumpsite soil samples were collected separately from the fruit and vegetable dumpsites of the fruit and vegetable market in Yola Adamawa State.

Sample Collection

Dumpsite soil samples were collected from the fruit and vegetable dumpsites located in the *Kasuwan Gwari* market Yola, Adamawa State Nigeria using a systematic random sampling method. Four (4) composite samples were collected at a depth of approximately 0-20 cm (2m x 2m) to ensure representation of the microbial community present in the soil and also for routine soil physical and chemical analysis. The soil samples were sorted into organic and inorganic parts by sorting to remove stones. The samples were air-dried at room temperature and sieved using a 2-mm mesh to remove any coarse particles and homogenize the soil. The biological properties of the dumpsite soil were assessed by investigating microbial abundance and diversity. Plate count analysis was performed to quantify the population of bacteria and fungi present in the soil samples. For this purpose, serial dilutions of the soil suspensions were plated onto nutrient agar and PDA for bacteria and fungi count respectively, followed by incubation under suitable conditions. The colony-forming units (CFUs) were counted and expressed as log CFU/g soil.

All isolates were subjected to morphological characterization and identification, using seven-day-old growing cultures on appropriate media at 25 ± 2 °C. Each culture plate was opened and viewed under a light microscope. Fungal colony colour and texture were studied while several numbers septa, shapes, and sizes of fungal spores were also studied and recorded under the compound light microscope (Nikon, ECLIPSE E200).

Data Analysis

The collected data were analysed using one way analysis of variance and Dunnett's test was used to test significant difference between the population of the microbes between the 2 dumpsite soils and a control using statistical analysis software (SAS) version 9.4

Results and Discussion

Physical and chemical properties of dumpsite soils of fruit and vegetable market in Yola, Adamawa State Nigeria

Table 1 presents the results for various physical and chemical properties of the fruit and vegetable dumpsite soils. A pH of 6.10 and 6.15 recorded for the fruit and vegetable dumpsite soils respectively is an indication that the dumpsite soils are acidic in nature, and are not within the ideal range of 6.5-7.5 required for optimal plant growth. This pH level is close to the optimal range (6.0-6.5) for many crops, including citrus, suggesting that nutrient availability may be favourable for plant growth (Mohammed and Mohammed, 2012). Ogbemudia and Mbong, (2013) observed that dumpsite soils mostly have high levels of heavy metals which easily become bioavailable posing health risks when being taken up by plants during growth and development. The pH can also influence the mobility and solubility of these metals, potentially increasing their uptake by plants (Nta et al., 2020). However, these are fruit and vegetable market dumpsite soils and the heavy metal load will not be expected to be high. Therefore, while a pH of 6.10 may support crop growth, it is crucial to monitor heavy metal concentrations to ensure food safety and soil quality (Jadoun and Singh, 2014). Singh (2017) reported that slightly acidic soils can support the growth of various crops, including vegetables. Crops like chilli and tomato can thrive in acid soils with appropriate management practices like liming and/or integrated nutrient management. This is because liming by raising the pH makes available more nutrient release which consequentially increases crop productivity (Abdi, 2024).

The mean EC of 0.30 and 0.29 dSm⁻¹ for fruit and vegetable dumpsites respectively is considered moderate, suggesting a low concentration of soluble salts in the dumpsite soil. This is favourable for plant growth as high salinity can negatively impact plant health and water uptake. The electrical conductivity (EC) levels of 0.30 and 0.29 dSm⁻¹ in fruit and vegetable dumpsites can also significantly influence microbial communities and nutrient cycling. These levels indicate a moderate salinity, which can affect microbial diversity and nutrient availability.



Table 1: Physical and Chemical Properties of Dumpsite Soils

Parameter	Fruit dumpsite soil	Vegetable dumpsite soil
pH	6.10±0.34	6.15±0.21
EC (dSm ⁻¹)	0.30±0.29	0.29±0.12
Organic carbon (%)	1.36±0.09	1.35±0.14
Organic matter (%)	2.35±0.14	2.33±0.24
Total nitrogen (g kg ⁻¹)	0.14±0.01	0.14±0.01
Available phosphorus (mg kg ⁻¹)	11.87±3.46	10.29±2.16
Calcium (cmol (+)/kg)	5.71±1.77	7.24±2.20
Magnesium (cmol (+)/kg)	2.39±0.74	2.18±0.90
Sodium (cmol (+)/kg)	0.28±0.15	0.31±0.14
Potassium (cmol (+)/kg)	0.59±0.14	0.62±0.16
TEB (cmol (+)/kg)	8.99±1.72	10.36±2.10
TEA (cmol (+)/kg)	3.15±0.69	3.27±0.85
Effective CEC (cmol (+)/kg)	12.13±1.92	13.63±2.51
Percent base saturation	73.86±5.76	75.85±4.87
Sand (%)	77.44±4.66	80.27±3.52
silt (%)	16.03±4.20	12.4±2.93
Clay (%)	6.53±2.81	7.33±1.83
Bulk density (Mg m ⁻³)	1.65±0.06	1.63±0.04
Total porosity (%)	37.93±2.37	38.6±1.55

Elevated EC can enhance nutrient solubility, impacting the cycling of essential elements like nitrogen and phosphorus, which are crucial for plant growth (Gyabaah et al. 2023). Fungal spores released from decomposing organic matter in dumpsites contribute to nutrient cycling, although their activity may vary with EC levels (Arigela et al., 2023). While moderate EC levels can support microbial activity and nutrient cycling, excessive salinity may lead to detrimental effects on plant health and soil quality, highlighting the need for careful management of dumpsite environments.

The organic carbon content of 1.36 and 1.35 % and organic matter contents of 2.35 and 2.33 % for fruit and vegetable dumpsites respectively indicate their moderate levels in the dumpsites. Organic matter plays a crucial role in nutrient retention, soil structure, and microbial activity, which are beneficial for plant growth. In a study by Musa et al. (2021) they observed that organic matter improves soil structure, enhancing moisture retention and aeration, which are vital for root development while Asare & Száková (2023) added that higher organic carbon content supports a favourable C/N ratio, facilitating effective mineralization and nutrient cycling.

The mean total nitrogen content of 0.14% is low compared to the ratings of Landon (2014). However, a study conducted by Chokor & Agbai. (2022) revealed that dumpsite nitrogen levels can be as high as 1.48% at the surface but decrease with depth and distance from the dumpsite. The phosphorus content of 11.08 mg/kg in dumpsite soil can be considered moderate compared to various soil nutrient level studies. The assessment of soil from different dumpsites reveals a range of phosphorus concentrations, indicating variability based on location and contamination levels. Ogoko & Ijeoma (2016) reported a range of 5.10 to 15.10 mg/kg across different dumpsites in Aba, Nigeria while a study carried out by Obianefo et al. (2017) in Port Harcourt Rivers state, Nigeria reported phosphorus levels between 0.041 and 4.07 mg/kg, suggesting that the 11.08 mg/kg value is significantly higher than some sites but lower than the maximum observed in the present study. In contrast, Amos-Tautua (2014) reported available phosphorus levels that ranged from 35.00 to 84.20 mg/kg, which is considerably higher than the 11.08 mg/kg found in the current study. These are all indications that the nutrient content of dumpsite soil is always a function of the type and amount of waste being deposited. The mean values for calcium, magnesium, sodium, and potassium fall within the typical ranges for agricultural soils. The total exchangeable base (TEB) of 9.67 cmol/kg and percent base saturation (BS) of 74.85% indicates a moderate level of base saturation. This suggests good buffering capacity against soil acidification. The high sand content (78.85%) indicates a sandy loam texture, which is well-drained but has a low water-holding capacity. This could pose challenges for plant growth in dry periods. The bulk density of 1.63 g/cm³ is within the typical range for agricultural soils, indicating good aeration and root penetration. The total porosity of 38.27% is also within the recommended range for good drainage and aeration, further supporting the suitability of the soil texture for plant growth.

Total Heterotrophic Microbial Counts in Fruit and Vegetable Dump Soil Sites

The total heterotrophic microbial counts in fruit and vegetable dump soil sites is presented in Table 2. Data obtained reveal that the results are significantly different ($P < 0.05$) between the dumpsites in comparison to the control soil. The Bacterial count in fruit dumpsite soil is 7.22×10^5 cfu/g while in the vegetable dumpsite soil it is 5.63×10^5 cfu/g, with a value of 1.50×10^5 cfu/g in the control. This suggests a relatively diverse bacterial



population across the dump soil sites. However, notable differences exist between fruit and vegetable dumpsites, with fruit dumpsite showing consistently higher bacterial counts than vegetable dumpsite. This could be attributed to factors like type of waste generated, organic matter content, pH, or moisture availability, which differ between the two sites and influence bacterial growth. This highlights the elevated microbial activity in the dumpsite areas, likely due to the abundance of organic matter and nutrients from decomposing fruit and vegetable wastes.

Fungal counts is 5.14×10^5 cfu/g in the fruit dumpsite soil while it is 4.14×10^5 cfu/g in the vegetable dumpsite, with the control soil recording 1.40×10^5 cfu/g. This indicates a lower fungal diversity compared to bacteria across the samples. Similar to bacteria, plots within the same site tend to have comparable fungal counts. However, unlike bacteria, the difference in fungal counts between the two sites less pronounced. This suggests that factors influencing fungal growth might be more evenly distributed across the two sites. As with bacteria, both dumpsite soil samples have higher fungal counts than the control soil. This could indicate that while the dumpsite soil provides a suitable habitat for fungi as well, specific factors might be limiting their growth to a greater extent than for bacteria. In all samples, the bacterial counts are consistently higher than the fungal counts, indicating a general dominance of bacteria in the dumpsite soil microbial communities. This is a common observation in soil environments, as bacteria tend to have faster growth rates and utilize organic matter more efficiently than fungi. While bacterial dominance is evident, the ratio of bacteria to fungi remains relatively constant across the samples. This suggests a potentially balanced ecosystem where both bacterial and fungal populations contribute to the decomposition process and nutrient cycling within the dumpsite soil.

Table 2: Total Heterotrophic microbial counts in fruit and vegetable dump soil sites

Dumpsite	Bacteria (Cfu/g) 10^5	Fungi (Cfu/g) 10^5
Fruit dumpsite	7.23a	5.14a
Vegetable dumpsite	5.63b	4.14b
Control	1.50c	1.40c

The higher total heterotrophic microbial counts in dump soil compared to the control (Table 2) highlight the increased microbial activity fueled by the abundant organic matter in the dump site. This indicates a potentially active and diverse ecosystem, but also raises concerns about potential pathogen presence and potential for odor generation. Wastes in some tropical fruits like durian and jackfruit can be as high as 60% (Sagar et al., 2018) and such wastes can increase waste being generated in the markets. In addition, approximately 48.6% of fruits and vegetables are discarded as wastes after processing in a study at Rio de Janeiro, Brazil (de Brito Nogueira et al., 2020). Increase in consumption of fruits and vegetables will come with its attendant consequence of increasing waste to dispose and odour generation.

Biochemical Characteristics and Identification of the Bacterial Isolates obtained from Vegetable and Fruit Dump Sites

The biochemical characteristics of bacterial isolates obtained from fruit and vegetable dump sites is presented in Table 3. All isolates are Gram-negative, indicating their affiliation with the Proteobacteria phylum. This is a common group of bacteria known for their metabolic diversity and presence in various environments, including soil. The majority of isolates (5 out of 8) are positive for citrate utilization, indicating their ability to utilize this organic acid as a carbon source. This suggests their potential contribution to the breakdown and recycling of organic matter in the dumpsite. Three isolates show positive indole production, a characteristic of some tryptophan-degrading bacteria. This ability allows them to break down tryptophan, an amino acid found in organic matter, and utilize it for growth. All isolates exhibit an "acid/acid" reaction on TSIA, indicating their ability to ferment both glucose and lactose. This further confirms their metabolic versatility and potential role in organic matter degradation. Four isolates display gas production, a characteristic of some fermentative bacteria. This ability contributes to the release of carbon dioxide, which can impact the soil's gas composition and potentially influence other microbial populations. Three isolates show positive urease activity, indicating their ability to hydrolyze urea and utilize the resulting ammonia as a nitrogen source. This capability could be crucial for their survival in environments with limited nitrogen availability. Based on the combination of these biochemical characteristics, five isolates were identified as *Escherichia coli*, two as *Klebsiella sp.*, and one each as *Pseudomonas sp.* and *Proteus sp.* These are common bacterial genera found in soil and known for their ability to thrive in organic-rich environments. The biochemical profiles reveal a diverse range of metabolic capabilities among the isolated bacteria. Their ability to utilize different carbon and nitrogen sources suggests their active role in the decomposition and nutrient cycling processes within the dump soil ecosystem. The presence of *Escherichia coli* and *Klebsiella sp.*, which can be opportunistic pathogens, also highlights the potential public health concerns associated with these environments. The biochemical profiles of the bacterial isolates (Table 2) reveal their varied metabolic capabilities. The dominance of *Escherichia coli* and *Klebsiella sp.* aligns with previous studies on dump sites (Odum et al., 2020), suggesting their adaptation to organic-rich environments.



Table 3: Biochemical characteristics and identification of the bacterial isolates obtained from vegetable and fruit dump site soils

S/No	Isolates identification	Grams Reaction	Citrate	Indole	TSIA	Gas production	Urease	Isolate identification
1.	A	-	-	+	Acid/Acid	+	-	<i>Escherichia coli</i>
2.	A	-	+	-	Acid/Acid	+	+	<i>Klebsiella</i> sp.
3.	A	-	+	-	Acid/Acid	-	+	<i>Pseudomonas</i> sp.
4.	A	-	-	+	Acid/Acid	+	-	<i>Escherichia coli</i>
5.	B	-	-	+	Acid/Acid	+	-	<i>Escherichia coli</i>
6.	B	-	+	-	Acid/Acid	+	+	<i>Klebsiella</i> sp.
7.	B	-	+	+	Alkaline/Alkaline	+	+	<i>Proteus</i> sp.
8.	B	-	+	-	Acid/Acid	-	+	<i>Pseudomonas</i> sp.

Key: A- bacteria isolate from fruit dumpsite soil, B- bacteria isolate from vegetable dumpsite soil

The ability of some isolates to utilize citrate, indole, and gas production indicates their potential contribution to organic matter decomposition and nutrient cycling (Madigan et al., 2009). However, the presence of *Escherichia coli* raises concerns about potential faecal contamination and associated public health risks.

Morphological characteristics of isolated fungi

Table 4 presents the morphological characteristics of fungal isolates obtained from fruit and vegetable dump sites. Fungal isolate A1 showed a black and powdery-like appearance suggesting a filamentous fungus with abundant spore production. This description is consistent with *Aspergillus niger*, a common saprobic fungus known for its ability to degrade organic matter. Fungal isolate A2 showed a whitish/light cotton-like appearance indicating a fast-growing fungus with aerial mycelia. This aligns with *Mucor species*, which are known for their rapid growth and efficient degradation of organic matter.

Table 4: Morphological characteristics of Fungal Isolated

Isolates	Macroscopy	Microscopy	Organism (s)
A1	Black and powdery like	Conidiophores smooth walled and non-septate	<i>Aspergillus niger</i>
A2	Whitish/ Light Cotton like	Round, Conidia non – Septate	<i>Mucor species</i>
A3	Light green and powdery light	Long, erect septate, conidiophores	<i>Aspergillus flavus</i>
B1	Brown and cottony-like	Long erect conidiophores round-shape conidia	<i>Penicillium species</i>
B2	Gray-green fluggy colonies	Long erect non septate conidiophores	<i>Aspergillus fumigatus</i>
B3	Yellow pink creamy colonies	Cylindrical to ovoid conidia, curved septate conidiophores	<i>Fusarium species</i>

Key: A -fruit dumpsite soil, B- vegetable dumpsite soil

Fungal isolate A3 showed a light green and powdery-light appearance suggesting another *Aspergillus* species, possibly *Aspergillus flavus*, known for its green conidia and potential to produce mycotoxins.

Fungal isolate B1 obtained from the vegetable dumpsite soil showed a Brown and cotton-like appearance could indicate *Penicillium species*, another common soil fungus known for its ability to degrade organic matter and produce antibiotics. Fungal isolate B2 showed Gray-green fluggy colonies suggesting *Aspergillus fumigatus*, a ubiquitous fungus known for its ability to cause respiratory infections in humans and animals. Fungal isolate B3 showed Yellow-pink creamy colonies with curved septate conidia pointing towards a *Fusarium* species, a diverse group of fungi with saprobic and pathogenic lifestyles.

In addition, Fungal isolate A1 showed Smooth-walled and non-septate conidiophores that are characteristic features of *Aspergillus niger*. This confirms the macroscopic identification. Fungal isolate A2 showed a Round, non-septate conidia that are consistent with *Mucor species*. This further corroborates the initial identification. Fungal isolate A3 showed a Long, erect septate conidiophores support the identification of *Aspergillus flavus*. However, additional tests might be needed for definitive confirmation. Fungal isolate B1 showed a Long, erect conidiophores with round-shaped conidia that are typical of *Penicillium species*. This strengthens the macroscopic identification. Fungal isolate B2 showed Long erect non-septate conidiophores that are consistent with *Aspergillus fumigatus*. This observation aligns with the macroscopic features. Fungal isolate B3 showed a Cylindrical to ovoid



conidia with curved septate conidiophores that are characteristic of *Fusarium* species, this confirms the initial identification.

The morphological characterization revealed a diverse range of fungal isolates, including saprobic species like *Aspergillus niger*, *Mucor species*, and *Penicillium species*, which play crucial roles in organic matter decomposition and nutrient cycling. Additionally, the presence of *Aspergillus flavus* and *Fusarium species* highlights the potential presence of mycotoxin-producing fungi, which could pose human health concerns. The identified fungal isolates (Table 4) – *Aspergillus niger*, *Mucor species*, *Penicillium species*, *Aspergillus flavus*, and *Fusarium species* – are commonly found in soil environments and dumpsites too (Owhonka et al., 2024). Their presence indicates a diverse fungal community with potential roles in organic matter degradation, nutrient cycling, and even antibiotic production (Gadd, 2011). However, the presence of *Aspergillus flavus* and *Fusarium* species necessitates further investigation due to their potential to produce mycotoxins, which pose human health risks.

Conclusion

The dumpsite soils exhibited a slightly acidic pH, moderate organic matter content, low electrical conductivity, and sandy loam texture. Diverse fungal and bacterial communities were identified, including species like *Aspergillus niger*, *Mucor sp.*, *Penicillium sp.*, *Escherichia coli*, and *Klebsiella sp.* The bacterial isolates displayed varied metabolic capabilities, suggesting their involvement in organic matter decomposition and nutrient cycling. Total heterotrophic microbial counts were significantly higher in the dump soil compared to the control, indicating increased microbial activity. The dumpsite soil supports an active and diverse microbial community, but the slightly acidic pH, presence of potential pathogens like *Escherichia coli* and mycotoxin-producing fungi like *Aspergillus flavus*, and the potential for odor generation raise concerns about environmental and public health risks and raises concern for more caution in organic waste disposition especially near waterways and its subsequent use in Nigeria. Molecular techniques can be employed for precise microbial identification, evaluating pathogen presence and risk, investigate bioremediation potential, and explore soil amendment strategies.

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ID: 559

Antioxidant Potential, Proximate and Mineral Analysis of Selenium Enriched Functional Food (Cheese)

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Abstract

Functional foods are foods that offer additional health benefits that extend beyond their nutritional values. Cheese a nutritious dairy product; have garnered significant attention due to their nutrient-rich profiles, including high-quality protein, essential vitamins and minerals. *Lactobacillus paracasei* is a lactic acid bacterium that plays a crucial role in cheese production. Selenium deficiency can lead to various health issues, and optimal intake appears to have protective effects against certain diseases. This study aimed at enriching cheese with selenium, investigating the nutritional values and the antioxidant potential of the cheese produced. Cheese samples were produced with *L. paracasei* and enriched with selenium using standard procedures. Viability tests were done using pour plate method. Proximate and mineral content were analysed. Antioxidant activity measured using DPPH assay. *L. paracasei* remained viable in 4 mM concentration of selenium and cheese was produced. Proximate analysis revealed variations in moisture, crude protein, fat, ash, crude fiber, and carbohydrate content among the cheese samples. Selenium enriched cheese had higher content of ash (0.70%), crude fiber (16.13%), protein (22.40%) and moisture content (26.75%). Mineral analysis showed significant differences in selenium, calcium, iron, potassium, and sodium levels, with selenium-enriched cheese. Antioxidant activity demonstrated a concentration-dependent increase in scavenging capacity. The cheese enriched with Selenium demonstrated improved nutritional composition and extended shelf life.

Keywords: Functional food, Cheese, Selenium, *Lactobacillus paracasei*, Nutritional values.



ID: 560

The Determining Factors for Adopting a Food Safety Management System in Algerian Agri-food Businesses

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Abstract

This article analyses the main factors influencing implementing a food safety management system (FSMS) in Algerian agri-food companies. Our study focuses on 218 companies operating in the agri-food sector. We used the questionnaire and face-to-face interviews to facilitate data collection. We conducted a statistical analysis of linear correlation and a linear logistic model to assess the factors influencing the adoption of systems in these companies. The results of our study indicate that several key factors significantly influence the adoption of FSMS practices in food companies. This includes the age of the company, the age and education level of its leaders, the industry sector of the agri-food businesses, their target market, and the company's size. The results of our study indicate that companies established for 5 to 15 years have a probability of 43.5% and p-value = 0.043 of adopting the FSMS system, while those established for 15 to 25 years have a probability of 37.0% and p-value = 0.012. Managers with a university education are very likely (91.3%) to implement an FSMS, with a p-value of 0.043. The analysis also shows that limited liability companies (LLCs) have the highest likelihood of adoption (50.0%, p=0.019) and that businesses targeting both local and international markets have a significant probability of adoption (10.6%, p=0.020). These results highlight the importance of experience, training, and market reach in promoting a Food Safety Management System (FSMS) in the agri-food sector.

Keywords: FSMS; Determinant; Adoption, agri-food companies; Algeria.

Introduction

Since the mid-1980s, agricultural markets in many developing and transitioning countries have shifted from state-controlled to privately governed systems. This transition has led to a significant rise in high-value exports to global retail markets, driving a notable transformation in agricultural value chains characterized by increased coordination and consolidation (Reardon and Timmer, 2007; Reardon et al., 2009). Consequently, the importance of food safety and quality standards has grown, with their scope, diversity, and complexity expanding significantly. Agricultural producers worldwide now face more stringent requirements in key export markets and high-value domestic markets (Faour-Klingbeil and Todd, 2018; Asfaw et al., 2010). The impact of these evolving standards on small-scale farmers in developing countries remains a debated issue in the literature. Recent food safety incidents, such as the melamine-contaminated milk scandal in China and the presence of dicyandiamide (DCD) in New Zealand dairy products, have renewed concerns about dairy product safety (Pei et al., 2011; Montgomery et al., 2020). These incidents highlight the broader risks associated with food safety, which affect public health, the stability of national food markets, and the livelihoods of small-scale producers (Henson and Caswell, 1999; Maestre et al., 2017; King et al., 2017). Animal-derived products, due to their nature, are particularly vulnerable to microbial contamination, posing significant public health risks ranging from mild gastrointestinal discomfort to severe illness (Prache et al., 2022; Ribeiro et al., 2024). The assessment of the implementation of food safety practices in agri-food businesses, specifically in the dairy production sector, relies on a scoring system derived from the extent to which essential practices are adopted. This scoring system measures the effectiveness of these practices in ensuring food safety, taking into account the factors that influence their adoption (Simmons et al., 2007; Soderlund et al., 2008; Pappa et al., 2018). The significance of an FSMS and financial aid in upholding adherence to food safety procedures is occasionally overlooked. Assessing the understanding and implementation of food safety protocols is vital, particularly for perishable items such as milk and milk products, which are susceptible to contamination. Cost-effective behavioral changes, improved infrastructure, and targeted financial support can address many of these issues effectively. By adopting hygienic practices such as using clean utensils, ensuring animal health, maintaining sanitary conditions, and following proper storage and transportation protocols, contamination risks throughout the supply chain can be significantly reduced (Ebert, 2018; Weber and Meemken, 2018). However, structural challenges remain that hinder the ability to ensure food safety at various stages of the supply chain (Maruchek et al., 2011; Astill et al., 2019). Food security is closely tied to producers' understanding and awareness



of food safety requirements. This system security emphasizes the critical role of producers in implementing safety practices and argues that despite existing laws and regulations, food security cannot be guaranteed without increased awareness among value chain participants, particularly producers. Research conducted in various countries indicates that farmers are generally hesitant to implement food safety practices, primarily due to the lack of financial incentives and consumer unwillingness to pay premiums for safer products. (Kumar et al., 2016; Mwambi et al., 2020). The cost of compliance with food safety standards is often inversely proportional to the size of the agri-food business, meaning smaller businesses bear a higher per-unit cost of compliance (Bourlakis et al., 2014; Rabada'n et al., 2019). In addition to business size, the availability of resources, including human capital such as education, expertise, and experience in dairy farming, significantly influences the adoption of food safety practices (Rezaei et al., 2018; Lawton et al., 2024). Other factors, such as marketing channels, demographic characteristics, access to information, and the perceived likelihood of inspections, also play crucial roles in determining the level of adoption (Tonsor et al., 2009; Schoneveld et al., 2019). Furthermore, while farmer training is instrumental in increasing awareness and improving attitudes towards safe dairy production, these changes do not always translate into long-term behavioral shifts. The connection between training, awareness, and attitude is more robust than the link between training and actual food safety practices (Vyas et al., 2020; Feyisa et al., 2024). This study aims to identify the factors that affect the adoption of a food safety system within Algerian agri-food companies. To achieve this, we developed a logistic model to analyse the relationship between different factors and the implementation and adoption of a food safety system in the agri-food companies under study.

Methodology

In our study on the factors affecting the implementation of a Food Safety Management System (FSMS) in Algerian agri-food companies, we gathered information from various government institutions, including the Ministry of Industry, the National Chamber of Industry and Commerce, and the trade departments of the wilayas of Algiers and Blida in northern Algeria. Based on this data, we identified 218 agri-food companies in the study area. To gauge the willingness of these companies to participate in our study, we contacted them by phone. Out of the contacted companies, only 46 agri-food companies have adopted the FSMS system, making up 21% of the surveyed companies. Following this, we distributed questionnaires to the managers to address our expectations. The questionnaire was carefully designed in collaboration with experts in the agri-food industry and colleagues from ENSA. Before creating this questionnaire, a preliminary survey was conducted to gather the perspectives of the managers of these agri-food companies regarding their behavior, the questions posed to them, and the production methods employed by these companies. Additionally, the survey aimed to evaluate the practicality of our questionnaire in implementing a food safety system. The questionnaire was created and sent to the management of food companies for reading and data collection. This step was followed by a series of face-to-face conversations conducted in several sessions to ensure consistent responses from these managers. This type of discussion allowed managers to openly discuss the adoption of their organizations' food safety systems.

Results and Discussion

Implementing a food safety system in Algerian agri-food enterprises is imperative to enhance a nation's progress and yield advantages for customers. This safety system enables the mitigation of potential hazards and threats that may lead to significant disruptions in the production process of agri-food and processing firms and in the manufacturing of food products.

Characteristics of the Surveyed Agri-food Businesses and their Managers

Table 1 displays the primary attributes of the agri-food enterprises surveyed by the managers in charge of the food safety system. It is important to acknowledge that most of these agri-business (80.5%) have been operating for over 15 years. The majority of employers surveyed in these companies were university graduates, accounting for 91.3% of the total. Additionally, 96.6% of the managers in these companies were aged 31 or older. Most managers (91.3%) in agri-food enterprises have more than 15 years of experience. The legal status of the companies includes three types: joint-stock company (JSC) with 23.9% ownership, Limited Liability Company (LLC) with 50% ownership, and Multinational with 26.1% ownership. Approximately 97.8% of enterprises operate within the private sector.

The concept of adopting an FSMS encompasses multiple aspects, including monitoring, traceability, food quality, safety assurance, information collection on food products, storage, sharing, logistics, and marketing. These factors contribute to the value of food products. Each aspect can be considered separately by company employees depending on their position, level of education, and gender. Individuals involved in management and administration (owners, managers, and administrators) perceive the adoption of an FSMS for products as an element that adds value; individuals with substantial knowledge, including high school and university degrees and doctorates, view food safety as a factor that enhances product value (Saurabh and Dey 2021; Corallo et al., 2020). Consumer perceptions of food safety vary based on demographic and socio-economic variables, such as gender, age, educational attainment, and economic status (Waaswa et al., 2021; Rizzo et al., 2024).



Table 1 : Characteristics of the surveyed agri-food businesses and their managers (n=46).

Charachteristics	Frequencies (%)
Year of setting up the company	
less than 5 years	4,3 (2)
Between 5 and 15 years	43,5 (20)
Over 25 years	15.2 (7)
Manager's level of education	
Secondary	8.7 (4)
University	91.3 (42)
Age of manager	
30 years or less	4.3 (2)
between 31 and 50 years old	63 (29)
Over 50 years old	32.6 (15)
Nnumber of years' experience of the manager in the food industry	
less than 5 years	8,7 (4)
Between 5 and 15 years	32,6 (15)
Between 15 and 25 years old	43,5 (20)
Over 25 years	15,2 (7)
Company legal status	
JSC	23,9 (11)
LLC	50,0 (23)
Multinationanl	26,1 (12)
Business sector	
Public sector	2.2 (1)
Private sector	97.8 (45)

Support provided by cooperation programs

The table 3 presents key insights into the sectoral distribution, professional affiliations, and support from cooperation programs among surveyed companies. It reveals that the majority of companies operate in the private sector (97.8%), with a smaller portion in the public sector (2.2%). A significant 61.4% of the companies are affiliated with professional associations or clusters, indicating active engagement in industry networks, while 38.6% are not affiliated. Membership in professional associations is diverse, with notable participation in Association of Algerian Beverage Producers (APAB) (32.1%) and Club of Entrepreneurs and Industrialists of Mitidja (CEIMI) (35.7%). Additionally, the table highlights that over half of the companies (51.1%) have not received support from cooperation programs, with Support program for SMEs (PMEII) being the most accessed program (22.2%), United Nations Industrial Development Organization (UNIDO) with 11.1% and other cooperation programs such as Support program for SMEs (PMEI), Economic Diversification Program (DIVECO) and United Nations Development Programme (UNDP) with a low rate. These findings underscore the dominance of the private sector, the importance of professional networks, and the mixed levels of engagement with external support programs within the industry.

Increasing investments in agricultural research and development is essential for boosting farm productivity worldwide, particularly in developing countries, and is widely recognized as a cornerstone for ensuring long-term global food security (Alston et al., 2009; Lobell et al., 2013). Traditionally, the public sector has spearheaded investments in agricultural research and development, largely due to market failures and the relatively small scale of agricultural enterprises. However, in recent years, the private agro-industry has begun to take on a more prominent role, complementing and sometimes even surpassing public sector efforts (Fuglie and Toole, 2014). Recent estimates indicate that global research and development expenditures in the food and agriculture sector have seen more rapid growth in the private sector compared to the public sector. In developed countries, private research and development investments now exceed those of the public sector, reflecting a shift in the dynamics of innovation and development within the industry (Fuglie et al., 2018; Anderson, 2018). Companies are associated with professional associations or clusters, which indicates their active involvement in industry networks. Inclusion involves integrating small-scale producers into existing local knowledge exchange networks, which are designed to meet the demands of agribusiness markets. The configuration of social networks offers valuable insights into the relationships between individuals, their social capital, the breadth of knowledge accessible to them, and the resources they can acquire (Carpenter et al., 2012; Anderson, 2018). Network governance elucidates the process by which new technologies and practices are introduced, as well as the role played by various actors (Mansuri and Rao, 2013; Mansuri and Rao, 2012).

The competitiveness of agri-food firms is intricately tied to their capacity to engage in collaboration with other companies and associations. The growing need for collaboration highlights the importance of forming closer, enduring working relationships and even alliances with suppliers at various stages of the supply chain. This is done



to create supply chains that are increasingly efficient and responsive, ultimately providing exceptional value to customers (Lamming et al., 1996; Willem Ziggers and Trienekens, 1999; Benos et al., 2016).

Services from the quality institutions

The table 4 reveals distinct patterns in how companies engage with various quality institutions. Algerian Accreditation Organization (ALGERAC) shows low engagement, with only 15.2% of companies requesting its services, while 80.4% have not, suggesting a need for greater outreach or demonstration of value. In contrast, Algerian Institute of Standardization (IANOR) and National Office of Legal Metrology (ONML) have very high engagement rates, with 89.1% of companies utilizing their services, reflecting strong industry trust and reliance on these institutions for maintaining standards. National Algerian Institute of Industrial Property (INAPI) is also widely used, with 87.0% engagement, though a slightly higher 13.0% of companies do not use its services. The data indicates that while some institutions are well-integrated into business practices, others like ALGERAC may benefit from strategies to increase awareness and perceived value among companies, highlighting opportunities for improving the overall effectiveness of quality assurance efforts across the sector. The trade of agricultural and food products, both within Algeria and globally, is increasingly dominated by supply chains controlled by agribusinesses. These supply chains impose a growing number of standards on suppliers to secure market access (Tallontire, 2007; Tallontire et al., 2011; Havinga, 2018). Often, these standards take the form of voluntary norms established and monitored by new alliances between private and non-governmental sector actors, collaborating through private standards initiatives. These public-private sustainability initiatives, represent a new mode of governance in the agri-food sector, raising important questions about sustainability and the democratic legitimacy of these initiatives (Garbutt and Coetzer, 2005). The adoption of private forms of regulation, such as standards, by Algerian agri-food companies has become a prominent subject in the literature on agri-food, trade, and value chains.

Table 3. Distribution of company sector, professional affiliations, and support from cooperation programs.

Responses	Valid Percentage
Sector activity of the company	
Public sector	2.2
Private sector	97.8
Are you affiliated with a professional, employers' association, or a cluster?	
Yes	61.4
No	38.6
Professional Association	
APAB	32.1
FCE	25.0
CEIMI	35.7
CCI	3.6
Has your company ever been supported by cooperation programs such as PMEI and PMEII?	
PMEI	6.7
PMEII	22.2
UNDP	4.4
UNIDO	11.1
None	51.1
DIVECO	4.4

Table 4. Algerian agri-food businesses seek help from reliable institutes to guarantee the authenticity of their products.

Responses	Frequencies (%)
Has your company ever requested services from the quality institutions? AILGERAC	
Yes	15.2
No	80.4
Not familiar with these institutions	2.2
New company	2.2
Has your company ever requested services from the quality institutions? IANOR	
Yes	89.1
No	10.9
Has your company ever requested services from the quality institutions? ONML	
Yes	89.1
No	10.9
Has your company ever requested services from the quality institutions? INAPI	
Yes	87.0
NO	13.0



Perceptions of quality concept

The table 5 provides a comprehensive overview of how respondents perceive quality in various aspects of their agri-business operations. The majority view quality as essential for maintaining a good company image, with 65.2% strongly agreeing and 34.8% somewhat agreeing, indicating a near-universal recognition of its role in shaping public perception. Quality is also overwhelmingly associated with meeting customer needs, as 71.7% strongly agree and 26.1% somewhat agree, emphasizing its critical importance in customer satisfaction. Similarly, conformity to standard norms is widely regarded as a key component of quality, with 91.3% strongly agreeing, reflecting a strong consensus on the importance of compliance with established standards. However, opinions are more divided when it comes to linking quality with profit improvement and luxury products. While a majority still sees a connection between quality and profit, with 26.1% strongly agreeing and 28.3% somewhat agreeing, a significant portion of respondents are skeptical, with 30.4% strongly disagreeing. The perception of quality as synonymous with luxury is even more varied, with a nearly even split between those who agree and those who do not, highlighting diverse views on whether high quality necessarily implies luxury. Overall, the results underscores the multifaceted nature of quality and its varied implications depending on the business context. The managers interviewed in this customer study perceive quality as an essential element of a food company's reputation. The widespread agreement, with a majority of individuals expressing either strong or moderate agreement, demonstrates the nearly universal acknowledgment that quality plays a crucial role in shaping a company's reputation in the market. This image is especially evident in the agri-food industry, where quality encompasses not just the product itself, but also the company's dedication to sustainability and ethical standards (Borsellino et al., 2020).

Consumers' opinion of quality has a direct impact on a company's image. In the era of digitalization, where information spreads rapidly, it is crucial to uphold a reputation for superior products in order to preserve a favorable public perception. Companies that are viewed as consistently delivering high-quality products tend to benefit from increased consumer trust and loyalty, which is important for sustaining a positive reputation (Fernández et al., 2024). The findings offer useful insights on the perception of quality in the context of luxury products and adherence to established standards. De Barnier et al (2012) explore the multifaceted perspectives of luxury, highlighting the strong connection between the excellence of luxury goods and their rarity, skilled craftsmanship, and brand legacy. This is consistent with the conventional perspective that luxury is determined by exceptional levels of excellence and scarcity (De Barnier et al., 2012).

Relationship Between Enterprise Longevity and Quality System Adoption

Table 6 presents the crosstabulation analysis, revealing significant trends in the adoption of quality systems HACCP, ISO 22000, and FSSC 22000 across various agribusiness characteristics. Among newly established agri-business (less than 5 years), HACCP and FSSC 22 000 are equally preferred, while those in operation for 5 to 15 years favor HACCP (75%), with minimal adoption of ISO 22 000. Interestingly, older enterprises (15-25 years) show a higher inclination towards ISO 22 000 (41.2%), with no adoption of FSSC 22 000.

Table 5. Perceptions of quality and its impact on agri-business

Responses	Frequencies (%)
What does quality mean to you: A good company image	
Strongly agree	65.2
Somewhat agree	34.8
What does quality mean to you: Profit improvement	
Strongly agree	26.1
Somewhat agree	28.3
Somewhat disagree	15.2
Strongly disagree	30.4
What does quality mean to you: Meeting customer needs	
Strongly agree	71.7
Somewhat agree	26.1
No opinion	2.2
What does quality mean to you: Luxury products	
Strongly agree	30.4
Somewhat agree	32.6
No opinion	8.7
Somewhat disagree	13.0
What does quality mean to you: Conformity to standard norms	
Strongly agree	91.3
Somewhat agree	6.5
No opinion	2.2



The adoption of quality systems across agri-business of different ages reflects strategic choices tied to their development stage. Newly established companies (under 5 years) often prefer HACCP and FSSC 22 000 due to their flexibility and focus on food safety, which are crucial for building market trust. Enterprises that have been operating for 5 to 15 years show a strong preference for HACCP, as maintaining stringent safety standards becomes key to expanding their market share. The minimal adoption of ISO 22 000 in this group might be due to the complexities and costs associated with ISO certification, which are typically more accessible to older, more established companies. Companies with 15 to 25 years of operation increasingly favor ISO 22 000 (41.2%), likely due to its comprehensive integration with broader quality management systems, enhancing their competitiveness and credibility in international markets (Karaman et al., 2012; Soon and Baines, 2013; Herath and Henson, 2010). Overall, HACCP remains the most widely adopted system (69.6%), particularly among older enterprises and those with legal statuses like JSC and LLC agri-food companies. The preference for HACCP is based on its demonstrated efficacy in mitigating food safety hazards and assuring adherence to regulatory requirements, which are essential for upholding market reputation and stability. HACCP is highly advantageous for organizations in the agri-food industry that prioritize long-term performance because the haccp system is less costly than ISO 22000 and FSSC 22000 standards (Mayett-Moreno and López Oglesby, 2018; Beestermöller et al., 2018). However, multinational agri-business demonstrate a more diverse adoption pattern, including a higher adoption rate of FSSC 22 000 (33.3%). The analysis also indicates that managers with higher education levels and those over 50 years are more likely to adopt a broader range of quality systems, including ISO 22 000 and FSSC 22 000, compared to younger managers and those with secondary education, who predominantly opt for HACCP. These findings underscore the varying preferences for quality systems based on enterprise age, legal status, and manager characteristics, with a clear preference for HACCP across most categories. The adoption of quality systems by multinational agri-business often reflects their need to meet diverse regulatory requirements and market demands across different regions. The higher adoption rate of FSSC 22 000 (33.3%) among multinationals can be attributed to its comprehensive approach, which integrates ISO standards with additional requirements, making it suitable for global operations where stringent food safety protocols are necessary (Mensah & Julien, 2011). FSSC 22 000 is particularly favored in agri-business where supply chains span multiple countries, and where certification can enhance credibility and competitiveness (Overbosch and Blanchard, 2023; Mensah and Julien, 2011).

The table 6 also highlights key findings regarding the adoption of quality systems across various agri-business characteristics. Agri-business targeting local markets predominantly adopt HACCP (81.3%), while those with broader scopes, such as international markets, favor ISO 22 000 (75%). Agri-business in the African market show an equal split between ISO 22 000 and FSSC 22 000, with no adoption of HACCP. Additionally, older agri-business and those with a legal status of JSC or LLC are more likely to adopt HACCP and ISO 22 000, whereas multinationals demonstrate a more diverse pattern, including FSSC 22 000 standards. Managers with higher education levels and older managers tend to adopt a broader range of systems, with a strong preference for HACCP across all age groups. Overall, HACCP remains the most commonly adopted system (69.6%), reflecting its widespread acceptance across different market scopes and enterprise characteristics, while ISO 22 000 is preferred by those with international aspirations.

The Pearson's chi-squared test value of 0.025 indicates a significant relationship between a business's age and its choice of quality management system, suggesting that these choices are influenced by the maturity and experience of the agri-business. Older businesses are more likely to adopt established systems like HACCP, while newer companies tend to favor more standards such as FSSC 22 000. This significant association underscores the importance of aligning quality system adoption with the specific operational and strategic needs of businesses at different stages of their development. Understanding this relationship can guide better decision-making in quality management practices (Ghobadian and Gallea, 1996; Davila et al., 2009).

The chi-square test value of 0.0125 indicates a significant correlation between a manager's education level and the choice of FSMS in agri-food businesses. Managers with secondary education predominantly adopt HACCP, while those with a university education are more likely to implement advanced systems like ISO 22 000 and FSSC 22 000. This suggests that higher education levels provide managers with the knowledge and confidence to adopt more complex quality systems, emphasizing the role of education in strategic decision-making in FSMS (Mensah and Julien, 2011; Hu et al., 2023). The chi-square value of 0.0250 suggests a significant relationship between manager age and the adoption of FSMS. Managers aged 30 years or less exclusively adopt HACCP, while those aged 31-50 and over 50 show more diversity, including ISO 22000 and FSSC 22000. This indicates that younger managers prefer simpler systems, while more experienced managers opt for more comprehensive systems that align with advanced operational needs (Keen, 1993; Davila, 2005).

The chi-square coefficient of 0.038 indicates a statistically significant association between the legal status of a corporation and its selection of quality management systems (Kafetzopoulos and Gotzamani, 2014; Ferrón Vilchez and Darnall, 2016). The majority of JSC firms (81.8%) implement the HACCP system without adopting the FSSC 22000 certification. On the other hand, LLC agri-business also favor HACCP (73.9%), but they also demonstrate some utilization of the ISO 22000 and FSSC 22000 certifications. Multinational corporations exhibit a higher level of diversity, as seen by 50% of them adopting the HACCP system and 33.3% implementing the Food Safety System Certification (FSSC) 22000. This trend highlights their requirement for strong worldwide standards. It may be inferred that the legislative framework has a substantial impact on the decisions about the deployment of an FSMS.



Table 6. Test of association between factors affecting the adoption of a system in agri-food businesses.

What is the nature of this system?				Pearson	Khi- deux coefficient
	HACCP	ISO 22 000	FSSC 22 000		
Year of setting up the business					
less than 5 years	50,0%(1)	0%(0)	50,0%(1)	0.025	
Between 5 and 15 years	75,0%(15)	5,0%(1)	20,0%(4)		
Between 15 and 25 years old	58,8%(10)	41,2%(7)	0.0%(0)		
Over 25 years	85,7%(7)	14,3%(1)	0.0%(0)		
Manager's education level					
Secondary	100,0%(4	0,0%(0)	0,0%(0)	0.0125	
University	66,7%(28)	21,4%(9)	11,9%(5)		
Manager age					
30 years or less	100,0%(2)	0,0%(0)	0,0%(0)	0.0250	
between 31 and 50 years old	69,0%(20)	20,7%(6)	10,3%(3)		
over 50 years	66,7%(10)	20,0%(3)	13,3%(2)		
Legal status of the business					
JSC	81.8%(9)	18.2%(2)	0%(0)	0.038	
LLC	73.9%(17)	21.7%(5)	4.3%(1)		
Multinational	50.0%(6)	16.7%(2)	33.3%(4)		
Your company's target market					
Local	81.3%(26)	9.4%(3)	9.4%(3)	0.015	
North African	66.7%(2)	0%(0)	33.3%(1)		
African	0%(0)	50%(1)	50%(1)		
International	25,0% (1)	75,0% (3)	0%(0)		
Local and international	60.0%(3)	40.0%(2)	0%(0)		

The chi-square coefficient of 0.015 indicates a significant relationship between a company's target market and the adoption of quality management systems (Talib et al., 2013; Willar et al., 2016). Local market-focused companies predominantly adopt HACCP (81.3%), while those targeting North African and broader African markets show a preference for ISO 22000 and FSSC 22000, with 50% of African market-oriented companies adopting each. This suggests that companies targeting wider markets adopt more comprehensive and globally recognized standards to meet diverse regulatory and consumer expectations. The chi-square coefficient of 0.015 reveals a significant relationship between a company's market scope (international versus local and international) and its adoption of quality management systems (Spadoni et al., 2014; Carrillo-Labela et al., 2020). Companies targeting international markets primarily adopt ISO 22000 (75%), while those operating both locally and internationally show more diversity, with 60% adopting HACCP and 40% ISO 22000. This indicates that companies engaged in international markets prioritize globally recognized standards like ISO 22000 to meet international regulations and market demands.

Logistic Regression in Assessing HACCP System Adoption Determinants

This study uses a logistic regression model to determine the characteristics influencing the adoption of an FSMS in agri-food companies. The study employs a linear model aligned with our research aims and the dependent variables influenced by the deciding factors. This model aims to analyze the anticipated goals, which are often continuous, assuming a linear connection between these goals and the independent components being studied. Simple linear regression examines the impact of a solitary independent variable on a continuous outcome, whereas multivariate linear regression assesses the influence of many factors concurrently. By accounting for the impacts of other variables, researchers can see the distinct contributions of each variable, therefore gaining a comprehensive picture of how various factors influence the outcome. The fundamental equation for multiple linear regression has several independent variables and is described as follows (Kafetzopoulos and Gotzamani, 2014; Herath& Henson 2010):

$$Y^* = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i \quad (1)$$

The constituents of this equation are as follows: Y^* represents the predicted continuous outcome, while $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_i X_i$ represents the linear regression equation for the independent variables in the model.

The term β_0 refers to the intercept of the regression line, which represents the point where the line intersects the vertical Y-axis. This is regarded as an immutable value. The expression $\beta_1 X_1 + \beta_2 X_2 + \dots$ represents a linear



combination of variables. The value of each independent variable (X_i) is multiplied by its appropriate beta coefficient (β_i) to obtain the weighted value ($\beta_i X_i$). Beta coefficients represent the rate of change of the dependent variable for every one- unit increase in the independent variable, as indicated by the slope of the regression line. A higher beta coefficient indicates a stronger contribution of the related independent variable to the result.

Table 8 provides a thorough analysis of the factors that affect the adoption of efficient agri-food systems within Algerian agri-businesses. This analysis covers variables such as the year the business was established, the manager's level of education, the manager's age, years of experience in the agri-food sector, the business sector (public or private), the legal status of the business, and the target market. The results of the logistic regression study indicate that the agro-industry in the middle age range, specifically those that were created between 5 and 25 years ago, have a notable likelihood of adopting efficient FSMS. The probability is 43.5% with a p-value of 0.431 for 5 and 15 years ago and 37.0% with a p-value of 0.012 for 15 and 25 years ago. This is likely attributed to the collected experience of these organisations. The data suggests that managers with a university degree are highly likely (91.3%) with a p-value of 0.043 to embrace systems, emphasizing the importance of higher education in effectively managing complex systems. Moreover, managers older than 31 are the most likely to adopt the system, with an adoption rate of 63.0% and a statistically significant p-value of 0.039. This outcome could be attributed to their ability to integrate their experience and willingness to adopt an FSMS.

The table 8 highlighted also the highest level of flexibility and adaptability when it comes to adopting advanced systems for the LLC Companies, with a coefficient of 0.090 and a 50.0% likelihood. Companies that operate in both local and international markets also show a significant probability of adopting an FSMS, with a likelihood of 10.6% and a p-value of 0.020. This emphasizes the importance of market scope in driving efficiency and adherence to global standards. market scope in driving efficiency and adherence to global standards (Hashemi and Hedjazi, 2011; Ai et al., 2023).

The table 9 shows the outcomes of a logistic regression analysis exploring the factors that impact agribusinesses' implementation of an FSMS. The analysis showed that companies established 5 to 15 years ago have a 43.5% adoption rate for these practices, with a p-value of 0.043, indicating a moderate correlation. Managers aged 15 to 25 are most likely to implement FSMS commitments, with a probability of 52.2% and a p-value of 0.022.

Table 8. Logistic regression for the adoption of agrifood systems by agribusinesses.

Does the system work effectively?						
Variables	Probability	Frequency	Yes	No	Overall Sig	Coefficient
			88.3	0.002	11.7	
Year of Business Establishment						
Less than 5 years	4.3	2				0.751
Between 5 and 15 years	43.5	20				0.431
Between 15 and 25 years	37.0	17				0.012
More than 25 years	15.2	7				0.043
Manager's Education Level						
Secondary	8.7	4				0.214
University	91.3	42				0.043
Manager's Age						
30 years or less	4.3	2				0.690
Between 31 and 50 years old	63.0	29				0.039
More than 50 years old	32.6	15				0.029
Business Sector						
Public Sector	2.2	1				0.548
Private Sector	97.8	45				0.032
Legal Status of the Business						
JSC	23.9	11				0.090
LLC	50.0	23				0.494
Multinational	26.1	12				0.017
Market						
Local	69.6	32				0.093
North African	6.5	3				0.015
African	4.3	2				0.768
International	8.7	4				0.0431
Local and International	10.6	5				0.020

Note: The logistic model is constructed with a 95% confidence level.



University-educated managers show a strong likelihood (91.3%) of defining such policies, emphasizing the role of education in effective management (p -value = 0.050). Additionally, JSCs have the highest probability (50.0%) of adoption, with a significant p -value of 0.019, highlighting the influence of legal status. Companies that focus on local and international markets have a significant adoption probability of 69.6% with a p -value of 0.028 and 8.7% with a p -value of 0.032. These results suggest that a broader market presence increases the demand for comprehensive health of an FSMS. The agribusiness sector demonstrates a high commitment to an FSMS for the private sector, with a probability of 97.8% and a p -value of 0.011. The years of manager's experience in the agri-food sector over 5 years have the highest reliability to the commitment to an FSMS and target market. These results underscore the importance of company age, managerial education, legal status, and market scope in determining the likelihood of adopting robust health safety practices in agribusinesses.

Table 9. Logistic Regressions for the Adoption of Agrifood Systems by Agribusinesses: Policy, Objectives, and Commitment in Health Safety Management and Target Market.

Have you defined a policy, objectives, and commitment in health safety management?						
Variables	Probability	Frequency	Yes	No	Overall Sig	Coefficient
<u>Year of Business Establishment</u>						
Less than 5 years	4.3	2				0.951
Between 5 and 15 years	43.5	20				0.043
Between 15 and 25 years	37.0	17				0.022
More than 25 years	15.2	7				0.694
<u>Manager's Education Level</u>						
Secondary	8.7	4				0.755
University	91.3	42				0.050
<u>Manager's Age</u>						
30 years or less	4.3	2				0.741
Between 31 and 50 years old	63.0	29				0.033
More than 50 years old	32.6	15				0.043
<u>Business Sector</u>						
Public Sector	2.2	1				0.724
Private Sector	97.8	45				0.011
<u>Legal Status of the Business</u>						
JSC	23.9	11				0.019
LLC	50.0	23				0.041
Multinational	26.1	12				0.312
<u>Years of Manager's Experience in the Agri-food Sector</u>						
Less than 5 years	8.7	4				0.722
Between 5 and 15 years	32.6	15				0.023
Between 15 and 25 years	43.5	20				0.048
More than 25 years	15.2	7				0.249
<u>Business Sector</u>						
Public Sector	2.2	1				0.724
Private Sector	97.8	45				0.011
<u>Your Target Market</u>						
Local	69.6	32				0.028
North African	6.5	3				0.504
African	4.3	2				0.789
International	8.7	4				0.032
Local and International	10.6	5				0.755

Conclusion

The implementation of systems in agri-food businesses is a very detailed and complex process that is significantly influenced by numerous internal and external factors. These include the age, experience, and education level of the managers working in the business, the types of national and international markets targeted, the nature and status of the business, market trends, consumer needs, and other relevant considerations. Furthermore, the process of making decisions is consistently influenced by factors such as deeply ingrained business principles, the



unwavering drive for effectiveness and competitiveness, the necessity of upgrading facilities, the critical aspect of business succession, and the invaluable impact of social connections. To adopt such a food safety system, agri-food company managers, in collaboration with specialised consultancies, carefully analyse these complex elements while at the same time assessing in-depth and making precise use of even intelligent technologies. This enables them to change their deeply rooted attitudes, firmly held opinions, and unshakeable perceptions. This study aims to identify the factors that affect the adoption of a food safety system in Algerian agrifood companies. To achieve this, we developed a logistic model to to determinize various factors and the implementation and acceptance of a food safety system in the agrifood firms being studied. The logistic regression analysis reveals that mid-aged agribusinesses, particularly those established between 5 and 25 years ago, have a significant probability of adopting an efficient FSMS, with adoption probabilities of 43.5% with p -value=0.043 and 37.0% with p -value =0.012 respectively. University-educated managers are shown to have a strong likelihood 91.3% with p -value=0.045 of implementing such system. Managers aged 31 to 50 years have the highest adoption probability (63%, p =0.033). LLCs compaignies exhibit the highest likelihood (50.0%, p =0.019) of adopting an FSMS. Additionally, companies operating in both local and international markets have a significant likelihood adoption of an FSMS (10.6%, p =0.020). These findings emphasize the crucial roles of company age, managerial education, legal status, and market scope in determining the likelihood of adopting robust FSMS in agribusinesses.

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ID: 562

Isolation and Identification of Pesticides and Heavy Metals Degrading Bacteria and Fungi from Contaminated Soil of Peach Orchards in District Swat

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Abstract

The current study screens heavy metal-contaminated soil of peach orchards in district swat for the presence of soil microbial flora. The sampling was random and performed in 20 different locations. In the preliminary screening, different bacterial and fungal isolates were identified. Bacterial isolates were identified based on the morphological features of culture, gram staining, and biochemical tests. Fungal isolates were studied and identified on morphological features. A total of eleven different types of bacterial isolates were identified with different frequencies of occurrence. Highest frequency of occurrence was noted for the genus *Bacillus* (26.5%) followed by *Streptomyces* (22.44 %). The lowest frequency of occurrence was shown by both *E.coli* and *Staphylococci* (2.04%). On the other hand, fungal isolates of seven different genera were also recovered with different frequencies of occurrence from heavy metal-contaminated soil of peach orchards. The species of genus *Aspergillus* and *Trichoderma* showed the same and high frequency of occurrence (19.6%) followed by *Geotrichum* spp (17.64%). The most dominant genera among fungi were *Aspergillus* spp., *Trichoderma* spp., *Geotrichum* spp., and *Fusarium* spp., accounting for approximately 72% of all fungal isolates. The effects of pH and temperature on the growth of the selected microorganisms were investigated. Bacterial isolates showed maximum growth in slightly acidic to neutral environments with an optimum temperature range from 30 to 40°C .

Keywords:



Review on Biomaterial Characters of Silk Proteins

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Abstract

Insects include important species in the animal kingdom in terms of biodiversity, economic impact and ecological role. *Bombyx mori* (L., 758) (Insecta: Lepidoptera), known as the silkworm, is one of the most important insect species that has maintained these characteristics for centuries and is the main production source of silk. Silk is a natural polymer synthesized by the epithelial cells of silkworms and spiders. Silk, which is used especially in the textile sector, is also used in the production of biomaterials in the biotechnology age we are in. Today, raw silk obtained from silkworm cocoons is used in many different areas such as silk fabric, silk carpet, surgical and parachute cord, souvenirs, and military bulletproof vest manufacturing. Silk consists of two main proteins called fibroin (fibrous protein) and sericin (globular, gluing protein). Silk fibroin; It is quite suitable for biomaterial production due to its properties such as biocompatibility, permeability, high mechanical properties, controllable biodegradation rate, and processability in aqueous solutions. Approximately 75% of unprocessed silk consists of fibroin. Silk sericin is a globular protein that wraps fibroin fibers with its adhesive properties and sticks them together in the cocoon and is necessary to add shine to the fabric. Sericin is an inflexible, brittle substance. It is also antibacterial, resistant to ultraviolet wavelength rays, and has a structure that can take and give moisture. As a result, the scope and content of this study consists of the analysis of silk proteins and biomaterial characters.

Key Words: *Bombyx mori*, Biomaterials, Silk, Sericin, Fibroin



ID: 564

Impact of ISO 45001 Implementation on Occupational Health and Safety Management: A Case Study of NCA Rouiba.

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Abstract :

This research explored the impact of ISO 45001:2018 implementation on occupational health and safety (OHS) management at NCA Rouiba, a company specializing in the production of non-alcoholic beverages. Questionnaires were distributed to 100 employees out of 434, representing all levels of the organization across three professional categories : managers, supervisors, and operational staff. The results showed that the adoption of ISO 45001 significantly improved OHS performance indicators, including the reduction of workplace accidents. The standard reinforced existing prevention measures and introduced new ones, improving overall risk prevention practices. Employees' perception of safety in the workplace improved after the implementation of ISO 45001, as confirmed by the responses to the questionnaire. The structured approach of ISO 45001 has enabled NCA Rouiba to strengthen its preventive measures, increase employee involvement and create a safer working environment. While progress in OHS management is evident, the study underlines the importance of continuous improvement efforts to maintain and build on these achievements, aiming for excellence in workplace safety at NCA Rouiba

Key words : *Impact, ISO 45001, Implementation, Health and Safety Management.*

Introduction :

Occupational accidents and work-related diseases result in about 6,300 fatalities per day, constituting a significant burden on organizations and society as a whole. This concerning number highlights the pressing necessity for improved occupational health and safety (OHS) management strategies to mitigate accidents and morbidity (Zimolong & Elke, 2006; Liu et al., 2020). An essential measure in this regard is adopting ISO 45001, which organizations may follow to enhance health and safety standards. Modern occupational health and safety management systems methodologies emphasize the importance of personal knowledge about workplace and daily hazards. Employers are responsible for identifying risks associated with work processes, implementing procedures to eliminate or minimize such risks, and educating employees about any remaining hazards (Pouliakas & Theodossiou, 2013; Díaz-Cabrera et al., 2010). The implementation of ISO 45001 is expected to bring about significant improvements in workplace safety, leading to a reduction in occupational accidents and illnesses. This standard establishes a systematic framework for occupational health and safety management, promoting a proactive risk identification and reduction methodology (Nag et al., 2020; Marhavi et al., 2022). ISO 45001 seeks to improve overall workplace safety performance by promoting a culture of safety awareness and ongoing enhancement. Its execution necessitates dedication from all organizational tiers, from senior management to individual employees, to foster a safer and healthier workplace (Morgado et al., 2019; Dilokwattanakul et al., 2023). The development of occupational health and safety (OHS) has traditionally focused on reducing accidents related to the use of technology in work processes, and it has evolved over specific eras (Badri et al., 2018; Botti et al., 2022). There is a significant increase in the use of risk management theory across different levels and activities, even considering low-probability catastrophic events due to their potentially severe societal consequences. This risk-based approach now includes other areas such as land use planning, construction of new facilities, transportation of hazardous materials, and other operations with significant potential social impact (Nocco & Stulz, 2006 ; Krause & Tse, 2016). This shift indicates a growing recognition of the need to anticipate and mitigate even unlikely events with far-reaching consequences, integrating risk management principles into various occupational and public safety aspects (Paape & Speklé, 2012 ;Settembre-Blundo et al., 2021). This progression reflects an increased emphasis on proactive risk assessment and management to enhance workplace and public safety across various industries. Protecting individuals in the workplace is rooted in the Declaration of Fundamental Rights and Freedoms and goes beyond just preserving life and health (Li et al., 2015 ; Hauke et al., 2020). It involves safeguarding workers and others from the adverse effects of labour and the work environment, considering all relevant factors associated with employment. This includes establishing favourable working conditions, promoting employee well-being, ensuring social and legal protections for individuals, and conserving material assets, labour, and the environment (Noroozi & Taherian, 2023 ; Briamonte et al., 2024). Regarding employee protection, it is essential to consider factors such as stress, pressure, job monotony, working environment, interpersonal interactions, workplace facilities, and fair compensation. The European Union's health and safety policy is underpinned by a comprehensive approach, as seen in the 'Community strategy '. This strategy



advocates for the integration of all aspects of labour, from physical conditions to social and legal protections (Randall, 2001). It's this holistic view that has led to the wider implementation of integrated management systems. In this regard, the ISO 45001:2018 standard serves as a significant resource. It offers a comprehensive methodological framework for implementing an efficient occupational health and safety (OHS) management system (Marhavilas et al., 2022; Dilokwattanakul et al., 2023). By adhering to its stipulations, organisations can avert accidents and occupational illnesses, enhance overall efficiency, and guarantee a healthy and safe workplace (Lourenço et al., 2019 ; Musungwa & Kowe, 2022). This research study investigates the effects of the ISO 45001:2018 standard on occupational health and safety management. The standard provides guidelines for identifying hazards, assessing risks, and implementing control measures. There is limited research on the impact of ISO 45001 in the Algerian context, specifically in the food sector. This study aims to fill this gap by examining the influence of the ISO 45001 standard on enhancing health and safety at work in the NCA-Rouiba food company, which specializes in non-alcoholic beverage production. The research question addressed is: What are the contributions of the ISO 45001:2018 standard to occupational health and safety management within the NCA Rouiba company?

Methodology

The agri-food company NCA Rouiba boasts an excellent organizational structure and offers a wide range of products certified to ISO standards. It demonstrates a strong commitment to quality, food safety, environmental protection, and worker health and safety through rigorous production and control processes. This commitment is further evidenced by the acquisition of several internationally recognized certifications, notably ISO 9001:2015 for quality management, ISO 14001:2015 for environmental management, ISO 26000 for social responsibility (implemented in 2011), and ISO 22000 for food safety management (achieved in January 2013 after two years of dedicated effort). The ISO 22000 certification in particular reinforces NCA Rouiba's commitment to its clients and consumers by providing an additional quality guarantee for its diverse product range. Collectively, these certifications reflect NCA Rouiba's dedication to continuous improvement and adherence to international standards across various operational aspects.

The data collection for this study was carried out in two phases. The first phase involved developing questionnaires, while the second phase included on-site observations at NCA Rouiba and evaluation of company data. To verify our initial hypotheses, we used stratified random sampling to create two questionnaires targeting three professional categories: Managers, Supervisors, and Operational staff. These questionnaires were distributed to a sample of 100 employees out of a total workforce of 434, ensuring representation across all levels of the organization. The first questionnaire, aimed at managers, was designed to measure their level of involvement in occupational health and safety (OHS) and their perception of safety since the implementation of ISO 45001 at NCA Rouiba. The second questionnaire was intended for supervisors and operational staff. Both questionnaires aimed to assess safety improvements since the implementation of ISO 45001 at NCA Rouiba, considering that NCA was committed to OHS even before ISO 45001 requirements were established. This assessment was done through various variables such as safety instructions, OHS communication methods, and the use of personal protective equipment. This approach has allowed us to gather comprehensive data on the impact of implementing ISO 45001 from various perspectives within the company.

Table 1. Répartition de la Population Socioprofessionnelle Enquêtée au sein de l'Entreprise NCA Rouiba.

Socio-professional Category	Population	Sample	Percentage relative to total population (%)	Percentage of sample relative to total sample (%)
Managers	130	20	30	4.6
Supervisors	168	44	38.7	10.13
Operational staff	136	36	31.33	8.4
Total	434	100	100	23.13

The initial questionnaire, directed at managers, assessed their commitment to occupational health and safety (OHS) and their perception of safety following the adoption of ISO 45001 at NCA Rouiba. This specific questionnaire was essential for gathering targeted information relevant to the "Managers" group, including their involvement in safety behaviour visits and identifying and assessing risks. The second questionnaire was designed for supervisors and operational staff. Both questionnaires aimed to evaluate the improvements in safety following the adoption of ISO 45001 at NCA Rouiba, recognizing that the company had already been committed to health and safety at work before implementing the ISO 45001 standards. This evaluation was conducted using various criteria, including safety protocols, health and safety communication strategies, and the use of personal protective equipment.



Result and discussion

Descriptive information about the food company NCA Rouiba

Table 2 summarizes the results for the main characteristics of the NCA Rouiba agri-food company and the managers of its various agri-food businesses.

Table 2. Profile of Managers and Staff in the NCA Rouiba Food Industry.

Variable	Category	Frequency	Percentage
Age	20-29 years	5	5%
	30-39 years	16	16%
	40-49 years	44	44%
	Over 50 years	35	35%
Seniority	Less than 1 year	4	4%
	1-5 years	7	7%
	6-9 years	10	10%
	10-19 years	48	48%
	Over 20 years	31	31%
Socio-professional Categories	Manager	20	20%
	Supervisor	44	44%
	Operational staff	36	36%

The sample data shows a wide range of ages, with the majority (79%) of participants being 40 years old and over. This result suggests that the participants have significant professional experience and maturity, which could enhance the application of ISO 45001. Regarding tenure, 89% of the sample had over 5 years of experience, while 79% had more than 10 years with the organization, indicating employee stability and a comprehensive understanding of safety protocols and hazards. This long-term view provides unique insights into the evolution of workplace safety culture before and after adopting ISO 45001. The socio-professional categories are 44% supervisory personnel, 36% operational personnel, and 20% managerial workers, providing diverse jobs and responsibilities within the organization. This diverse composition offers multiple perspectives on the impact of ISO 45001 on workplace safety culture.

Managerial participation in ISO 45001

In the following section, we will highlight the active and visible participation of managers at all levels within the Occupational Health and Safety Management System (OHSMS) under ISO 45001.

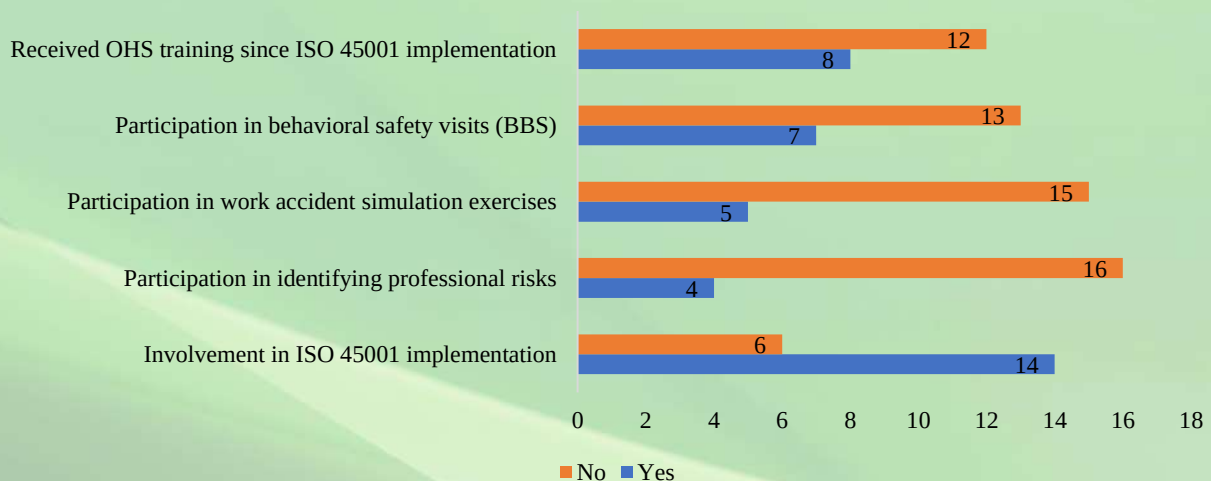


Figure 1. Managers' Perceptions and Involvement in ISO 45001 Implementation

Figure 1 shows essential findings regarding management involvement in occupational health and safety (OHS) practices after implementing ISO 45001. The figure displays the responses from participants on their involvement in various Occupational Health and Safety (OHS) activities after adopting ISO 45001. It shows the number of participants who have received OHS training since the implementation, with 12 affirming and 8 denying involvement. Similarly, 13 participants confirmed their participation in behavioural safety visits, while 7 did not. The chart also indicates a higher engagement in work accident simulation exercises and identifying professional



risks, with 15 and 16 participants respectively affirming their participation, compared to 5 and 4 who did not. Lastly, 14 participants were involved in implementing ISO 45001, against six who were not. Coloured bars—blue for "Yes" and orange for "No"—visually differentiate the responses, highlighting a solid engagement, particularly in identifying professional risks and ISO 45001 implementation.

Although there was initial solid engagement in implementing the standard, participation in specific OHS activities decreased, indicating potential discrepancies between policy and practice. This aligns with recent studies on the challenges of implementing ISO 45001 (Ghahramani, 2016; Domínguez et al., 2023). The significant involvement during the initial implementation demonstrates a strong commitment from management, which is critical for effectively implementing an OHS management system. However, reduced participation in specific activities indicates ongoing issues with leadership involvement. Only four managers identified professional hazards despite ISO 45001's emphasis on proactive hazard identification and risk assessment (Darabont et al., 2017). The limited participation in behavioural safety visits and work accident simulations suggests the potential for improvement in fostering a strong safety culture (Da Silva & Amaral, 2019). Following the implementation, only eight managers underwent OHS training, potentially leading to deficiencies in continuous learning and improvement, which are fundamental aspects of ISO 45001 (Madsen et al., 2020). The gap between initial implementation engagement and sustained participation may indicate challenges in fully integrating OHS management into daily operations, which Ramos et al., (2020) deemed essential for realizing the full benefits of ISO 45001 (Ramos et al., 2020). The findings highlight the need for increased managerial involvement in effective safety protocols and ongoing occupational health and safety education to leverage the benefits of ISO 45001 fully.

Occupational health and safety training

In the upcoming section, we will showcase how managers actively and visibly participate in training staff for the Occupational Health and Safety Management System (OHSMS) in accordance with ISO 45001 (Figure 2). From figure2, eight out of twenty managers have undergone OHS training since adopting ISO 45001, accounting for 40% of all participants. This finding suggests that a significant number of managers have taken part. In general, participation in training represents the highest percentage of managerial involvement. Nonetheless, recognizing occupational hazards remains the domain with minimal management engagement and needs specific focus.



Figure 2. Occupational Health and Safety Training Participation by NCA Rouiba Managers.

The data on manager training frequencies provides insights into the implementation of ISO 45001 and OHS practices at the organization. The high frequency of chemical handling certification training suggests a strong emphasis on chemical safety, aligning with research indicating chemical hazards remain a significant concern in many industries (Morrow et al., 2021). The focus on workplace safety training reflects ISO 45001's core principles of creating a prevention culture (Muñoz-Pascual et al., 2020), while attention to emergency response through first aid and firefighting training demonstrates commitment to emergency preparedness (Haas & Yorrio, 2016). The presence of risk identification and assessment training aligns with ISO 45001's risk-based approach (Darabont et al., 2017), and the inclusion of behavioral safety visits training suggests an attempt to incorporate principles shown to improve safety outcomes (Guo et al., 2020). The diverse range of training topics indicates a comprehensive approach to OHS as recommended by ISO 45001 (ISO, 2018). However, lower frequencies in areas such as work



permits and workplace risks might indicate potential areas for increased focus (Fernández-Muñiz et al., 2018). Overall, this training profile suggests a proactive approach to OHS management, aligning with ISO 45001's emphasis on leadership engagement and continuous improvement, while also indicating potential areas for more balanced training distribution.

Managers' perspectives on enhancing workplace safety

This section examines managers' perspectives on enhancing workplace safety after the introduction of the Occupational Health and Safety Management System.

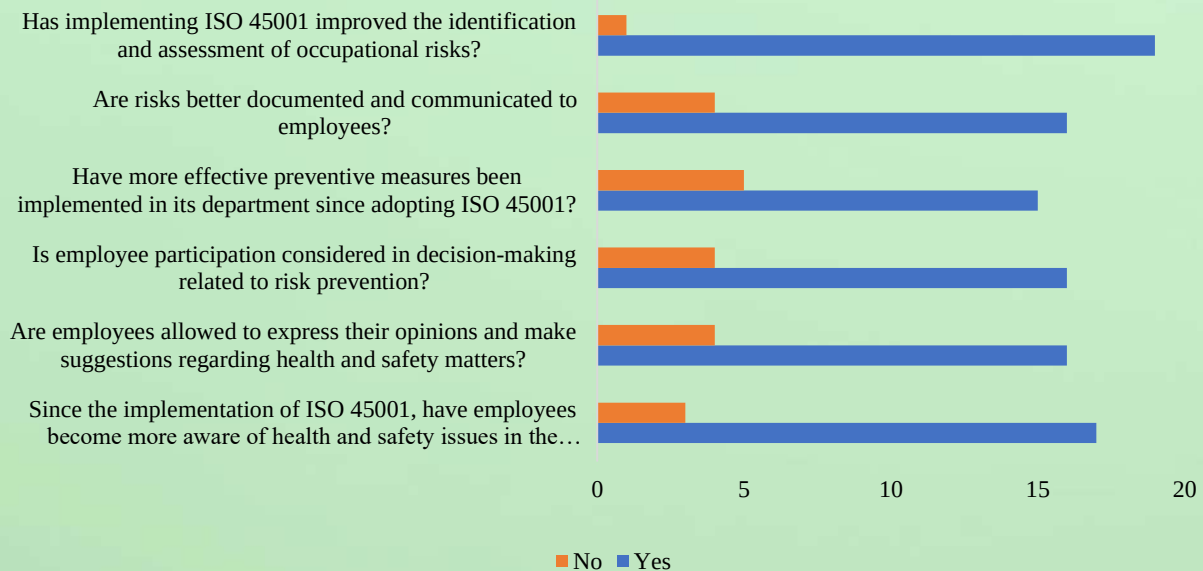


Figure 3. Managers' perceptions of enhancements in workplace safety.

The findings from figure 3 indicate a significant beneficial effect of ISO 45001 on several facets of occupational health and safety. Ninety-five per cent of managers (19 out of 20) recognised enhancements in the Identification of Hazards and Risk Assessment (IDER) procedures, demonstrating the standard's ability to optimise and formalise these essential operations, hence increasing their efficacy. This indicates that ISO 45001 has implemented systematic methods for recognising and alleviating hazards, which are crucial for ensuring a safe workplace (Coze, 2005 ; McNamara, J. H. (2014). Moreover, 80% of managers indicated risk reporting and communication advancements, highlighting increased openness. This finding indicates that the standard has cultivated a culture of transparent communication concerning risks, ensuring that staff are adequately informed about potential dangers and requisite safety protocols (Kohl, 2020 ; Bautista-Bernal et al., 2024). The adoption of ISO 45001 has led to significant improvements in preventive measures, with 75% of respondents noting the use of more effective methods. This highlights the standard's practical effect in fostering proactive risk management strategies instead of reactive event reactions (Asbury, 2021 ; Claxton et al., 2022). Regarding employee involvement, the finding that 80% of managers acknowledge workers' participation in decision-making linked to risk avoidance signifies a transition towards more inclusive methods. ISO 45001 advocates for a participatory approach, enabling employees to engage in health and safety measures and cultivating ownership and accountability. The 85% rise in employee understanding of OHS problems underscores the efficacy of ISO 45001 in facilitating consistent awareness programs. This fosters a safety-oriented staff since regular communication and training may cultivate a safety culture inside the organisation. The findings indicate that ISO 45001 has significantly and positively influenced organisational procedures and safety culture (Majumdar, 2019 ; Kabiesz & Tutak, 2024).

Employees' Perception of Workplace Safety Improvements

The subsequent section examines employees' perspectives on improvements in workplace safety following the implementation of the Occupational Health and Safety Management System.

According to the findings, a significant majority, 89% of respondents, believe that the ISO 45001 standard has positively impacted health and safety within the company, while 11% do not perceive a positive effect from the implementation of this standard. An overwhelming majority of 75 respondents feel that safety is a paramount priority within the company, corroborated by an impressive 93.75% who affirm that safety is paramount at NCA Rouiba. The general sense of safety at work has reportedly improved for 85% of respondents since adopting ISO 45001, suggesting that the company's safety efforts are having a tangible impact on employee well-being.



Moreover, 83.75% of respondents feel better informed about the specific occupational risks associated with their roles and the preventive measures in place. A similar proportion, 85%, attest that the company considers employees' opinions in safety-related decision-making. Additionally, 86.25% of respondents observe more frequent awareness campaigns about good safety practices since the standard's implementation. Finally, the same majority perceives a strengthened commitment from management towards safety, indicating a shift towards a proactive and prioritized approach to safety by the leadership. This holistic improvement in safety culture and practices likely stems from the structured and systematic approach enforced by ISO 45001, which emphasizes continual improvement, risk prevention, and employee involvement, fostering a safer and more informed workplace environment. ISO 45001 offers a systematic framework for hazard identification, risk assessment, and control implementation in risk management. This methodical approach enhances overall safety performance and employee perceptions of safety. Morgado et al. (2019) observed that adopting ISO 45001 frequently enhances hazard identification and risk assessment procedures, hence fostering a greater sense of safety among employees in the workplace. Augmented safety culture: The standard underscores the importance of leadership commitment and employee involvement, essential in cultivating a robust safety culture. Bautista-Bernal et al. (2024) discovered that organisations adopting Occupational Health and Safety Management Systems (OHSMS) such as ISO 45001 frequently observe enhancements in safety culture, resulting in heightened employee knowledge and favourable perceptions of safety initiatives.



Figure 4. Employees' responses concerning the impact of the ISO 45001 standard on OHS within the company.

Preventive Measures for OHS in NCA Rouiba

In the following section, we will outline the preventive measures that have been put in place to manage occupational risks as part of the occupational health and safety management system at the NCA Rouiba food company

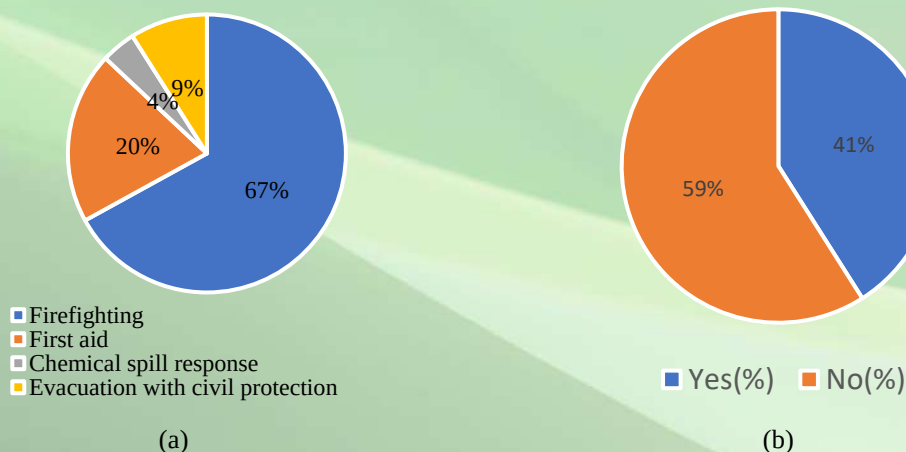


Figure 5. a) Types of Safety Simulation Exercises at NCA Rouiba and b) Total number of employees who have taken OHS training courses



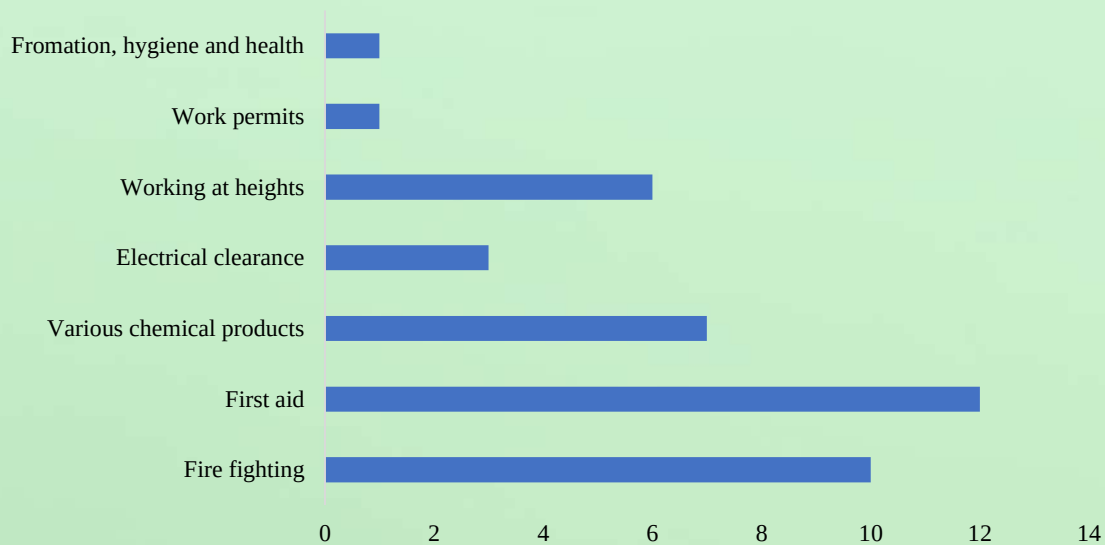


Figure 7. Employee training on the Occupational Health and Safety (OHS) system.

The data about training frequency for several occupational health and safety (OHS) issues at NCA Rouiba presents some significant findings (Figure 5a and 5b). The frequent occurrence of fire fighting (10) and first aid (12) training signifies a robust focus on disaster preparedness, along with the findings of Haas & Yorio (2016) about effective occupational health and safety management systems. The emphasis on training regarding chemical goods (7) indicates an acknowledgement of chemical hazards as a substantial occupational concern, along with the results of Morrow et al. (2021). Focusing on high-risk tasks such as working at heights (6) and electrical clearance (3) demonstrates an understanding of possible hazards, as corroborated by Li et al.'s (2015) study on task-specific safety training. The seldom issuance of work licenses (1) and training in hygiene and health (1) suggest a necessity for enhanced focus on systemic Occupational Health and Safety management strategies, as emphasised by Morgado et al. (2019). The distribution of topics indicates a thorough approach to OHS training aligned with ISO 45001 standards; however, there are opportunities to enhance systemic elements of OHS management by augmenting training in work permits and comprehensive health and hygiene management. The data showing that only 41% of employees have taken OHS training courses, while 59% have not suggests a potential gap in the implementation of safety training programs at NCA Rouiba (see Figure 6). This finding warrants further analysis and can be interpreted in several ways, including training prioritization, resource constraints, the recent implementation of ISO 45001, the effectiveness of communication, and employee engagement issues. Research has shown comprehensive safety training is crucial for improving safety outcomes and reducing workplace accidents (Robson et al., 2012).

Conclusion

In the context of our research, we have explored fundamental concepts related to Occupational Health and Safety, the ISO 45001:2018 standard, and risk prevention in the workplace. For the practical case study, we conducted an investigation within NCA Rouiba to assess the impact of the ISO 45001:2018 standard on Occupational Health and Safety management and to propose improvement actions. Implementing ISO 45001:2018 at NCA Rouiba enhances workplace safety by reducing accidents, reinforcing safety measures, and ensuring compliance with Algerian regulations. Firstly, our analysis demonstrated that the adoption of the ISO 45001 standard led to a significant improvement in Occupational Health and Safety (OHS) performance indicators. This was reflected in a notable reduction in the number, severity, and frequency of workplace accidents. These results highlight the effectiveness of the preventive measures implemented by the company. Furthermore, the findings revealed that not only were existing preventive measures reinforced, but new measures were also adopted following the implementation of the ISO 45001 standard. This underscores the positive impact of the standard on the continuous improvement of professional risk prevention practices within the company. Moreover, our investigation showed a positive perception among employees regarding the enhancement of workplace safety since the implementation of the ISO 45001 standard. The results of the administered questionnaires confirmed that the actions taken have contributed to strengthening employees' trust in their work environment concerning safety. The adoption of ISO 45001 has undeniably contributed to improving OHS management at NCA Rouiba. The structured, rigorous approach imposed by the standard has enabled the company to reinforce its preventive measures, involve its employees more effectively and create a safer, healthier working environment for all. The progress made by NCA



Rouiba in terms of OHS is very promising, and it is essential to pursue continuous improvement efforts to maintain and reinforce these achievements and aim for excellence in workplace safety.

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ID: 565

Correlation analysis of achene yield in sunflower (*Helianthus annuus* L.) to study genetic variability

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Abstract

Sunflower (*Helianthus annuus* L.) is an important edible oilseed crop which contain 35-50% oil content. Achene yield is 1.3 tons hectare¹ in Pakistan which is low as compare to other sunflower growing countries. Therefore a study was conducted in experimental field of Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad. Eighty sunflower accessions were planted following a Randomized Complete Block Design (RCBD) during 2022-23 season. Data were collected on several yield-related traits, including 50% flowering, plant height, number of leaves per plant, achene yield per plant, maturity, head angle, leaf area, and oil content. Recorded data was subjected to genetic variability, correlations and path coefficient analysis. Results revealed that genotype L11 stood out with the highest yield (43.5g), while genotype L1 had the lowest yield (24.66g). Genotypes included L-1 for days to 50% flowering, L-10 for plant height, L-61 for number of leaves, L-11 for head diameter and achene yield, L-41 for maturity, and L-31 for oil content showed better results. Achene yield per plant strongly correlated with head diameter, oil content, and leaf area, while plant height correlated positively with head diameter and correlated negatively with 50 % flowering initiation. Analysis of variance showed highly significant variation among genotypes for traits studied. Accession numbers L-11, L-21, L-10, L-31, L-61, L-41, L-71, L-51, L-30, L-20, L-9, L-60, L-50, L-70, L-80, L-40, and L-19 exhibited strong performance across both seasons., and others, which consistently performed well across different sowing times and seasons. These findings offer valuable resources for future breeding programs that enhance sunflower yield and productivity.

Keywords: Sunflower, Genetic variability, Correlation, Yield, Oil content, ANOVA



ID: 567

Next Generation Food Approaches: 3D Printed Food Items Benefits And Challenges

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Abstract

Three-dimensional food printing is a new technique that has potential uses in personalized nutrition, texture alteration, and sophisticated food design. Extrusion is the most commonly utilized process, especially for cereal derivatives and chocolate. This technology provides prospects for nutritional content customization, addressing unique dietary demands, and potentially resolving malnutrition disorders. However, obstacles remain, including as microbiological contamination, customer acceptance, and regulatory issues. Additional research is needed to determine the impact on nutrient density, bioavailability, and overall diet quality. Despite these obstacles, 3D food printing offers prospects for novel business methods and enhanced sustainability in the food supply. Future improvements could include merging 3D printing with cooking procedures and the introduction of 4D printing. 3D food printing is a novel technology with potential applications in individualized nutrition, sustainability, and creative food design. It enables the development of sophisticated geometric structures as well as customized foods based on individual nutritional requirements, textures, and flavors. Extrusion, inkjet, binder jetting, and selective sintering are some of the processes used in this technology. While 3D food printing has advantages in terms of customization and waste reduction, it has obstacles such as assuring nutritional quality, food safety, and consumer acceptance. Furthermore, there is still room for improvement in terms of production scale and printing resolution. Despite these challenges, 3D food printing has the potential to transform food innovation and manufacturing, addressing concerns such as malnutrition and sustainability in the food sector. In this review, the benefits and potential challenges of 3-D printed food items were thoroughly examined.

Key Words: 3D printing, food systems, consumer, industry, novel approaches

Yeni Nesil Gıda Yaklaşımları: 3D Baskılı Gıda Ürünlerinin Faydaları ve Zorlukları

Özet

Üç boyutlu gıda baskısı, kişiselleştirilmiş beslenme, doku değişikliği ve gelişmiş gıda tasarımı potansiyel kullanımları olan yeni bir tekniktir. Ekstrüzyon, özellikle tahıl türevleri ve çikolata için en yaygın kullanılan işlemdir. benzersiz beslenme talepleri ve potansiyel olarak yetersiz beslenme bozukluklarının çözümü. Ancak mikrobiyolojik kontaminasyon, müşteri kabulü ve mevzuat sorunları gibi engeller devam etmektedir. Besin yoğunluğu, biyoyararlanım ve genel diyet kalitesi üzerindeki etkiyi belirlemek için ek araştırmalara ihtiyaç vardır. Bu engellere rağmen, 3 boyutlu gıda baskısı, yeni iş yöntemleri ve gıda tedarikinde gelişmiş sürdürülebilirlik için umutlar sunuyor. Gelecekteki iyileştirmeler, 3 boyutlu baskının pişirme prosedürleriyle birleştirilmesi ve 4 boyutlu baskının tanıtılmasını içerebilir. 3 boyutlu gıda baskısı, bireyselleştirilmiş gıda endüstrisinde potansiyel uygulamalara sahip yeni bir teknolojidir. beslenme, sürdürülebilirlik ve yaratıcı gıda tasarımı. Bireysel beslenme gereksinimlerine, dokulara ve tatlara dayalı özelleştirilmiş gıdaların yanı sıra karmaşık geometrik yapıların da geliştirilmesine olanak tanır. Ekstrüzyon, mürekkep püskürtme, bağlayıcı püskürtme ve seçici sinterleme bu teknolojide kullanılan işlemlerden bazılarıdır. 3D gıda baskısının avantajları vardır. kişiselleştirme ve atıkların azaltılması açısından beslenme kalitesinin sağlanması, gıda güvenliği ve tüketici kabulü gibi engellere sahiptir. Üstelik üretim ölçeği ve baskı çözünürlüğü açısından hala iyileştirmeye yer vardır. Bu zorluklara rağmen 3D gıda baskısı, Gıda sektöründeki yetersiz beslenme ve sürdürülebilirlik gibi endişeleri ele alarak gıda inovasyonunu ve üretimini dönüştürme potansiyeli. Bu incelemede, 3 boyutlu baskılı gıda maddelerinin faydaları ve olası zorlukları kapsamlı bir şekilde incelenmiştir.

Anahtar Kelimeler: 3D baskı, gıda sistemleri, tüketici, endüstri, yeni yaklaşımlar



Introduction

Recent advancements in 3D printing have transformed many industries, including healthcare and biology. Using patient-specific data, the method allows for the development of complicated biomedical devices, implants, and scaffolds for tissue engineering (Chia and Wu, 2015). Significant advances in printing processes, materials, and post-processing methods have enabled the development of piezoelectric devices, blood vessel-like hydrogel structures, and even live cells (Karakurt & Lin, 2020). In healthcare, bioprinting mixes biomaterials to create biomedical parts, addressing medical crises in locations without advanced technology (Mukhopadhyay & Poojary, 2018). 3D printing's versatility and efficiency have led to its widespread use in areas such as prototype, automobile, aviation, and space exploration. Advanced printing processes such as SLS, DLP, and LOM, as well as the development of composite and nanocomposite materials containing carbon fibers, graphene, and carbon nanotubes, are boosting the capabilities of this technology (Ghongde and Sachdev, 2020). Recent breakthroughs in 3D food printing have demonstrated intriguing uses for generating customized and functional food products. This technique enables personalized nutrition, customized textures, and complex geometries (Díaz et al., 2022; Leontiou et al., 2023). Díaz et al. (2022) report that extrusion-based systems with in situ gelation and mixing capabilities offer improved control over final product qualities. The utilization of functional components and interior structures can influence both the physiological advantages and the physicochemical features of printed foods (Zhao et al., 2020). However, obstacles remain in adjusting food ink compositions and printing conditions for successful results (Zhang et al., 2021). The new concept of 4D food printing adds another level of utility (Zhao et al., 2020). In this review the benefits and challenges were evaluated deeply in comparison.

Benefits of 3D-printed Foods

Advancements in 3D food printing (3DFP) hold promise for generating personalized, healthy, and sustainable food items (Hamilton et al., 2024; Díaz et al., 2022). This method has the ability to adapt dietary qualities to specific demands (Zhang et al., 2021). Material qualities, printing settings, and food ink printability are all important aspects in determining the success of 3D printed foods. Díaz et al. (2022) are developing innovative technologies, such as in situ gelation and mixing devices, to automate the printing process and improve end product attributes. Hydrogel-based inks have emerged as a viable method for producing 3D printed foods with actual food qualities (Sharma et al., 2023). However, obstacles remain, such as food safety concerns, machine hygiene, and the requirement for standardized reporting of critical physicochemical parameters (Hamilton et al., 2024; Zhang et al., 2021). Overcoming these challenges is critical to the general implementation of 3DFP in the food business. Three-dimensional (3D) food printing is a new technology with several potential applications in the food business. It permits the development of complicated geometric structures, personalized nutrition, and customized textures for specific consumer demands, such as dysphagia patients (Zhu et al., 2023). The technology has economic and environmental benefits, such as waste reduction and the utilization of eco-friendly ingredients (Le-Bail et al., 2020). 3D food printing enables the modification of color, shape, flavor, and nutritional content, addressing concerns such as malnutrition (Singhal et al., 2020). It also has uses in intelligent food packaging, which might help reduce food waste (Leontiou et al., 2023). However, obstacles persist, including worries regarding nutritional quality, food safety, and regulatory issues (Zhu et al., 2023). Current research aims to improve print resolution and create large-scale production systems (Le-Bail et al., 2020). As technology progresses, it may transform food production and consumption habits.

Challenges of 3D-printed foods

3D printed food is a new technology with potential uses in personalized nutrition, food sustainability, and addressing global food supply issues (Tran, 2016; Roslin et al., 2022; Baiano, 2020). However, it confronts a number of challenges, including safety concerns, labelling requirements, and consumer acceptance (Tran, 2016; Baiano, 2020). The technology primarily employs extrusion techniques and a variety of ingredients, including grain derivatives, chocolate, and alternative protein sources (Baiano, 2020). Religious considerations, such as halal certification, also apply to 3D printed food goods (Roslin et al., 2022). Consumer opinions regarding 3D printed food are mixed, with concerns about its "unnatural" nature and the redefining of what constitutes food (Lupton and Turner, 2016). Legal frameworks may have to classify 3D printed foods as "novel foods" (Baiano, 2020). Despite the limitations, 3D food printing provides prospects for new business strategies and increased food supply chain sustainability (Baiano, 2020). 3D food printing has the potential to improve individualized nutrition and texture modification, especially for dysphagic patients (Zhu et al., 2023; Lorenz et al., 2022). Carbohydrate-based inks are widely used to generate desirable textures and can be supplemented with prebiotics and probiotics (Singh et al., 2022). However, the technique presents problems in terms of nutritional quality, food safety, and regulatory issues (Zhu et al., 2023). The ultra-processed nature of 3D-printed foods may have a negative influence on digestion and gut flora, however methods such as adding hydrocolloids and probiotics can help alleviate these



impacts (Lorenz et al., 2022). Safety and labeling issues are key concerns, particularly in terms of food poisoning hazards and long-term consumption impacts (Tran 2016).

Conclusion

In this review, benefits and challenges of 3D-printed foods were evaluated. While 3D food printing holds promise for enhancing texture-modified diets and developing appealing foods for certain populations, additional study is needed to address potential health hazards and assure proper regulation. The important comments given from this review, the highlights could be beneficiary for not only academicians but also industry and public.

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ID: 568

Interactive Effect of Plant Spacing and Phosphorus Concentration on Yield and Yield Components of Soybean (*Glycine max. L.*)

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Abstract

Determination of the optimum plant population necessary for optimum yield is a major agronomic goal. Phosphorus nutrition is the main and most common constraint behind poor soybean productivity. A field experiment was conducted at Ibadan Nigeria (transition between Rain forest and Guinea savannah zone) during 2015 cropping season to evaluate the effect of Phosphorus application and soybean plant population on the productivity of soybean. The trial was laid out in a Randomized Complete Block Design (RCBD) with split plot arrangement, replicated three times. The main plots consisted of four Phosphorus (P) levels (0, 20, 40 and 60 kg/ha) while four soybean populations (666700, 333333, 222200 and 166700 plants/ha) were the sub plots. Data collected include: number of branches, number of pods produced per plant, actual grain yield, seed weight, number of seed per pod, pod length and threshing percentage. Data collected were subjected to analysis of variance and significant means separated using Least Significant Difference ($p < 0.05$). It was discovered that application of 60kg P/ha produced significantly ($p = 0.05$) higher soybean yield (1103. kg/ha) with a yield advantage of 53.33% over Zero kg P /ha. also, plant population of 222200 plants/ha had significantly ($p = 0.05$) higher soybean yield (1,188kg/ha) with a yield advantage of 33.33% and 18.01% over 666700 and 333333 plants/ha respectively. It was concluded that combination of 60kg P/ ha planted at 15 cm spacing produced optimum soybean yield and yield components. Hence, application of 60kg/ha of Phosphorus to soybean planted at 15 cm is recommended for optimum yield and yield components of soybean.

Key words: phosphorus, soybean, yield, spacing, population.

Introduction

Soybean requires phosphorus for attaining high yield especially under low available soil P status. However, it's response to phosphorus fertilizer application is dependent on the crop environment and management factors (Mallarino and Reuben, 2005). Shanker Lai Khaswa *et al.* (2014) also reported that inadequate phosphorus nutrition is the main and most common constraint behind poor soybean productivity. Many studies have confirmed that the use of P is essential for the increasing soybean seed yield (Nimje and Potkile, 1998; Ogoke 2006). However, there is a need to ascertain the level of phosphorus that is needed for the optimum yield of soybean before diminishing returns sets in. Determination of the optimum plant population necessary for optimum yield is a major agronomic goal. This can be achieved through sowing at a correct seed rate which reduces seed cost, lodging and also ameliorate disease problems (Hosseini *et al.*, 2001). Plant population is a production factor which affects light interception by plant canopy (Board, 2001). Increase plant population decrease number of side branches (Ibrahim and Hala, 2007, Caliskan *et al.*, 2007), pod number per plant (Shafshak *et al.*, 1989) seed yield per plant (Shafshak *et al.*, 1989, Pawlowski *et al.*, 1993), harvest index (Spaeth *et al.*, 1984) while seed yield per hectare is increased (Caliskan *et al.*, 2007).

Two general concepts are frequently used to explain the relationship between row spacing, plant densities and yield. Firstly, maximum yield can be obtained only if the plant community produces enough leaf area to provide maximum interception of the photo-synthetically active radiation during reproductive stage. Secondly, equidistant spacing between plants will maximize yield because it minimizes interplant competition Egli, (2011). Looking at these two factors that are important in determining the yield of soybean becomes imperative so as to know their relationship for optimum performance of soybean.

Materials and Method

Field experiments was conducted at the Teaching and Research Farm of the Federal College of Agriculture, Moor Plantation, Ibadan (Latitude 7° 22N and Longitude 3° 58'E) . The soil of the experimental site was sandy loam. Pre cropping soil samples were randomly collected from the experimental plots at both sites with a soil auger from a depth of 0-30cm prior to fertilizer treatment application. The collected samples were bulked into a composite sample, air dried, grounded and passed through 2mm sieve. The sieved samples were subject to routine analysis at the soil laboratory of Federal College of Agriculture, Ibadan.



Field Procedures

The land of the experimental plot was ploughed and harrowed using tractor. Planting was done on the flat after marking out the plots using a tape rule. The whole experimental plot was 11.1x35m² which was marked out into 12 plots of 11x2 m² separated by 1m alley way. The plot was sub divided into plots of 2.4x2.0 m². The treatments consisted of four levels of phosphorus application (0, 20, 40 and 60kg P/ha) in the main plot and four soybean population densities of 166700, 222200, 333333, and 666700 plants/ha, derived by varying intra row spacing in each sub-plot. The various intra row spacing were 20cm, 15cm, 10cm and 5cm respectively while the inter row spacing was 60cm. The treatments were fitted to randomized complete block design and laid out in split plot arrangement with three replications. Each replicate was separated by 1m alley way. The four phosphorus rates were assigned to the main plots, while the four population densities were allocated to the sub- plots. The main plot was 11.1 x 2.0 m (22.2m²) while the sub plot was 2.4 x 2.0 m (4.8m²). The main plots were separated by 1m apart while the sub plots were separated by 0.5m apart. Two seeds of were sown manually per hole using a meter tape to achieve the desired spacing. Phosphorus fertilizer application was done as single super phosphate ((18%P) at the treatment rates by uniform broadcast and mixed with the soil a week before planting. Nitrogen in form of urea was applied to the crop as a basal dose at the rate of 20 kg/ha at 2 weeks after planting. Weeds were controlled by using metaphox pre-emergence herbicide with glyphosate as an active ingredient at the rate of 3 litres/ha immediately after sowing and manually using traditional hoe at six (6) and nine (9) weeks after emergence.

Data collection and analysis

Crop measurements and data collection were taken from five (5) randomly selected and tagged plants within the net plot measuring 2.4 m² for computations. The data taken were number of branches/ plant at 6, 8 and 10 WAS, number of harvested pods per plant, pod length, number of seeds per pod, threshing percentage, final grain yield and 100 seed weight. All data collected were subjected to analysis of variance (ANOVA) using Genstat Discovery Edition 4 (2011) and significant means were separated using the Least Significant Difference at 5% level of probability (LSD_{0.05}) Steel *et al.* (1997).

Results and Discussion

The results of laboratory analyses of the pre-cropping soil samples of the experimental site is presented in Table 1. The physical and chemical properties shows that the soil is moderately acidic. The nitrogen content was low (0.96 g/kg) while the available phosphorus contents was moderately okay. The textural class was sandy loam. The values of exchangeable bases (calcium, magnesium and sodium) are moderate.

Treatment effect on soybean number of branches and number of pod per plant is presented in table 2. Application of P had no significant effect on soybean branching but significantly influenced pod production where P at 60 kg/ha had significantly ($p < 0.05$) higher pod number than all the other levelsof 40, 20 and 0 kg P / ha by 13.84, 21.77 and 51.87% respectively.

Application of P was observed to promote production of more pods significantly because of the importance of Phosphorus in legumes to be able promote nodule formation, flower and fruit or pod development. This agrees with the work of Elliot *et al.* (2014) who observed that application of phosphorus to legumes aids nodule formation, flower and fruit development.

Table 1. Physical and chemical properties of pre cropping soil of experimental sites (2015 season).

Soil properties	Value
pH	6.05
Organic carbon (g/kg)	9.6
Total Nitrogen (g/kg)	0.96
Available phosphorus (mg/kg)	7.62
<i>Exchangeable cation (cmol/kg)</i>	
Na ²⁺	0.52
Ca ²⁺	1.34
Mg ²⁺	1.87
K ²⁺	0.23
Exchangeable acidity	0.11
Effective cation exchangeable capacity	4.06
<i>Particle size distribution (g/kg)</i>	
Sand	863
Silt	72
Clay	65
Textural class	Loamy sand



The effect of spacing was significant ($p < 0.05$) at 8 WAS for number of branches/plant with soybean planted at 20 cm spacing having higher number of branches than either 5 or 10 cm spacing but at par with those planted at 15 cm spacing. This could be due to less interplant competition hence they were able to utilize the available space for more horizontal growth. This result underscores the report of other authors like Liu *et al.*, (2010); and Kobrae and Shamsi, (2011) who observed that increased in plant density reduced the number of branches of individual plants and vice versa. Wider spacing (20cm) was also observed to contribute to more pod production, this could be because wider spacing encouraged more lateral growth and since pod bearing pedicels are located on branches this could lead to production of more pods. Researchers like Ball *et al.* (2000), also concluded that increased plant density reduced number of branches, pods and seed per plant and yield of individual plants. Also, Epler and Staggenborg (2008) reported that as plant density increased, number of pods/plant steadily decreased.

Table 2. Effect of phosphorus rate (kg ha⁻¹) and plant spacing (cm) on soybean number of branches and number of pods per plant

	NOB			NOP
Treatments	6WAS	8WAS	10WAS	
Phosphorus (P)				
0	0.80	4.10	4.91	51.13b
20	1.49	4.50	5.20	60.04b
40	1.75	4.59	8.35	66.13b
60	1.61	4.64	7.28	76.75a
LSD _{0.05}	ns	ns	ns	10.32
Spacing(S)				
5	1.23	3.59c	5.63	48.79c
10	1.50	4.25b	7.04	63.46b
15	1.52	4.89a	6.66	63.88b
20	1.42	5.07a	6.40	78.67a
LSD _{0.05}	ns	0.62	ns	11.07
Interaction				
P × S	ns	ns	ns	**

WAS = weeks after planting; NOB = Number of branches; NOP = number of Pods; ns = not significant; ** = Significant at 1% probability level

There was also an interaction of phosphorus and soybean spacing on the production of pods by soybean. The interactive table is shown in table 3 where it was observed that, Comparing effect of phosphorus at each spacing, more pod production was favoured with the application of 60 kg P/ ha at wider spacing of 20 cm. Also, soybean planted at spacing 10 cm and 15 cm with zero application of phosphorus was also observed to produced more pods significantly than those of 5 cm spacing under zero application of phosphorus. This result obtained could be the effect of Phosphorus on legumes which promotes pod development coupled with the fact that wider spacing encouraged lateral growth or production more branches and since pod bearing pedicels are located on the nodes of branches, more pod production is encouraged. This result agrees with the work of Elliot *et al.* (2014) who opined that phosphorus promotes nodule formation, flower and fruit or pod development. Also, Ball *et al.* (2000), Liu *et al.*, (2010) and Kobrae and Shamsi (2011) concluded that increased plant density reduced number of branches, pods and seed per plant and yield of individual plants.

Effect of phosphorus concentration and spacing on soybean yield and yield component is shown in table 4. Application of P significantly influenced soybean yield and number of seeds per pod. The yield of soybean was significantly ($p < 0.05$) higher with the application of 60 kg P/ha than other levels of P with a yield difference of 34.3 and 47.7% for 40 and 20 P respectively. This could be due to the response of the crop to available phosphorus in the soil. More P was needed to produce high yield because the soil P was lower. Mallarino and Reuben, (2015) reported that soybean utilizes applied P more when available soil P was low for attaining high yield. Significantly high yield ($p < 0.05$) was also recorded with 15cm spacing probably due to the effect of less interplant competition among the crops which promotes more lateral growth hence more pods were produced which translates to more yield. This corroborate the work of Kobrae and Shamsi (2011) who concluded that increased plant density reduce number of branches, pods and seed per plant and yield of individual plants.

Application of P at 60 kg/ha gave significantly ($p < 0.05$) higher seed number per pod than other P levels (table 4) this could be as a result of the fact that phosphorus is needed by legumes for seed formation. Gyaneswar *et al.*, (2002) had earlier reported that root improvement, stalk and stem vigor, flower and seed formation, crop production, crop maturity and resistance to plant pests and diseases are the attributes associated with phosphorus availability.

There was also an interaction between phosphorus application and soybean spacing on the production of seeds per pod. The interaction table (Table 5) showed that number of seeds per pod of soybean with application of P at all the spacing were more this reveals the importance of phosphorus and spacing in soybean being a legume and a crop



with branches. Phosphorus has been noted to be needed for seed formation hence soybean responded to application of P by producing more seeds compare to when P was not applied. This is in agreement with (Gyaneswar *et al.*, 2002) who reported that Phosphorus is a major factor in many plant processes such as energy transfer, stimulation of root growth, flowering, fruiting and seed formation. Also, Liu *et al.* (2008) had observed less interplant competition when crops are planted at wider spacing hence maximizing yield and yield components.

Table 3. Interactive effect of phosphorus (kg ha⁻¹) and spacing (cm) on soybean number of pods during the 2015 cropping season

Phosphorus	Spacing			
	5	10	15	20
0	73.00 ^{ab}	118.67 ^a	108.67 ^a	101.67 ^{bc}
20	77.33 ^a	55.00 ^c	73.67 ^b	117.67 ^b
40	45.00 ^b	82.33 ^{bc}	83.33 ^{ab}	78.67 ^c
60	54.33 ^{ab}	108.33 ^{ab}	84.00 ^{ab}	188.67 ^a
LSD _{0.05}	30.11			

Means followed by the same letter(s) are not significantly different from each other at 5 % level of probability LSD_{0.05};

Table 4. Effect of phosphorus rate (kg ha⁻¹) and plant spacing (cm) on soybean yield and yield components during the 2015 and 2016 cropping seasons

Treatment					
	GY (kg/ha)	PL	NSPP	100 SW (g)	TP
Phosphorus(P)					
0	514.8c	3.09	1.95b	15.00	36.27
20	576.4c	3.13	2.08b	16.00	37.05
40	724.9b	3.15	2.14b	17.00	35.46
60	1103a	3.19	2.43a	18.00	41.15
LSD _{0.05}	180.60	ns	0.24	ns	ns
spacing					
5 cm	792.0c	3.04	2.00b	15.00	37.78
10 cm	974.1b	3.15	2.09ab	18.00	40.02
15 cm	1188a	3.25	2.30a	17.00	36.75
20 cm	1110a	3.12	2.23a	17.00	35.38
LSD _{0.05}	120.2	ns	0.14	1.00	ns
PxS	ns	ns	**	*	ns

Means followed by the same letter(s) are not significantly different from each other at 5 % level of probability LSD_{0.05}; *, ** = Significant at 5% and 1% probability levels respectively; GY = grain yield; PL = pod length; NSPP = number of seeds per pod; 100SW = 100 seeds weight; TP = threshing Percentage.

Effect of spacing was also observed to be significant on 100 seed weight of soybean. The seeds obtained from soybean planted at 10 cm spacing had more weight (18.00g) than other spacing followed by 15 and 20 cm (17.00g) while those of 5 cm spacing had the least weight (15.00g). The interactive means for 100 seed weight of soybeans at the different combinations of spacing and phosphorus fertilizer are presented in Table 5. It was observed that at wider spacing (20 cm), 100 seed weight was significantly high at high rate of P application (60 kg P/ha) this could be due to the fact that because P was relatively low during the cropping season, hence soybean was able to utilize the applied P for better seed formation and since P is important for seed production in soybean coupled with space advantage, weightier seeds were produced.

(Ibrahim and Hala, 2007; Caliskan *et al.*, 2007). Also, plants with more branches have the tendency of producing more pods which in this experiment translates to more number of seeds with more weights. This is because according to Abimiku *et al.* (2009) branching is an important yield component since the flower bearing pedicels are produced on branch nodes.

The result obtained for soybean threshing percentage shows no significant effect of either P nor spacing on the parameter.

Conclusion and Recommendation:

The findings from this study showed that application of 60kg/ha of phosphorus to soybean planted at 15 cm produced optimum yield soybean with more number and weightier seeds. Hence, application of P at 60kg/ha with soybean planted at 15cm spacing is recommended for optimum yield and yield components of soybean.



Table 5. Interactive effect phosphorus (kg ha⁻¹) and spacing (cm) on soybean number of seed per pod and 100 seed weight (g)

Spacing	5	10	15	20
Phosphorus	Seed per pod			
0	1.55 ^c	1.82 ^b	2.33 ^{ab}	2.12 ^b
20	2.00 ^b	2.23 ^a	2.08 ^b	2.00 ^b
40	2.00 ^b	2.08 ^{ab}	2.25 ^{ab}	2.23 ^b
60	2.43 ^a	2.22 ^a	2.52 ^a	2.56 ^a
LSD _{0.05}	0.33			
<u>100 Seed Weight (g)</u>				
Phosphorus				
0	20.00 ^a	20.00 ^a	20.00 ^a	14.30 ^b
20	20.00 ^a	20.00 ^a	20.00 ^a	19.53 ^b
40	20.00 ^a	20.00 ^a	20.00 ^a	19.53 ^a
60	20.00 ^a	20.00 ^a	20.00 ^a	20.00 ^a
LSD _{0.05}	5.00			

Means followed by the same letter(s) are not significantly different from each other at 5 % level of probability LSD_{0.05}

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ID: 570

Kongo Kırmızısı ve Bromofenol Mavisi Boyalarının Adsorpsiyonunda Hiper Çapraz Bağlı Polimerlerin Performansları

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Özet

Su kirliliği sadece çevreye ciddi zararlar vermekle kalmaz, aynı zamanda önemli geri döndürülemez mali kayıplara da yol açar. Boyalar ve organik kirleticiler, su kirliliğine neden olan en önemli kirletici gruplarından ikisidir. Çünkü her yıl, gıda, kâğıt, kozmetik, boya, tekstil, deri, pestisit ve gübre gibi birçok endüstriden gelen tonlarca boya ve organik kirletici kontrolsüz bir şekilde su kaynaklarına boşaltılmaktadır. Endüstride kullanılan boyaların çoğu anyonik boyalardır ve hastalığa neden olan ve kanserojen gruplar içerirler. Ayrıca, çok düşük konsantrasyonlarda bile su kaynaklarının fiziksel ve kimyasal özelliklerini değiştirebilirler. Dolayısıyla su kaynaklarının sürdürülebilirliği için ciddi şekilde boyar madde içeren atıksuların verimli şekilde arıtılmasına ihtiyaç vardır. Su kaynaklarını korumak için, boyaların ve organik kirleticilerin arıtımı için birçok yöntem geliştirilmiştir. Ancak, bilim dünyasında, kolaylık, enerji verimliliği ve ucuzluk gibi avantajları nedeniyle adsorpsiyonun en umut verici ve başarılı yöntem olduğu kabul edilmektedir. Boya kirliliğine karşı inorganik ve organik birçok adsorbent geliştirilmiştir. Bu çalışmada Kongo kırmızısı (CR) ve bromofenol mavisi (BPB) boyalarının adsorpsiyonuna yönelik geliştirilen hiper çapraz bağlı polimerik adsorbentlerin gösterdikleri performansların ortaya konması amaçlanmaktadır.

Anahtar kelimeler: Kongo kırmızısı, bromofenol mavisi, hiper çapraz bağlı polimer, adsorpsiyon



ID: 573

Appraisal of Awareness and Adoption Level of Biosecurity Practices for Disease Prevention and Control among Poultry Farmers in Jos South Local Government Area of Plateau State, Nigeria

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Özet

Abstract

This study evaluates the awareness and adoption levels of biosecurity practices for disease prevention and control among poultry farmers in Jos South Local Government Area of Plateau State, Nigeria. A total of 120 poultry farmers were randomly selected, and data were gathered through questionnaires and interviews. The results showed that 100% of the respondents were aware of key biosecurity practices such as hand washing, daily cleanliness, and vaccination. However, lower levels of awareness were found for practices such as disinfecting visitors and vehicles (76%) and keeping records of farm visitors (46%). The adoption of biosecurity practices was also uneven, with vaccination against infectious diseases being the most widely adopted practice, with a mean score of 3.8 on a 4-point scale, followed by the isolation of infected birds (3.7). Practices like quarantining new birds (2.7) and providing farm-specific clothing for workers and visitors (2.3) had lower adoption rates. The logit regression analysis revealed that education ($P = 0.001$), household size ($P = 0.017$), stock size ($P = 0.012$), and farm income ($P = 0.012$) were significant factors influencing the adoption of biosecurity practices. Age had a marginally significant negative effect ($P = 0.057$), suggesting that younger farmers are more likely to adopt these practices. The study concludes that while awareness of biosecurity practices is generally high, adoption is uneven, particularly for practices perceived as more complex or costly. It recommends targeted education and financial support to increase the adoption of underutilized biosecurity measures.

Key words: Appraisal, awareness, adoption, biosecurity Practices, Diseases

Introduction

The poultry industry is the most popular livestock enterprise adopted by small and medium scale farmers in both rural and urban areas of Nigeria (Afolayan Bawa, Sekoni, Abeke, and Daramola, 2014). Poultry production is the domestication of chicken for the purposes of egg and meat. It also generates income and creates employment opportunity for the populace. Poultry production is one of the easiest ways to increase the availability of protein in food because eggs contain essential nutrients such as amino acids, minerals and vitamins that can augment protein deficiency in the body. Poultry include chicken, turkey, guinea fowl, pigeon, ostriches, quail, peafowl, duck and goose. Production of meats and eggs occupies a prime position for improving animal protein consumption of both rural and urban households in Nigeria (Eze, Chah, Uddin & Anugwa, 2017; Alhaji & Suleiman, 2017). Poultry are efficient in producing high quality protein (meat and eggs) (Aiyedun *et al.*, 2018). The Nigerian poultry industry has the second largest chicken population in Africa after South Africa (SAHEL, 2015); producing 650 000 tons of egg and 300000 tons of poultry meat (Central Bank of Nigeria (CBN), 2019 and FAOSTAT, 2017). According to CBN (2019), the poultry sub-sector is the most commercialized of all Nigeria's agricultural sub-sectors with a current net worth of N1.6 trillion and the sub-sector contributes about 25% of agricultural gross domestic product (GDP) to the Nigerian economy. Poultry production is an important source of animal protein, income generation, employment, industrial raw materials, manure and financial security. Poultry production outnumbers all other forms of livestock production in Nigeria and it thrives well in any part of the country (FAO, 2018). According to Ozoedu, Eseonu, and Emanalom (2015), poultry production is the fastest means of correcting the shortage of animal protein intake, because it has the best efficiency of nutrient transformation into high quality animal protein. The Food and Agriculture Organization (FAO, 2021) reported that, Nigeria has low animal protein intake with an average of 6g per head per day while the world average is 34g per head per day. The significance of poultry farming to the economic, social and biological needs of people in any nation cannot be over emphasized (AGRIS-FAO, 2021).



In spite of these important contributions of the poultry industry, Nigerian poultry sector faces high production costs, bio-risks, safety and biosecurity concerns due to lack of sanitary controls and technical constraints in production, processing and marketing. Diseases remain one of the major threats to boosting poultry production in Nigeria (Adewole, 2012). The major diseases are the Newcastle disease, avian influenza, avian pox etc. with Newcastle disease being the most recognized by poultry farmers (Tasie *et al.*, 2020). Poultry farmers all over the world face endemic disease challenges that threaten poultry health, welfare and the profitability of the poultry enterprise. These diseases can have a substantial economic impact on individual enterprises and on the poultry industry as a whole (Wierup, 2012). Several attempts were made in the past to reduce the negative effects of infectious diseases from endangering the lives of chicken through medications and vaccination. However, these attempts proved abortive without the implementation and compliance to recommended standard biosafety practices (Lawal, El-Yuguda & Ibrahim, 2016). The incessant outbreak of diseases in the poultry industry have made the practice of biosecurity an essential practice to protect the poultry industry from bio-risks and threats from any disease producing agents and the prevention and control of these diseases depends on the adoption of biosecurity and best management practices. A successful animal production, including poultry, requires the adoption of good biosecurity practices (Van Limbergen *et al.*, 2017), which is the most effective and inexpensive disease control measure (Wijesinghe *et al.*, 2017).

Biosecurity has multiple meanings and is defined differently according to various disciplines. Biosecurity also referred to as biosafety is regarded as all the management practices aimed at excluding or reducing the potential for transmission and spread of diseases to animals, humans or an area initially free from the disease-causing agents (Eze *et al.*, 2017; Matilda, Ralf, Jorgen & Eva, 2020). It can also be defined as measures or practices taken to prevent or control the introduction and spread of infectious agents to a flock. Such infectious agents, whether they cause clinical or subclinical disease, significantly reduce the productivity, profitability and long-term financial viability of poultry production (Abah, Abdu, & Assam, 2017). Biosecurity in poultry refers to a set of practices and measures taken to limit, control, or prevent the introduction and dissemination of infectious diseases in the poultry premises and facilities (Eltholth *et al.*, 2016; Scott *et al.*, 2018). Poultry farm biosecurity ranges from simple, low cost measures such as putting locks on gates to the more costly measures such as using high-pressure water sprayers to clean cars and constructing shower blocks to secure visitors and workers as they enter the farm. Some biosecurity activities are management changes, which may be low cost but require commitment from owners and farm workers to implement successfully. These include allocating a specific worker to a shed and not allowing staff to move from shed to shed. FAO (2016) and Kouam *et al.* (2018) classified biosecurity into three components. The classification based on the three components includes: Isolation, traffic control and sanitation. Isolation involves keeping birds protected from any source of infection like unauthorized access and carriers of disease, separating groups of animals to minimize the spread of infection across flock. Traffic control is the limitation of incoming human and material traffic within the farm and controlling the movement of equipment, vehicles, people, feeds, birds and eggs to prevent exposure to disease while sanitation is the regular cleaning, disinfection of poultry houses, equipment, vehicles, and people to eradicate disease causing agents (Abah, Abdu, & Assam, 2017; Oluwasusi, Akanni & Sodi, 2018). A biosecurity program uses a combination of physical barriers such as fences, mesh wire, and directed actions to prevent the introduction of or minimize the spread of infectious disease causing agents including the use of footbaths, carwash deep, and disinfection of farm equipment (Aiyedun *et al.*, 2018). According to Maduka *et al.* (2016), Biosecurity consists of conceptual, structural, and operational frameworks. Conceptual category includes: the location of farms; structural: covering the building design and facilities to protect against entry of wild birds and predators; and operational: covering the routine disinfection, sanitation, and work procedures those farm employees and visitors follow. The biosafety operational cost is usually low and the benefit-cost ratio is high (Ifeduba, Achonwa, Ukwu, Ogbuewu, & Okoli, 2020), but inadequate implementation of biosafety practices may be due to insufficient sensitization, lack of understanding of its economic benefits and motivation (Matilda, Ralf, Jorgen, & Eva, 2020; Maduka, Igbokwe, & Atsanda, 2016). Strict biosafety measures, in addition to vaccinations, are strategies to prevent and control some infectious poultry diseases as vaccination alone is not enough to curb the menace under field conditions (Oluwasusi, Akanni & Sodi, 2018). Good husbandry practices such as adequate feeding, housing and stocking to avoid overcrowding, good ventilation, proper disposal of wastes, cleaning and disinfection of poultry premises help to keep out infections and their spread (Mirza, Jaisan & Marya, 2020).

To avert human health risks (zoonosis) and economic losses, biosafety measures are inevitable in farms through isolation, limitations in number of visitors coming into the farm and/or sanitation practices. Poor or absence of biosafety practices in farms results in high levels of baseline mortality due to predators such as rodents, snakes, small carnivores or infectious diseases like Newcastle Disease-ND, salmonellosis, Gumboro disease or fowl typhoid. (Eze *et al.*, 2017). The structure of the commercial poultry industry in Nigeria is made up of sector two and three systems with little or no biosecurity and constant introduction of new birds from completely unknown sources thereby worsening the biosecurity problems (Oluwasusi, Akanni & Sodi, 2018). The sector 1 systems are those with full compliance to biosafety management practices on regular basis (Oladipo, *et al.* 2020; Abah, Abdu, & Assam, 2017). Biosafety level in most commercial poultry enterprise is minimal or in some cases non-existing



and this may lead to the spread of multiple infections within and between farms (Abah, *et.al* 2017). Performance of birds is influenced by the biosecurity measures of the farms (Wijesinghe *et al.*, 2017). Biosecurity has direct relevance to food security and safety, nutrition security, the conservation of the environment (including bio - diversity), and sustainability of agriculture. Absence or neglect of biosecurity practices in poultry farms can give rise to unprecedented situations like high mortality rate, reduced profit and loss of investment. Biosecurity invariably posits quality assurance for poultry operators against high mortality losses and commercialization of safe poultry products that can guarantee good healthy chickens and poultry products raised and bought by consumers for healthy consumption. This could therefore assist the marketability, sustainability and optimal profitability of the poultry business over a long period of time. Biosecurity according to the Food and Agriculture Organization (FAO, 2016) has been identified as the only sustainable solution to reducing the negative effects of infectious pathogens on poultry. Therefore, based on the above background information, the broad objective of this study was to ascertain the biosecurity measures adopted by poultry farmers in Jos South Local Government Area of Plateau State, Nigeria. Specific objectives are to:

- describe the socioeconomic characteristics of poultry farmers in the study area;
- assess the awareness level of the respondents on biosecurity practices in the study area;
- identify the prevalent poultry diseases in the study area
- ascertain the biosecurity practices adopted by poultry farmers in the study area;
- determine factors influencing adoption of biosecurity practices.

Materials And Methods

The study was conducted in Jos South Local Government Area of Plateau State, Nigeria which is geographically located between latitude 9° 30' to 10°N and longitude 8° 30'E of the Greenwich meridian. It is located in the northwestern part of the state and is headquartered in Bukuru, 15 km from the state capital Jos. The local government consists of four districts: Du, Gyel, Kuru and Vwang. The Local government has a population of 650,835 (National Population Commission, NPC 2006) with an average land area of 1, 037km². It borders the local governments of Barkin-Ladi to the south, Ryom to the southwest, Jos-Este to the east, and the local government of Bassa to the west. It is known for its cold and rocky nature due to its high altitude of over 1450 meters above sea level. The coldest period is between November and February, with an average daily temperature of 18°C while warmer periods occur between March and April. The rains fall between May and October, with a peak in August. The mean annual rainfall varies between 137.75cm and 146.0cm. The Local Government is a semi-urban location but served with vast agricultural land, with mining ponds readily supplying water for irrigation. Common edible crops grown include rice, corn, Irish potatoes, yams, acha, sweet potato, cocoyam, tomatoes, peanuts, and assorted vegetables.

Sampling Procedure and sample size

The population for this study consists of poultry farmers in the four district of Jos South Local Government Area of Plateau State. They include: Gyel, Du, kuru, and Vwang districts. A list of all the registered poultry farmers in the Local Government Area was obtained from the local government office of Poultry Association of Nigeria. Thirty poultry farmers were randomly drawn from each of the districts of the LGA to give a sample size of one hundred and twenty (120) respondents for the study. The data were collected through the administration of questionnaires and oral interview.

Methods of Data Analysis

Descriptive statistics such as frequencies, percentages and mean were used to analyze the socio-economic characteristics of the respondents and to identify the prevalent poultry diseases in the study area. Four point Likert rating scale was used to examine the levels of awareness and adoption of biosecurity practices while logit regression was used to determine the factors influencing adoption of biosecurity practices among poultry farmers in the study area.

Likert scale

The level of awareness of biosecurity practices was measured using a four- point Likert scale. Here awareness score was calculated against a four-point scale: 'highly aware (HA), aware (A), fairly aware (FA) and not aware (NA)' weighted as 4, 3, 2 and 1, respectively. Based on the 4- point scale, a mid-point of 2.50 was established i.e. $4+3+2+1 \div 4 = 2.5$. Thus a decision rule was that, a mean value of 2.5 was used as cut-off point to determine the level of awareness of the respondents with respect to each of the biosecurity practices. Thus, biosecurity practices with mean score equal or above 2.5 were regarded as having high level of awareness while those with score below 2.5 indicated low awareness by the poultry farmers.

Similarly, level of adoption of biosecurity practices was measured using a four- point Likert scale. Here adoption score was calculated against a four-point scale: 'highly adopted (HA), adopted (A), fairly adopted (FA) and never



adopted (NA)' weighted as 4, 3, 2 and 1, respectively. Based on the 4- point scale, a mid-point of 2.50 was established i.e. $4+3+2+1 \div 4 = 2.5$. Thus a decision rule was that, a mean value of 2.5 was used as cut-off point to determine the level of adoption of the respondents with respect to each of the biosecurity practices. Highly adopted and adopted were treated as positive response (High adoption) while fairly adopted and never adopted were treated as negative response (Low adoption). Thus, biosecurity practices with mean score equal or above 2.5 were regarded as those that received high level of adoption while those with score below 2.5 indicated low adoption by the poultry farmers i.e. adoption index score: high adoption: ≥ 2.50 , low adoption: < 2.50

Logit Model Specification

The logit regression model is a unit or multivariate technique which allows for estimating the probability that an event occurs or not by predicting a binary dependent outcome from a set of independent variables. The logit model is based on cumulative logistic probability function and it is computationally tractable. According to Gujarati and Porter (2009), it is expressed as:

$$P_i = E(Y = 1|X_i) = B_1 + B_2X_2 \dots \dots + B_3X_3 \dots \dots \dots B_nX_n \quad (1)$$

For ease of estimation, equation (1) is further expressed as:

$$P_i = \frac{1}{1 + e^{-z_i}} = \frac{e^{-z}}{1 + e^{-z_i}} \dots \dots \dots \quad (2)$$

Where:

P_i = probability of an event occurring

$P_i = B_1 + B_2 X_i$

The empirical model of the logistic regression for study assumed that the probability of the farmers' participation in community self-help projects is expressed as:

$$P_i = \frac{eb_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_5 X_5 + b_6 X_6 + b_7 X_7 \dots + b_9 X_9}{1 + eb_0 + b_1 X_1 + b_2 X_2 + b_3 X_3 + b_4 X_4 + b_5 X_5 + b_5 X_5 + b_6 X_6 + b_7 X_7 \dots + b_9 X_9} \quad (3)$$

P_i ranges between zero and one and it is non-linearly related to Z_i , Z_i is the stimulus index which ranges from minus infinity to plus infinity and it is expressed as:

$$Z_i = \ln\left(\frac{P_i}{1-P_i}\right) = b_0 + b_1 X_1 + b_2 X_2 \dots \dots \dots + b_9 X_9 + u \quad (4)$$

To obtain the value of Z_i , the likelihood of observing the sample was formed by introducing a dichotomous response variable. The explicit logit model was expressed as:

$$Y = b_0 + b_1 X_1 + b_2 X_2 \dots \dots \dots + b_9 X_9 + u \quad (5)$$

Where:

Y = Adoption index of the respondents (i.e. mean index of 2.5 and above = High adoption, index below 2.5 = Low adoption)

X_1 = Age of farmers (Years)

X_2 = Gender (1 if male, 0 if female)

X_3 = Marital status (1 if married, 0 if otherwise)

X_4 = Educational level of farmers (Years of formal education)

X_5 = Household size (number of persons in the household)

X_6 = Stock size (number of birds)

X_7 = Poultry farming experience (years)

X_8 = Access to credit (1 if yes, 0 otherwise)

X_9 = Monthly income of farmers (Naira)

$b_1 - b_9$ = Coefficients to be estimated

b_0 = Constant term

u = error term



Results And Discussions

Socio-Economic Characteristics of Poultry Farmers

Result in Table 1 below shows that 49% of the respondents were between the ages of 31-40 years, 25% were between the ages of 41-50, 18% were above 50 years while the remaining 8% were between the ages of 20-30. The mean age of the respondents was 41 years. This is an indication that poultry business in the area is dominated by persons in their economically active age who are more likely to adopt innovations faster than others in the older age brackets. Poultry farming is labour intensive and requires younger farmers who can cope with the tedious and rigorous biosecurity practices including disease management. This finding agrees with those of Tasie *et al.* (2020), Eze *et al.* (2017) and Ibekwe *et al.* (2015).

Table 1 show that 59% of the poultry farmers are male while 41% were female. This implies that men dominate the poultry sector in the study area. The male dominance can be attributed to the fact that poultry farming is labour intensive and so discourage women from engaging in it. This finding is in line with the studies of Alalade *et al.* (2018) and Eze *et al.* (2017) who reported in their separate studies that poultry farming is dominated by the male folk.

The result also showed that 90% of the respondents were married while only 10% were single. Marital status has implication for the adoption of improved farm technologies. Married people tend to have more responsibilities and hence they take new technology with seriousness to increases their productivity. This result also indicates that the poultry business has helped to sustain the families. It therefore implies that the married couples could try to adopt biosecurity practices in order to improve the families' incomes and meat protein for family consumption.

The result in Table 1 further showed that 73% of the poultry farmers had attended tertiary institution and 20% had secondary school education while 7% had only primary education. This result indicates high literacy level among the respondents. In essence, it shows that the occupation is taken up by people who can read and write and more so read manuscript and labels on poultry feeds, poultry drugs and medication. This result collaborates that of Tasie *et al.* (2020), Eze *et al.* (2017) and Ibekwe *et al.* (2015) who in their separate studies also reported higher literacy level among poultry farmers. High educational attainment is very essential, since practice of biosecurity and disease management requires some level of literacy and technical knowledge. Education enhances the productivity, accountability and profitability of the farm business.

Table 1 also showed that respondents with household size of 1-5 persons had the highest (67.5%) percentage. This was followed by those with 6-10 persons (27.5 %) and those with 10 persons and above (5%). The mean household size of the respondents is 5 persons. The average household size of the respondents is equal to the national average of 5 persons in Nigeria (NBS, 2009). This number is quite reasonable for any significant biosecurity improvement and achievement by the respondents in the study.

The study also reveals that 38% of the farmers raise flock size of 1001 – 2000 birds, 24% raise 2001 – 3000, 16% had 3001 – 4000, 13% had 500 - 1000 birds while 9% of the farmers raised above 4000 birds in their farms. The average stock size of the farmers was 2234 birds.

The result also showed that most (51.7%) of the respondents use deep litter system of poultry management. In the deep litter system, poultry birds have direct contact with their faecal matter. This implies high risk of infection and disease, which will result in high medication costs, increasing the overall cost of production Eze *et al.* (2017). In the battery cage system, the poultry droppings fall on the floor beneath the cages so the poultry birds have no contact with their faecal matter. This helps to reduce health risks and expenditure on drugs (Ayadole, 2016).

On farming experience, the result showed that 52% of the respondents had the highest poultry farming experience of between 6-10 years, 31% had between 1-5 years, 17% had poultry farming experience above 10 years. The average poultry farming experience was 7 years. This result implies that the respondents had reasonable experience in poultry farming. Long farming experience is an advantage for increased poultry production since it may encourage rapid adoption of improved practices. Bakut (2013) asserted that farmers with long years of farming experience would be conversant with the constraints and this would increase their level of acceptance of biosecurity measures as means of overcoming their production constraints.

The annual income of poultry farmers in the study area reveals that 32% of the farmers earned between ₦2001,000 – 300,000 followed by 27% who earned between ₦301,000 - 400,000. 16% of the farmers earned above ₦ 400,000 while the remaining 7.5 earned between ₦50,000 – 100,000 as annual income. The mean annual income of the farmers was ₦279004. It can be seen from this result that the annual income of poultry farmers in the study area is fairly enough to enable them adopt most of the biosecurity measures. With this result, it is likely that the adoption of biosecurity practices will be favourable because income is very important in adoption process.

All (100%) of the respondents of the responded selected were members of the poultry association of Nigeria (PAN) as well as others associations. Membership of farmers' association is very important because it is an avenue by which people come together to achieve in group what they cannot achieve alone. For example, membership of association can serve as a means to access credit, labour and information on techniques and enterprises.

The result further shows that 76% of the respondents have not had any visit from the extension agents or to the extension agents in all their years of poultry farming. Only 24% of the respondents have had visit from the extension agents in the



last two years indicating that the rate of extension visit is poor. This implies that most of the farmers were not adequately informed on current and emerging issues in poultry production such as biosafety practices. The result also showed that 38% of the respondents had access to credit while 62% of the respondents did not access credit. Access to credit is a very important factor in agricultural enterprise. Credit is a very strong factor needed to acquire or develop an enterprise. Without credit most farmers cannot afford recommended biosecurity measures because of the capital intensive nature of some of these practices amidst low incomes. Most of these farmers are not considered credit worthy because they have no collateral. The farmers that have access to credit may be due their membership of cooperative groups.

Table 1. Distribution of Respondents According to socio-economic characteristics

Variable	Frequency	Percentage	Mean
Age			
20-30	10	8.0	
31-40	59	49.0	
41-50	30	25.0	
>50	21	18.0	41
Gender			
Male	71	59.0	
Female	49	41.0	
Marital status			
Married	108	90.0	
Single	12	10.0	
Educational level			
Primary	8	7.0	
Secondary	24	20.0	
Tertiary	88	73.0	
Non formal	-	-	
Household size			
1-5	81	67.5	
6-10	33	27.5	
>10	6	5.0	5
Poultry farming experience			
1-5	37	31.0	
6-10	62	52.0	
<10	21	17.0	7
Stock size (No. of birds)			
500 - 1000	16	13.0	
1001-2000	45	38.0	
2001-3000	29	24.0	
3001-4000	19	16.0	
>4000	11	9.0	2234
Management system			
Deep liter system	79	66.0	
Battery cage system	41	34.0	
Annual income from poultry business			
50,000.00-100,000	9	7.5	
101,000-200,000	21	17.5	
201,000-300,000	38	32.0	
301,000-400,000	33	27.0	
>400,000	19	16.0	279004
Membership of cooperative			
Yes	120	100	
No	0	0.0	
Extension contact of the respondents			
Yes	29	24.0	
No	91	76.0	
Access to credit			
Yes	46	38.0	
No	74	62.0	

Source: Field survey (2024)



Common Poultry Diseases in the Study Area

The data in Table 2 offers a detailed view of the distribution of common poultry diseases among farmers in the study area. A closer analysis of the results reveals the varying prevalence and the potential challenges poultry farmers face in managing these diseases. Below is a comprehensive discussion of the findings:

Newcastle Disease (ND) is reported by 73% of respondents, making it the most common and concerning disease in the study area. ND is a highly contagious viral disease that can cause high mortality rates in unvaccinated flocks. Its dominance in this table suggests significant challenges related to vaccination, biosecurity, and disease control measures among poultry farmers.

Infectious Bursal Disease, also known as Gumboro, affects more than half of the respondents (52%). This viral disease, which primarily impacts the immune systems of young chickens, is also quite widespread in the study area. The fact that it affects a significant portion of farmers highlights the need for consistent vaccination programs and effective management practices to protect flocks.

Avian Influenza, reported by 41% of respondents, is another major concern. This disease is highly contagious and can result in severe losses due to its impact on both bird health and public health. The presence of Avian Influenza requires strict biosecurity measures, surveillance, and rapid response mechanisms to prevent widespread outbreaks and to protect the livelihoods of poultry farmers in the area.

Coccidiosis, affecting 39% of respondents, is a parasitic disease that can thrive in environments with poor sanitation and overcrowded conditions. The relatively high frequency of this disease in the study area suggests that many farmers may struggle with maintaining optimal hygiene on their farms, which is essential for controlling the spread of Coccidiosis. The use of anti-coccidial drugs and improved farm management practices are crucial to mitigating the effects of this disease.

Fowl Cholera, a bacterial disease, affected 22.5% of the respondents. Although less prevalent than viral diseases such as ND and Gumboro, Fowl Cholera remains a significant issue, as it can cause sudden deaths and severe drops in production. The presence of this disease among a sizable number of respondents indicates that biosecurity measures and hygiene practices may need to be strengthened in certain areas.

Fowl Pox, affecting 19% of respondents, is a viral disease that typically causes skin lesions or respiratory problems. Although not as deadly as some of the other diseases on this list, Fowl Pox can still significantly reduce productivity, particularly in smallholder farms with limited resources for disease control. Vaccination is an effective way to prevent Fowl Pox, and improving awareness and access to vaccines could help reduce its incidence.

Marek's Disease, reported by 11% of respondents, is a viral disease that causes tumors and paralysis, leading to substantial losses in unvaccinated flocks. The relatively low prevalence may suggest that some farmers are using preventive vaccination effectively. However, for those affected, the disease can be devastating due to its chronic nature and impact on bird productivity. Promoting widespread vaccination against Marek's Disease is essential to reducing the disease's impact on poultry farms in the area.

Salmonellosis, a bacterial disease, was reported by 7.5% of respondents. While its prevalence is lower compared to other diseases, it can still be a concern due to its zoonotic potential and the impact it can have on both poultry health and food safety. The low frequency may reflect better management practices or awareness about preventing this disease. Ensuring proper hygiene, sanitation, and control of feed and water sources is important to prevent Salmonellosis from becoming more widespread.

Table 2. Distribution of Respondents based on Common Poultry Diseases in the Study Area

Disease	*Frequency	Percentage
Newcastle disease (ND)	88	73.0
Fowl pox	23	19.0
Infectious bursal/Gumboro	62	52.0
Fowl cholera	27	22.5
Coccidiosis	47	39.0
Avian influenza	49	41.0
Salmonellosis	9	7.5
Marek Diseases	13	11.0

Source: Field survey (2024); *Multiple responses

Poultry Farmers Awareness of Biosecurity Practices

Table 3 presents the distribution of respondents' awareness of basic biosecurity practices in poultry farming. The data reveals varying levels of awareness among respondents regarding essential biosecurity measures. Findings revealed that all respondents (120) demonstrated awareness of some critical biosecurity practices, indicating a strong foundation in fundamental biosecurity measures. They are: hand washing with soap before and after handling birds/products, daily cleanliness of litter, burying or burning of dead birds, vaccination against infectious diseases, limiting non-essential human traffic on the farm, providing foot-dip with disinfectant, avoiding rodents



in/around of poultry house/feed bins, isolation of infected birds and examining flocks daily for disease symptoms. Practices with partial or moderate awareness include; disinfecting cars, bikes, trucks, visitors, and others before entering the farm (76.0% aware, 24.0% not aware), disinfecting outside equipment brought into the farm (84.0% aware, 16.0% not aware), fumigation of poultry house (73.0% aware, 27.0% not aware), quarantine of new birds (80.0% aware, 20.0% not aware). Practice with low awareness include; restraining farm workers from visiting other farms (47.0% aware, 53.0% not aware), Providing farm-specific clothes and footwear for employees and visitors (56% are aware, while 44% are unaware), Keeping a record of all farm visitors (46% are aware, with 54% unaware). Efforts should focus on increasing awareness and compliance with practices that have lower levels of awareness, possibly through targeted training programs. Awareness and knowledge of a technology is a prerequisite for its use as farmers with firsthand information from research and extension agents have higher awareness and use in all introduced technologies (Abdoulaye *et al.*, 2014).

Table 3. Distribution of Respondents based on Awareness of Basic Biosecurity Practices

Biosecurity Practices	Level of Awareness	
	Aware (%)	Not aware (%)
Hand washing with soap before and after handling birds/products	120 (100.0)	-
Daily cleanliness of litter	120 (100.0)	-
Burying or burning of dead birds	120 (100.0)	-
Disinfect cars, bikes, trucks visitors and others before entering the farm	91 (76.0)	29 (24.0)
Disinfect outside equipment brought into the farm	101 (84.0)	19 (16.0)
Vaccination against infectious diseases	120 (100.0)	-
Fumigation of poultry house	88 (73.0)	32 (27.0)
Limit non – essential human traffic on the farm	120 (100.0)	-
Providing foot-dip with disinfectant	120 (100.0)	-
Avoid rodents in/around poultry house/feed bins	120 (100.0)	-
Quarantine of new birds	96 (80.0)	24 (20.0)
Isolation of infected birds	120 (100.0)	-
Restraining farm workers from visiting other farms	56 (47.0)	64 (53.0)
Examine flocks daily for disease symptoms	120 (100.0)	-
Farm's specific cloth and foot wears for employees and visitors	67 (56.0)	53 (44.0)
Keep a record of all farm visitors	55 (46.0)	65 (54.0)

Source: Field survey (2024)

Adoption of Biosecurity Practice by the Poultry Farmers

The table 4 presents the distribution of respondents based on the adoption of biosecurity practices using a Likert scale where HA (Highly Adopted) = 4, A (Adopted) = 3, FA (Fairly Adopted) = 2, and NA (Not Adopted) = 1. The table provides both the sum and mean scores for each biosecurity practice, reflecting the degree of adoption among respondents.

Vaccination against infectious diseases (3.8): This practice is the most highly adopted biosecurity measure, indicating strong awareness of its importance in preventing widespread disease outbreaks, such as Newcastle Disease or Avian Influenza. With a mean score close to the maximum (3.8), nearly all respondents are consistent in vaccinating their flocks. This is critical for disease prevention, as vaccination significantly reduces mortality and maintains productivity. Continued availability of vaccines and farmer training on new diseases will help sustain this high adoption rate.

Isolation of infected birds (3.7): Isolation is crucial to prevent the spread of disease among birds. With a high mean score of 3.7, this practice is well implemented. Immediate isolation of sick birds helps farmers control disease outbreaks early. Since biosecurity breaches can occur from cross-contamination, farmers likely recognize this practice's importance. Further education on early disease detection and isolation protocols can improve effectiveness.

Hand washing with soap before and after handling birds/products (3.6): This practice is widely adopted with the majority of respondents scoring it highly. Hand washing is a fundamental biosecurity measure that reduces the spread of pathogens between birds and humans or birds to birds. The near-universal adoption (3.6) suggests that awareness campaigns have been effective. However, continuous reinforcement is necessary to ensure no complacency occurs, especially since any lapses in hygiene can have rapid consequences in densely populated poultry environments.

Daily cleanliness of litter (3.3): Clean litter is essential to prevent the build-up of harmful pathogens. While the mean score of 3.3 indicates reasonable adoption, the variation suggests some farms may not clean litter as



regularly. This is important because wet and dirty litter can harbor bacteria, viruses, and parasites that can affect poultry health. Increased education about the dangers of poor litter management could push this adoption rate higher.

Avoiding rodents in/around poultry house/feed bins (3.3): Rodent control is moderately adopted. Rodents can introduce diseases like salmonella into the poultry house, and their presence can contaminate feed and water sources. A score of 3.3 suggests farmers are reasonably aware, but more needs to be done to achieve universal rodent control. Rodent-proofing poultry houses and using traps or safe rodent poisons can be emphasized during training.

Disinfecting vehicles and visitors before entering the farm (3.0): Disinfecting vehicles and visitors is moderately adopted, with a mean score of 3.0. This measure is essential in preventing external contamination from entering the farm. Since farm equipment, vehicles, and visitors can carry pathogens, failing to disinfect them exposes farms to risk. While the mean score shows many farmers do implement this practice, a significant portion may not be rigorous enough. Educating farmers on how cross-farm contamination can introduce disease into biosecure farms could improve adoption.

Fumigation of poultry house (2.8): Fumigation is another moderately adopted practice, with a mean score of 2.8. This suggests that while farmers understand its role in disinfecting poultry houses, some may not see it as a regular requirement. Fumigation is an effective way to kill airborne pathogens and clean the environment post-flock removal. Increasing awareness of the timing and frequency of fumigation, along with demonstrations of its effectiveness, could boost this practice.

Providing foot-dip with disinfectant (2.8): Foot-dips are used to disinfect footwear and prevent the spread of pathogens. The adoption of this practice is moderate, with a mean score of 2.8, indicating room for improvement. Foot-dips are critical at farm entrances where staff and visitors enter. Training programs should highlight how easily pathogens can be carried on shoes and how simple it is to maintain a disinfectant foot bath.

Quarantine of new birds (2.7): Quarantining new birds before introducing them to the flock is essential to avoid introducing diseases. With a mean score of 2.7, many farms are not effectively quarantining new stock, potentially leading to disease outbreaks. Quarantine helps ensure new birds are free of diseases before being mixed with the flock. More focus should be placed on educating farmers about the dangers of mixing new and potentially infected birds with healthy ones.

Farm-specific clothing and footwear for employees and visitors (2.3): This practice is poorly adopted, with a mean score of 2.3. Farm-specific clothing helps prevent cross-contamination, yet many farms do not enforce this measure. This could be due to cost concerns or a lack of understanding of its importance. Providing affordable solutions for farm-specific clothing or subsidies could improve this practice.

Disinfecting outside equipment brought into the farm (Mean: 2.2): This practice has one of the lowest mean scores at 2.2, indicating low adoption. External equipment, when brought onto the farm, can be a major source of contamination, carrying pathogens that can infect the birds. Low adoption could stem from a lack of awareness or the perceived inconvenience of disinfecting every piece of equipment. Encouraging farmers to implement strict equipment disinfection protocols and showing the benefits in disease prevention could improve this score.

Restraining farm workers from visiting other farms (2.2): This practice has one of the lowest adoption levels. Workers who visit multiple farms are a significant risk for disease transmission. A mean score of 2.2 indicates that this practice is often overlooked, despite its importance in maintaining biosecurity. Farmers may underestimate the risk that human movement poses, and training programs should emphasize the necessity of restricting worker movement or enforcing hygiene protocols between visits.

Keeping a record of all farm visitors (2.2): With a low mean score of 2.2, record-keeping of visitors is another weak area. Visitor logs are critical for tracking potential sources of disease in the event of an outbreak. Farmers may not recognize the importance of maintaining these logs or might find it burdensome. Simplifying the process and explaining its role in biosecurity could lead to better adoption.

Practices with high mean scores, such as vaccination, hand washing, and isolation of infected birds, reflect a strong understanding among farmers of core biosecurity principles. These areas show that existing training and outreach have been effective, particularly in emphasizing the most direct ways to prevent disease spread. Low adoption practices like quarantining new birds, keeping visitor records, and providing farm-specific clothing indicate gaps in biosecurity. These practices, though often seen as less critical or time-consuming, are essential for preventing external sources of contamination. Targeted training programs should focus on these lower-scoring areas, using demonstrations and real-world examples to show the consequences of neglecting such measures.

Factors Influencing Poultry Farmers Adoption of Biosecurity Practices

The regression results in Table 5 provide insight into the factors influencing poultry farmers' adoption of biosecurity practices. Various socioeconomic and farm-related variables are analyzed to determine their significance in predicting adoption behavior. The Chi-Square value (14.30) is significant at the 5% level, indicating that the overall model is a good fit. This means the independent variables, taken together, significantly explain the variation in the adoption of biosecurity practices. The Hosmer-Lemeshow statistic



(4.88) and Pearson statistic (142.50) further assess model fit. Although these values are not significant, they suggest that the model fits the data reasonably well without major discrepancies. The significant determinants of biosecurity adoption are education, household size, stock size, farming experience, and farm income.

Age (X₁): The coefficient of age is -0.0538, with a T-value of -1.90 and a P-value of 0.057, which is significant at the 10% level. This indicates that age has a negative but marginally significant effect on the adoption of biosecurity practices. As farmers' age increases, the likelihood of adopting these practices decreases slightly. Older farmers may be less inclined to adopt new practices compared to younger farmers, possibly due to traditional farming methods or resistance to change.

Education (X₄): Education has a positive and highly significant coefficient of 2.049 (P-value = 0.001). This suggests that higher levels of education have a strong positive impact on the adoption of biosecurity practices. Educated farmers are more likely to be aware of the benefits of biosecurity, understand the risks associated with disease transmission, and adopt preventive measures effectively. This variable is significant at the 1% level, indicating a robust relationship between education and biosecurity adoption.

Household Size (X₅): The coefficient for household size is -0.542 with a P-value of 0.017, making it significant at the 5% level. This negative relationship implies that as household size increases, the likelihood of adopting biosecurity practices decreases. Larger households may face more financial or labor constraints, potentially limiting the resources available for implementing proper biosecurity measures.

Stock Size (X₆): Stock size has a positive and significant coefficient of 0.0581 (P-value = 0.012). This indicates that larger flock sizes are associated with a higher likelihood of adopting biosecurity practices. Farmers with larger flocks may be more motivated to protect their investment, recognizing the importance of preventing disease outbreaks that could cause significant financial losses.

Table 3. Distribution of Respondents based on Adoption of Biosecurity Practices

Biosecurity practices	HA(4)	A(3)	FA(2)	NA(1)	Sum	Mean
Hand washing with soap before and after handling birds/products	308	129	-	-	437	3.6*
Daily cleanliness of litter	196	189	22	-	407	3.3*
Burying or burning of dead birds	128	222	28	-	378	3.1*
Disinfect vehicles/visitors before entering the farm	220	192	46	12	470	3.0*
Disinfect equipment brought into the farm from outside	44	69	132	20	265	2.2
Vaccination against infectious diseases	364	87	-	-	451	3.8*
Fumigation of poultry house	84	87	-	-	341	2.8*
Limit non – essential human traffic on the farm	188	189	20	-	397	3.3*
Providing foot-dip with disinfectant	92	198	20	-	343	2.8*
Avoid rodents in/around poultry house/feed bins	184	216	2	-	404	3.3*
Quarantine of new birds	84	132	110	-	326	2.7*
Isolation of infected birds	352	96	-	-	448	3.7*
Restraining workers from visiting other farms	44	63	142	17	226	2.2
Examine flocks daily for disease symptoms	396	63	-	-	459	3.4*
Specific wears for employees and visitors	40	78	164	-	282	2.3
Keep a record of all farm visitors	60	63	110	29	262	2.2

Table 5: Determinants of Poultry Farmers Adoption of Biosecurity Practices

Variable	Coefficient	Std. Error	T-value	P-value
Constant	-1.304	0.793	0.793	0.100
Age (X ₁)	-.0538	.02831	-1.90*	0.057
Gender (X ₂)	-0.149	0.181	-0.82	0.411
Marital status (X ₃)	-0.302	0.432	-0.70	0.485
Education (X ₄)	2.0490	.6040	3.39***	0.001
Household size (X ₅)	-0.542	0.227	-2.39**	0.017
Stock size (X ₆)	.0581	.0250	2.50**	0.012
Farming experience (X ₇)	0.016	0.208	0.08	0.938
Access to credit (X ₈)	0.237	0.828	0.29	0.775
Farm income (X ₉)	1.2366	.4940	2.50**	0.012
Chi-Square	14.30**			
Hosmer-Lemeshow	4.88			
Pearson	142.50			

***, ** and * = Significant at 1%, 5% and 10%



Access to Credit (X₈): The coefficient for access to credit is 0.237 with a P-value of 0.775, indicating that access to credit is not a significant factor in determining the adoption of biosecurity practices. While credit can support farm investments, it does not appear to play a direct role in influencing biosecurity adoption in this sample.

Farm income (X₉): Farm income has a positive and significant coefficient of 1.2366 (P-value = 0.012). This suggests that higher farm income is associated with a greater likelihood of adopting biosecurity practices. Farmers with higher incomes are likely to have more resources to invest in biosecurity measures, such as vaccinations, improved housing, and sanitation, which help prevent disease outbreaks.

Conclusion

The study concludes that while the majority of poultry farmers in Jos South Local Government Area are aware of essential biosecurity practices, the adoption of these measures is still uneven. Key practices like vaccination and handwashing are widely adopted, while other measures such as quarantining new birds and keeping farm visitor records are less common. Factors such as education, household size, stock size, and farm income significantly influence the adoption of biosecurity practices. Older farmers, in particular, are less likely to adopt new biosecurity measures, possibly due to traditional farming methods or resistance to change. The findings highlight the critical role of education and economic factors in promoting the adoption of biosecurity practices, which are essential for preventing the spread of poultry diseases and ensuring sustainable poultry production.

Recommendations

The study's conclusions led to the following recommendations being made:

Enhance Education and Training Programs: Extension services should focus on educating poultry farmers, especially those with lower levels of formal education, on the importance of comprehensive biosecurity practices. Practical demonstrations and workshops on underutilized practices like quarantining new birds and maintaining visitor logs should be prioritized.

Target Younger Farmers: Programs designed to promote biosecurity practices should target younger farmers, who are more likely to adopt new technologies. Efforts should also be made to engage older farmers by demonstrating the economic benefits of adopting biosecurity measures.

Provide Access to Credit: Since financial constraints may hinder the adoption of biosecurity practices, the government and financial institutions should improve access to credit for small-scale poultry farmers. This will enable them to invest in critical biosecurity infrastructure and supplies.

Strengthen Farm Management Practices: Farmers should be encouraged to adopt better management practices, including regular farm inspections, disinfection of equipment, and the use of farm-specific clothing. Emphasizing the long-term cost savings from reduced disease outbreaks could motivate adoption.

Promote Cooperative Membership: Since cooperative groups can provide financial and technical support, farmers should be encouraged to join these associations. Cooperative membership can also facilitate the sharing of knowledge and resources related to biosecurity practices.

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Proximate Composition, Functional and Qualitative Analyses of Sweet Deter (*Deterium Senegalense*)

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Abstract

Detarium microcarpum also known as sweet deter tree, is an underutilized tree legume that grows natively in the drier parts of West and Central Africa. Referred to as taura in Hausa language. Proximate composition, functional and qualitative phytochemical analysis was determined on the three parts of the sweet deter fruit (Bark, flesh and whole fruit). The result shows no significantly in the moisture content of the whole fruit (9.29%) and bark (9.30%) compared to the fruit pulp (8.95%). Ash contents should no significant difference between the pulp (1.87%) and the bark (1.92%). High protein content was observed in the fruit pulp (9.94%), while high fiber content was observed in the whole fruit. The fruit showed a significantly low fat content (2.49, 2.98 and 2.70%) respectively. Water absorption capacity shows a significantly different result with the highest in the pulp (8.90%) and the lowest in the bark (7.08%). The pH of both samples where acidic (5.5, 5.6 and 5.5), respectively. The fruit pulp gelatinized higher with about 70% compared to the other samples (bark and whole fruit). Flavonoids was found in abundance in the pulp, while moderate in the bark and the whole fruit. Alkaloids where mild in all the samples. Steroids where observed in abundance in all the samples, but no tannins where observed.

Key Words: *Detarium senegalense*, sweet deter, phytochemical, extraction, Taura

Introduction

In Nigeria, several wild fruits remain unknown or less exploited by the local population, despite their importance and their richness in health promoting compound (Sourou *et al.*, 2020). Edible wild plants are incredibly nutrient-dense and can serve as a great source of additional vitamins and minerals (Duguma, 2020). They can also be used to augment dietary needs. Wild edible plants are utilized by various ethnic groups in Nigeria as supplemental, seasonal, or survival food sources; as such, they help to reduce food insecurity (Zahra'u *et al.*, 2014). *Detarium senegalense* commonly known in English as sweet deter is a tree that is found in Africa (Olatunji *et al.*, 2021). Sweet deter tree is common in tropical Africa, found near the coast and known for its round pods (Olatunji *et al.*, 2021). It is a spherical drupe with a diameter of 3 to 8 cm, with a large stone in the center, surrounded by green, fibrous, acidic and sweet flesh pulp. The fruits are highly appreciated and widely used in the form of honey or fresh fruits (Ndiaye *et al.*, 2016). The tree's leaves, seeds, and fruit pulps are all useful in various ways both as food and medicinal (Nwozo *et al.*, 2018). Sweet deter fruit is well received in Nigeria and Senegal, mainly consumed as drinks, marmalades, as soup thickeners, sorbets or in its fresh form (Dossa *et al.*, 2020). The pulp of the fruit is traditionally used against rheumatism, kidney disease, spinal tuberculosis, fever medication, eye ointment, enema, poison remedy, and skin disease treatment, making it a valuable resource in eastern Nigeria (Nwozo *et al.* 2016). Sweet deter, a wild fruit tree with numerous applications, is economically feasible in West Africa and has the potential to contribute significantly to food security. The fruits are widely utilized and sold for a variety of reasons (Neuenschwander *et al.*, 2011). Oibiokpa *et al.*, 2014 reported the nutritional composition of the fruit; moisture content of sweet deter as 11.06%, ash content 4.47%, crude fat 2.23%, crude fiber 12.19%, protein 4.68% and carbohydrate content of 65.38%. The mineral composition of the fruit was reported to be; calcium (70.97mg), iron (78.71mg), potassium (908.10mg) and magnesium (113.50mg). The fruit was reported to have a vitamin C content of 55.10mg/100g, vitamin B₂ (4.20mg/100g) and vitamin E (12.44mg/100g) (Adamu & Nzelibe., 2022). Sweet deter fruit was also reported to have high phenols, flavonoids and other antioxidants (Dossa *et al.*, 2020). Despite its nutritional value, the fruit is not fully utilized. The fruit has always been used locally by children; they eat it as dessert/snack. It is underutilized and not fully known throughout the city or in the international world. The fruit production is close to zero. Screening and integrating the fruit into our food system will be a step forward to improve our diet status by increasing the nutritional level, given the composition of the foods that reach in functional characteristics and demonstrating the work of compounds contained in fruits. A thorough examination of the sweet deter fruit's nutritional value and antinutritional characteristics is necessary before incorporating it into culinary products and that leads of the objectives of this research.



Materials and Methods

Sample Collection

The sample of sweet detar was purchased from Wudil market, Kano State. The samples were transported under careful condition to the food processing laboratory of Food Science and Technology Department, Kano University of Science and Technology Wudil, for further assessment. All the chemicals used were of analytical grade and distilled water was used for all the cleaning and preparation of solution. Figure 1 shows a pictorial view of the sweet detar.



Fig. 1 Sweet Detar

Sample preparations

The sample preparation was carried out by separating the fruit pulp from the whole fruit, bark of the fruit was also collected and the whole fruit of the sweet detar was used as well. The fruit separation was done using sharp laboratory knife, which was then packaged and stored at room temperature prior to analysis.

Extraction for Phytochemicals

Ten (10 grams) of sample was added into a conical flask containing 100 ml of solvent (ethanol) (at room temperature) and then plugged with cotton wool. The mixture was kept at room temperature for 48 hours. After which, the mixture was filtered using filter paper which yielded crude extract (Rodríguez-Miranda *et al.*, 2012)

Methodology

The moisture content, ash content, fiber, crude fat, and crude protein was analyzed using association of analytical chemists (AOAC) official method (2005) and carbohydrates by difference. Bulk density and pH. Was determined using the method described by Wan *et al.* (2014). Gelatinization of the fruit samples were determined according to the method described by O’Kane *et al.* 2005, while, solubility and water Absorption capacity was determined according to the method described by Rodriguez-Ambriz *et al.* (2005). Qualitative phytochemicals analysis of the sweet deter fruit was carried out on the samples using the standard method to identify phytochemicals constituents according to the methods described by Vertuani *et al.*, 2002. Triplicate sample was used to obtain measurement values which was reported as mean $\pm$ standard deviation. One-way ANOVA was used to teste the statistical significance ($P < 0.05$) using Turkey test. Minitab statistical software was used for the statistical analyses.

Results and Discussion

From the result obtained in table 1.0 below, the moisture content of the pulp (8.95%) has a lower mean compared to other samples. The whole fruit (9.29%) and the peel (9.30%) show no significant different at $p > 0.05$. The ash content shows no significant different at $p > 0.05$ in the pulp which has a value of 1.87% and 1.92% for the whole fruit, while the peel differs with a mean value of 1.59%. The fiber content ranges from 4.87%, 6.95% and 8.47% for the pulp, whole fruit and the peel respectively. This shows that there is significant different between the three samples at $p < 0.05$. Protein ranges from 9.42% for the pulp, 9.94% for the whole fruit and 8.82% for the peel which statistically shows significant different for the three samples at $p < 0.05$. The calculated carbohydrate ranges from 72.40%, 68.90% and 69.12% for the pulp, whole fruit and the peel respectively. The result showed that the peel and the whole fruit are not significantly different at $p > 0.05$ compared to the pulp which has a mean value of 72.40%. The result of the moisture, fat and carbohydrate content of the sweet deter was in line with that reported by oibiokpa *et al.*, 2014, while the ash, fiber and protein content were lower than that obtained in this research.



The difference in the proximate composition may be due to the climate condition or species of the samples. The samples of oibiokpa et al., 2014 were obtained from Niger state, while the one used in this studies from Kano state. Table 1.2 present the functional properties result. As seen in the table, water absorption is higher in the bark (8.90%), followed by the whole fruit (8.80%) and lowest in the fruit pulp (7.00%), there is no significant difference at $P \leq 0.05$ between the whole fruit and the peel. The pH was found to be 5.5 for the pulp, 5.6 for the whole fruit and 5.5 for the fruit peel. There was no difference in the pH of all sweet detar samples. The gelatinization properties were determined and the temperature was recorded as the gelatinization temperature. The gelling temperature was found to be 70 °C for the pulp and the peel compared to the whole fruit which has a mean value of 60 °C. Table 1.3 shows the phytochemical analysis results for the bark, pulp section, and whole fruit of the sweet detar fruit. The phytochemical examination of the fresh sample found that flavonoids are highly available and abundant in the pulp and whole fruit, but moderately available in the peel. Phytochemicals are compounds produced by plants through primary or secondary metabolism. They often have biological functions in plants and play a role in plant growth or resistance to diseases, competitors and predators (El-beltegiet *et al.*, 2018). Steroids where found in abundant in both the pulp entire fruit and the peel fruit. Studies have shown that steroids have anti-hyperglycemic properties as well as treatment of tumors and inflamed or ulcerated tissues. Tannins are absent in the peel, pulp, and whole fruit, although alkaloids are moderate in all three sample.

Table 1. Proximate Composition (%) of the Different Parts of Sweet detar

Parameters (%)						
Sample code	Moisture	Ash	Fiber	Fat	Protein	Carbohydrate
Pulp	8.95±0.01 ^a	1.87±0.02 ^a	4.87±0.04 ^a	2.49±0.11 ^a	9.94±0.14 ^c	72.40±0.32 ^b
Peel	9.30±0.21 ^b	1.92±0.04 ^a	6.95±0.07 ^b	2.98±0.03 ^c	9.42±0.04 ^b	68.90±0.29 ^a

Conclusion

The qualitative results obtained shows that the sweet deter fruit extracts (pulp, peel and whole fruit) contain a good quantity of antioxidants. This may help as anti-inflammatory effects and protect cells from oxidative damage that can cause disease such as heart disease, diabetes, cancer and cognitive impairment. Flavonoids have been reported to be potent free radical scavengers with potent anticancer properties that prevent oxidative cellular damage and prevent all stages of carcinogenesis, while alkaloids are reported to have important pharmacological properties for bacteria and bactericidal bacteria. In contrast, sweet detar fruit samples can be very useful and a valuable raw material resource in Nigeria. With the increase in food security and the current economic situation of the country, utilizing the available local raw materials will be a step forward and an economic boost to the country

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The Effect of Chemical and Organomineral Fertilizer Treatments on the Yield and Some Yield Parameters of Wheat Plants

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Abstract

For sustainable agriculture in harmony with the ecological balance, the use of organic matter and organomineral fertilizers (OMG) is required. In recent years, use of OMG has become widespread. In this study, the effects of OMG and chemical fertilizer use on yield and quality characteristics of wheat plant in 2018-2019 growing period were investigated. In the research, as chemical fertilizers 20-20-0+(25 SO₃) and 15-15-15+(20 SO₃) base fertilizers and as top fertilizer urea (46% N) were used. As OMG 16-15-0+(10 SO₃)+15 OM and 12-15-5+(10 SO₃)+15 OM base fertilizers and fertilizer with 26% N content [(urea + ammonium sulphate) + OM] as top fertilizer were used. Experiment were carried out according to the random blocks. According to the data obtained, when plant height, spike length, spike number in spike, grain number in spike, grain weight in spike, protein content in grain, there is no significant difference between them. But average highest values was found OMG [(16-15-0+(10 SO₃)+15 OM + (%26 N + OM))] application. The highest protein value in straw was obtained in OMG [12-15-5+(10 SO₃)+15 OM + (%26 N+OM)] application. In terms of thousand grain weight, the highest average value was obtained in chemical fertilizer 15-15-15+(20 SO₃) + (%46 Urea) application. The difference between grain yield (kg da⁻¹) and biomass yield (biomas) values obtained from chemical fertilizer applications with OMG is statistically significant, and the highest grain yield was obtained in the application of the [(16-15-0+(10 SO₃)+15 OM + (%26 N + OM))]. When the data are evaluated in general, it has been observed that organomineral fertilizer applications in wheat plants yield better results than chemical fertilizer applications.

Key Words: Organomineral fertilizer, chemical fertilizer, wheat plant

Buğday Bitkisinin Verim ve Bazı Verim Parametreleri Üzerine Kimyasal ve Organomineral Gübre Kullanımının Etkisi

Ekolojik denge ile uyum içerisinde sürdürülebilir tarım için topraklarda organik madde ve organomineral gübre (OMG) kullanımına ihtiyaç vardır. Son yıllarda OMG kullanımı yaygınlaşmaktadır. Bu çalışmanın amacı; kimyasal gübre ve OMG kullanımının buğday bitkisinin verim ve kalite özelliklerine etkisini incelemektir. Araştırmada kimyasal gübre olarak 20-20-0+(25SO₃) ve 15-15-15+(20SO₃) ekimle birlikte, Üre (%46 N) ise üst gübre olarak kullanılmıştır. OMG olarak 16-15-0+(10SO₃)+15 OM ve 12-15-5+(10SO₃)+15 OM taban gübreleri, üst gübre olarak %26 N [(Üre+Amonyum Sülfat)+OM] içeren gübre kullanılmıştır. Deneme tesadüf blokları deneme desenine göre yürütülmüştür. Elde edilen verilere göre bitki boyu, başak uzunluğu, başakta başakçık sayısı, başakta tane sayısı, başakta tane ağırlığı, tanede protein içeriği incelendiğinde, istatistiksel olarak aralarında önemli bir fark yoktur. Ancak, ortalama en yüksek değerler OMG [(16-15-0+(10 SO₃)+15 OM + (%26 N + OM))] uygulamasında, sap kısmında ise ortalama en yüksek protein değeri e OMG [12-15-5+(10SO₃)+15OM + (%26 N+OM)] uygulamasında elde edilmiştir. Bin tane ağırlığı bakımından en yüksek ortalama değer 15-15-15+(20 SO₃) + (%46 Üre) kimyasal gübre uygulamasında elde edilmiştir. OMG ile kimyasal gübre uygulamalarından elde edilen tane verimi (kg da⁻¹) ve biyolojik verim (biomas) değerleri arasındaki fark istatistiksel olarak farklı olup, en yüksek tane verimi (16-15-0+(10 SO₃)+15 OM)+(%)26 N+ OM) OMG uygulamasında elde edilmiştir. Veriler genel olarak değerlendirildiğinde, buğday bitkisinde organomineral gübre uygulamalarının kimyasal gübre uygulamalarına kıyasla daha iyi sonuçlar verdiği gözlemlenmiştir.

Anahtar Kelimeler: Organomineral gübre, kimyasal gübre, buğday bitkisi

Giriş

Bitkisel üretimde, bitkinin ihtiyacı olan besin maddelerini karşılamak amacıyla kimyasal ve organik gübre uygulamaları önerilmektedir. Buğday (*Triticum aestivum*) yetiştiriciliğinde ise gerekli olan besin elementi ihtiyacı ağırlıklı olarak yüksek konsantrasyon ve çözünürlükteki kimyasal gübrelerden sağlanmaktadır (Bejarano Herrera ve ark., 2016). Son yıllarda kullanımı artan kimyasal gübreler toprağın hem yapısal hem de mikrobiyolojik özellikleri üzerine olumsuz etkileriyle birlikte çevre kirliliğine de yol açmaktadır (Singh ve ark., 2020). Yapılan



araştırmalarda uygulanan azotlu gübrenin %50'den fazlasının bitkiler tarafından alınmadığı, bu nedenle yeraltı sularındaki nitrat kirliliğinin, azot (N) içeren kimyasal gübre uygulamalarından kaynaklandığı ileri sürülmektedir (Craswell, 2021). Buna karşın, organik gübrelerin besin maddesi içeriği kimyasal gübrelerle göre daha düşük olmasına karşın hem toprak özelliklerini iyileştirmekte hem de çevre sorunlarını azaltmaktadır. Organik gübreler besin maddelerini yavaş bir şekilde toprak çözeltisine serbestler ve bitkilerinin sağlıklı büyümesi için besin dengesini korurlar (Kominko ve ark., 2017; Shaji ve ark., 2021). Ayrıca toprak mikroorganizmalarının besin ve enerji kaynağı olarak da işlev görürler (Shaji ve ark., 2021). Geleneksel tarım uygulamalarında verim artışı kimyasal gübre kullanımıyla elde edilmeye çalışılmakta, ancak kullanılan gübrelerin daha etkin olabilmesi için toprak organik madde miktarının belirli bir oranın üzerinde olması gerekmektedir (Karaca ve ark., 2006). Konvansiyonel tarımın yaygın olduğu ülkemizde topraklarının %65'nin organik madde içeriği %2'nin altındadır (Eyüpoğlu, 1999).

Kimyasal gübrelerin çevre üzerindeki olumsuz etkilerini, yetiştirilecek ürünün verimini kaybettirmeden nasıl azaltılacağı oldukça önemli bir konudur. Bu nedenle günümüzde kimyasal ve organik gübrelerin faydalarının kombinasyonunu sağlamak amacıyla organik materyallere kimyasal gübreler eklenip organomineral gübreler (OMG) elde edilmektedir (Sa ve ark., 2017). Organomineral gübrelerin içerdikleri organik madde sayesinde bitki besin maddelerinin yıkanarak yeraltı sularına karışmasını azalttığını ve bitkisel üretimde önem teşkil eden bu durumun ise gübrenin uzun vadeli yararını ve etkinliğini artırdığı ileri sürülmektedir (Kominko ve ark., 2016).

Tejada ve ark. (2005) tarafından OMG ve kimyasal + organik gübre birleşiminin buğday bitkisinin verimine olan etkileri üzerine yaptıkları bir çalışmada; OMG uygulandığı parsellerde buğday tanesinde protein içeriği %2.9, başaktaki tane sayısı %2.2, metre kareye düşen başak sayısı %3.4, bin tane ağırlığı %3.9 ve verimin diğer gübre uygulamasına göre %2.5 oranında artırdığı istatistiksel olarak önemli bulunmuştur.

Namlı ve ark. (2018), içerikleri belli olan organik toprak düzenleyicileri ve bunların farklı oranlarda kimyasal gübrelerle kombinasyonu ile elde edilen OMG buğday üzerindeki etkinliklerinin belirlenmesi amacıyla yürüttükleri çalışmada organik materyalin bitki boyunu artırdığını bildirmişlerdir. Bunun yanı sıra bölgede uygulanan 20 kg da⁻¹ DAP gübresine kıyasla toprağa ilave edilen organik materyallerin tek başlarına ve kimyasal gübrelerle birlikte uygulanması buğday verimini de önemli düzeyde artırdığı rapor edilmiştir.

Son yıllarda ülkemizde OMG gübre üretiminin ve kullanımının artmasına rağmen, ülkemizde kimyasal ve OMG etkinliği konusunda araştırmalar yeterli değildir. Bu çalışmanın amacı, tarla koşullarında ekimle ve üst gübre şeklinde uygulanan kimyasal ve OMG buğday bitkisinin verim ve bazı kalite özellikleri üzerine etkisini incelemektir. Bu çalışmadan elde edilen verilen OMG ve kimyasal gübrelerin buğday bitkisinin verim ve bazı verim parametreleri üzerine etkisinin karşılaştırılması bakımından temel veriler oluşturacaktır.

Materyal ve Yöntem

Çalışma Alanı ve Toprak Özellikleri

Bu çalışma Kahramanmaraş Sütçü İmam Üniversitesi, Ziraat Fakültesi, Tarla Bitkileri Bölümüne ait araştırma alanında yürütülmüştür. Çalışma alanına ait toprakların bazı fiziksel ve kimyasal özellikleri Çizelge 1'de verilmiştir.

Çizelge 1. Çalışma alanına ait toprakların bazı fiziksel ve kimyasal özellikleri

Tekstür	pH	Organik						
		EC	Madde	Kireç	P	K	Fe	Zn
		dS m ⁻¹	%	%	mg kg ⁻¹	mg kg ⁻¹	mg kg ⁻¹	mg kg ⁻¹
Killi	7.62	2.89	1.8	2.1	8.3	216	5.5	0.45

Çalışma alanı topraklarının tekstürü killi bünyeye sahiptir. Toprak reaksiyonu 7.62 ile hafif alkalin olup tuzsuz (2.89 dS m⁻¹) sınıfında yer almaktadır. Toprağın organik madde düzeyi %1.8 ile düşük ve az kireçli (% 2.1) sınıfındadır. Değişebilir K (216 mg kg⁻¹) ve ekstrakte edilebilir Fe (5.5 mg kg⁻¹) konsantrasyonları yeterli düzeyde, yarıyışlı P (8.3 mg kg⁻¹) ile ekstrakte edilebilir Zn (0.45 mg kg⁻¹) yetersizdir.

Çalışma Alanı Tasarımı ve Gübre Uygulamaları

Tesadüf blokları deneme desenine göre 3 tekerrürlü olarak parselasyon (1.5 m x 5 m) işlemi yapıldı ve denemede Adana-99 buğday çeşidi kullanıldı. Çalışmada iki kimyasal ve iki OMG olmak üzere toplamda 4 farklı taban gübresi, bir kimyasal ve bir OMG olmak üzere toplamda 2 farklı üst gübre kullanılmıştır. Araştırmada kullanılan kimyasal ve OMG ait bilgiler Çizelge 2'de verilmiştir. Parsellere uygulanacak olan gübre dozları 0, 16, 24 kg N da⁻¹ olarak belirlenmiş olup ekimle ve üst gübre olmak üzere ikiye bölünerek uygulanmıştır. OMG gübreler leonardit esaslıdır.



Çizelge 2. Çalışmada kullanılan kimyasal ve organomineral gübreler

Kimyasal Gübreler	Organomineral Gübreler
20-20-0+(25 SO ₃)	16-15-0+(10 SO ₃)+15 OM [%10 humik+fulvik asit]
15-15-15+(20 SO ₃)	12-15-5+(10 SO ₃)+15 OM [%10 humik+fulvik asit]
Üre (% 46 N)	26 N+20 OM [%12 humik+fulvik asit]

Toprak ve Bitkilerde Belirlenen Özellikler

Çalışma alanına ait topraklarının toprak tekstürü bouyoucus hidrometre yöntemine ile (Gee ve Bauder, 1986), pH ve EC değerleri toprak-saf su karışımından elde edilen saturasyon çamurunda (Thomas, 1996), organik madde ise Nelson ve Sommers (1996) tarafından bildirilen Modifiye Walkley-Black yaş yakma yöntemine göre belirlenmiştir. Toplam kireç; kalsimetre yöntemine ile ölçülmüştür (Gülçur, 1974). Bitkiye yararışlı P; içeriği 0.5 M NaHCO₃ yöntemi ile (Olsen ve Sommers, 1982), değişebilir K; amonyum asetat yöntemine göre (Helmke ve Sparks, 1996), alınabilir mikro elementlerden Fe ve Zn; Lindsay ve Norvell (1978) tarafından bildirilen DTPA yöntemine göre belirlenmiştir. Vejetasyon süresini tamamlayan buğdayın hasat edilmeden önce; bitki boyu (cm), başak uzunluğu (cm), başakçık sayısı (adet/başak), hasat sonrasında ise başakta tane sayısı (adet/başak) ve başakta tane ağırlığı (g/başak) belirlenmiştir. Hasat edilen toplam buğday bitkisinin tartılması ile biyolojik verim (kg da⁻¹), bin tane ağırlığı (g) ve tane verimi (kg da⁻¹) hesap edilmiştir (Genç, 1974). Harman işlemiyle birbirinden ayrılan sap ve taneler önce çeşme suyunda daha sonra da saf suda yıkanarak sabit ağırlığa gelene kadar etüvde 65°C'de bekletilmiştir (Jones ve Case, 1990). Kuruyan bitki numuneleri öğütüldükten sonra Bremner ve ark. (1982) tarafından bildirilen Kjeldhal yöntemi ile toplam azot tayini yapılmış ve belirlenen % N değeri 6.25 faktörü ile çarpılarak % protein içeriği hesaplanmıştır (Anıl, 2000).

Bulgular ve Tartışma

Bitki Boyu (cm) ve Başak Uzunluğu (cm)

Buğday bitkisine uygulanan farklı çeşit ve dozlardaki gübrelerin bitki boyu (cm) ve başak uzunluğu (cm) üzerine etkisine ait ortalama değerler Çizelge 3'de verilmiştir. Elde edilen varyans analiz sonuçlarına göre uygulanan kimyasal ve OMG çeşitlerinin bitki boyu ve başak uzunluğu özellikleri üzerine önemli bir etkisinin olmadığı belirlenmiştir. Çalışmada uygulanan N dozlarının artmasının hem bitki boyu hem de başak uzunluğu özellikleri üzerine etkisi önemli bulunmuştur ($p < 0.01$). İncelenen her iki özellikteki en yüksek değerler 24 kg N da⁻¹ uygulama dozunda elde edilmiştir. Kullanılan gübre çeşidi x uygulama dozu kombinasyonlarında ise en yüksek bitki boyu (106.7 cm) 16-15-0+(10 SO₃)+15 OM OMG uygulamasının 24 kg N da⁻¹ dozunda belirlenirken, başak uzunluğu 9.63 cm ile 15-15-15+(20 SO₃) kimyasal gübrenin 24 kg N da⁻¹ uygulamasından elde edilmiştir. Elde edilen bu sonuçlar ise kontrol grubuna göre $p < 0.05$ düzeyinde önemli bulunmuştur. Azot, bitkilerin biyokimyasal ve fizyolojik fonksiyonlarında hayati bir rol oynayarak verim ile kaliteyi önemli ölçüde artıran ve bitkilerin vejetatif gelişmesini sağlayan bir elementtir (Leghari ve ark., 2019). Ali ve ark. (2011) yürüttükleri bir çalışmada, kontrole göre artan N seviyelerinin buğdayda bitki boyu ve başak uzunluğunu önemli düzeyde artırdığını bildirmişlerdir. Shehzad ve ark. (2012), Yadav ve ark. (2017), Ullah ve ark. (2018) buğdayda yürüttükleri çalışmalarda benzer sonuçlar elde etmişlerdir. Kimyasal gübre ve OMG uygulamalarının bitki boyu ve başak uzunluğuna etkisi istatistiksel olarak farklı bulunmamasına rağmen en yüksek bitki boyu (96.5 cm) ve başak uzunluğu (8.16 cm) [(16-15-0+(10 SO₃)+15 OM + (%26 N+OM)] OMG uygulamasından elde edilmiştir.

Çizelge 3. Farklı çeşit ve dozda gübre uygulamalarının bitki boyu (cm) ve başak uzunluğu (cm) üzerine etkisi

Type of Fertilizer Used (Seed + Top)	Bitki Boyu (cm)				Başak Uzunluğu (cm)			
	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.
20-20-0+(25 SO ₃) + Üre	79.6b	100.2a	105.3a	95.0	5.52b	8.95a	9.25a	7.91
15-15-15+(20 SO ₃) + Üre	79.6b	101.9a	104.2a	95.2	5.52b	8.99a	9.63a	8.04
16-15-0+(10SO ₃)+15 OM	79.6b	103.3a	106.7a*	96.5	5.52b	9.56a	9.41a	8.16
+ %26 N+20 OM								
12-15-5+(10 SO ₃)+15 OM	79.6b	100.5a	104.3a	94.8	5.52b	8.74a	9.53a	7.93
+ %26 N+20 OM								
Ort.	79.6C	101.5B	105.1A**		5.52B	9.06A	9.45A**	

OM:Organik Madde, *:p<0.05, **:p<0.01



Başakçık Sayısı (adet/başak) ve Başakta Tane Sayısı (tane/başak)

Uygulanan farklı çeşit ve dozlardaki gübrelerin başakçık sayısı (adet/başak) ve başakta tane sayısı (tane/başak) üzerine etkisine ait ortalama değerler Çizelge 4'te verilmiştir. Elde edilen varyans analiz sonuçlarına göre uygulanan kimyasal ve OMG çeşitlerinin başakçık sayısı ve başakta tane sayısı üzerine önemli bir etkisinin olmadığı belirlenmiştir. Araştırmada uygulanan N dozlarının artmasının başakçık sayısı ve başakta tane sayısı üzerine etkisi $p < 0.01$ düzeyinde önemli bulunmuştur. Belirlenen her iki özellikteki en yüksek veriler 24 kg da^{-1} N uygulama dozunda kaydedilmiştir. Kullanılan gübre çeşidi x uygulama dozu kombinasyonlarında ise en yüksek başakçık sayısı (18.4 adet) ve başaktaki tane sayısı (53 adet) $16-15-0+(10 \text{ SO}_3)+15 \text{ OM}$ OMG uygulamasının 16 kg da^{-1} N dozunda elde edilmiştir ve $p < 0.05$ düzeyinde önemli bulunmuştur. Ullah ve ark. (2018) buğdayda yürüttükleri çalışmada başakçık sayısının N seviyesinin artması ile arttığını ve maksimum başakçık sayısını 19.8 ile en yüksek N dozunda (203 kg ha^{-1}) elde ettiklerini bildirmiştir. Nourmohammadi ve ark. (2010) buğdayda daha fazla N alımının bitki büyümesi ve kardeş gelişiminin artmasından dolayı yüksek başak üretimi sağladığını bildirmiştir. Bununla birlikte N uygulama miktarının artması, başakçık oluşumunu olumlu etkilediği için tane/başak oranı da artmaktadır (Ullah ve ark., 2018). Kimyasal gübre ve OMG uygulamalarının başakçık sayısı (adet/başak) ve başakta tane sayısı (tane/başak) etkisi istatistiksel olarak farklı bulunmamasına rağmen en çok başakçık sayısı (16.0) ve başakta tane sayısı (41.8) [$16-15-0+(10 \text{ SO}_3)+15 \text{ OM} + (\%26 \text{ N+OM})$] OMG uygulamasından elde edilmiştir.

Çizelge 4. Farklı çeşit ve dozda gübre uygulamalarının başakçık sayısı (adet/başak) ve başakta tane sayısı (tane/başak) üzerine etkisi

Kullanılan Gübre Çeşidi Ekim + Üst	Başakçık Sayısı (adet/başak)				Başakta Tane Sayısı (adet/başak)			
	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.
20-20-0+(25 SO ₃) + Üre	12.0b	16.8a	16.8a	15.2	22.6b	48.0a	51.2a	40.6
(15-15-15+(20 SO ₃) +Üre	12.0b	17.0a	17.3a	15.4	22.6b	48.8a	49.4a	40.3
16-15-0+(10SO ₃)+15 OM	12.0b	18.4a*	17.6a	16.0	22.6b	53.0a*	49.7a	41.8
+%26 N+20 OM								
12-15-5+(10 SO ₃)+15 OM	12.0b	16.7a	17.2a	15.3	22.6b	46.9a	49.7a	39.7
+%26 N+20 OM								
Ort.	12.0B	17.2A	17.3A**		22.6B	49.1A	49.9A**	

OM:Organik Madde, *:p<0.05, **:p<0.01

Başakta Tane Ağırlığı (g/başak) ve Bin Tane Ağırlığı (g/başak)

Buğday bitkisine uygulanan farklı çeşit ve dozlardaki gübrelerin başakta tane ağırlığı (g/başak) ve bin tane ağırlığı (g/başak) üzerine etkisine ait ortalama değerler Çizelge 5'de verilmiştir. Elde edilen varyans analiz sonuçlarına göre uygulanan kimyasal ve OMG çeşitlerinin başakta bin tane ağırlığı (g/başak) üzerine etkisi $p < 0.01$ düzeyinde önemlidir. Çalışmada uygulanan N dozlarının artmasının başaktaki tane ağırlığı ve bin tane ağırlığı üzerine etkisi önemli bulunmuştur ($p < 0.01$). En yüksek başaktaki tane ağırlığı 2.15 g ile 24 kg da^{-1} N dozunda belirlenirken bin tane ağırlığı (42.7 g) 16 kg da^{-1} N dozunda elde edilmiştir. Kullanılan gübre çeşidi x uygulama dozu kombinasyonlarında ise en yüksek başaktaki tane ağırlığı (2.30 g) ve bin tane ağırlığı (43.5 g) ile $16-15-0+(10 \text{ SO}_3)+15 \text{ OM}$ OMG uygulamasının 16 kg da^{-1} N dozunda belirlenmiştir. Elde edilen bu sonuçlar ise kontrol grubuna göre $p < 0.05$ düzeyinde önemli bulunmuştur. Çalışma sonuçlarına göre N uygulamasının azalması ile başaktaki tane ağırlığının azaldığı açıkça görülmektedir. Bu durum ise buğday bitkisine yeterince N beslenmesi sağlanmazsa depolama hücrelerinin ve nişasta granüllerinin sayısının oluştuğu aşamada tahılın karbonhidratlar ve amino bileşiklerle daha az beslenmesi nedeniyle tane ağırlığını azalması ile ilişkilendirilmektedir (Paponov ve ark., 2005). Kaur ve ark. (2015) tarafından yürütülen çalışma N uygulama dozlarının artması ile bin tane ağırlığının artmasına rağmen, bu çalışmada 16 kg da^{-1} gübre uygulamasından sonra azalmaktadır. Bu durum, belirli bir dozdan sonra bin tane ağırlığının düşmesi, bitkinin tane oluşturma kapasitesinde artış göstermesiyle açıklanabilir.



Çizelge 5. Farklı çeşit ve dozda gübre uygulamalarının başakta tane ağırlı (g/başak) ve bin tane ağırlığı (g/başak) üzerine etkisi

Kullanılan Gübre Çeşidi Ekim + Üst	Başakta Tane Ağırlığı (g/başak)				Bin Tane Ağırlığı (g/başak)			
	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.
20-20-0+(25 SO ₃) + Üre	0.97b	2.15a	2.11a	1.74	41.3b	42.6a	42.1ab	41.9B
(15-15-15+(20 SO ₃) +Üre	0.97b	2.10a	2.20a	1.76	41.3b	43.1a	43.3a	42.6A**
16-15-0+(10 SO ₃)+15 OM	0.97b	2.30a*	2.12a	1.80	41.3b	43.5a*	41.2ab	41.9AB
+%26 N+20 OM								
12-15-5+(10 SO ₃)+15 OM	0.97b	2.02a	2.18a	1.72	41.3b	41.6a	39.2b	40.7B
+%26 N+20 OM								
Ort.	0.97B	2.14A	2.15A**		41.3B	42.7A**	41.4B	

OM:Organik Madde, *:p<0.05, **:p<0.01

Samanda ve Tanede Protein Oranı (%)

Uygulanan farklı çeşit ve dozlardaki gübrelerin saman ve tanede protein oranı (%) üzerine etkisine ait ortalama değerler Çizelge 6'da verilmiştir. Elde edilen varyans analiz sonuçlarına göre uygulanan gübre çeşidinin samanda protein oranı üzerine etkisi incelendiğinde kimyasal gübre ve OMG uygulamaları arasında istatistiksel olarak önemli (p<0.01) farklar bulunmuştur. OMG uygulamalarında genel olarak daha yüksek değerler elde edilmiştir. En yüksek samanda protein oranı %1.51 ile 12-15-5+(10 SO₃) + 15 OM OMG uygulamasının 24 kg da⁻¹ N dozunda elde edilmiştir. Araştırmada uygulanan N dozlarının artmasının saman ve tanede protein oranı (%) üzerine etkisi p<0.01 düzeyinde önemli bulunmuştur. Belirlenen her iki özellikteki en yüksek değerler 24 kg da⁻¹ N uygulama dozunda saptanmıştır. Kullanılan gübre çeşidi x uygulama dozu kombinasyonlarında ise en yüksek samanda protein oranı (%1.51) 12-15-5+(10 SO₃) + 15 OM gübre uygulamasının 24 kg da⁻¹ N dozunda iken, tanede protein oranı (%11.8) 16-15-0+(10 SO₃) + 15 OM OMG uygulamasının 16 kg da⁻¹ N dozunda elde edilmiştir (p<0.05). Haile ve ark. (2012) yürüttükleri çalışmada tanedeki protein içeriği en düşük N uygulamasında (30 kg ha⁻¹) %12.4 iken en yüksek N uygulamasında (120 kg ha⁻¹) %13.09'a kadar arttığı bildirilmiştir. Yapılan diğer çalışmalarda benzer sonuçlar elde edilmiştir (Otteson ve ark., 2017; Wang ve ark., 2022). Glenn ve ark. (1985) Stephens çeşidi kışık buğdayın tane protein içeriğinin %9.1'in altındaki her bir protein yüzdesinin düştüğünde %9.8'lik bir verim kaybına neden olduğu bildirilmiştir. Organomineral gübre kullanımı ile samandaki protein içeriği artmıştır. Bu durum, OMG içerisinde bulunan azot elementinin bitki tarafından daha etkin kullanılmasıyla açıklanabilir. Kulikova ve ark. (2021) organik ve OMG kullanımının bitkinin beslenme rejimini iyileştirdiğini bildirmiştir. Farklı OMG ve kimyasal gübre uygulamasının tanede protein oranına etkisi istatistiksel olarak önemli olmamasına karşın, ortalama en yüksek protein oranı %10.6 ile OMG [16-15-0+(10 SO₃)+15 OM] OMG uygulamasında elde edilmiştir.

Çizelge 6. Farklı çeşit ve dozda gübre uygulamalarının başakta tane ağırlı (g/başak) ve bin tane ağırlığı (g/başak) üzerine etkisi

Kullanılan Gübre Çeşidi Ekim + Üst	Samanda Protein Oranı (%)				Tanede Protein Oranı (%)			
	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.
20-20-0+(25 SO ₃) + Üre	0.64d	0.87cd	0.93cd	0.81C	9.04b	10.2ab	11.1a	10.1
(15-15-15+(20 SO ₃) +Üre	0.64d	0.93cd	1.10bc	0.89BC	9.04b	10.1ab	10.9ab	9.99
16-15-0+(10 SO ₃)+15 OM	0.64d	1.10bc	1.34ab	1.03AB	9.04b	10.9a	11.8a*	10.6
+%26 N+20 OM								
12-15-5+(10 SO ₃)+15 OM	0.64d	1.10bc	1.51a*	1.08A**	9.04b	10.6ab	11.7a	10.5
+%26 N+20 OM								
Ort.	0.64C	1.00B	1.22A**		9.04C	10.5B	11.4A**	

OM:Organik Madde, *:p<0.05, **:p<0.01



Biyolojik Verim (kg da⁻¹) ve Tane Verimi (kg da⁻¹)

Buğday bitkisine uygulanan farklı çeşit ve dozlardaki gübrelerin biyolojik verim (kg da⁻¹) ve tane verimi (kg da⁻¹) üzerine etkisine ait ortalama değerler Çizelge 7'de verilmiştir. Elde edilen varyans analiz sonuçlarına göre uygulanan kimyasal ve OMG çeşitlerinin hem biyolojik verim hem de tane verimi üzerine etkisi $p < 0.01$ düzeyinde önemlidir. İncelenen her iki özellikte de en yüksek verim değerleri 16-15-0+(10 SO₃)+15 OM OMG uygulamasından elde edilmiştir. Çalışmada uygulanan N dozlarının artmasıyla biyolojik verim ve tane verimlerinin artması önemli bulunmuştur ($p < 0.01$). En yüksek verim değerleri ise 24 kg da⁻¹ N uygulama dozunda elde edilmiştir. Azot uygulama seviyesinin artması ile birim başına düşen kardeş sayısı, daha fazla tane sayısı ve toplam kuru maddenin artışı ile yüksek biyolojik verim sağlamaktadır (Ullah ve ark., 2018). Khan ve ark. (2014) azotun buğdayın biyolojik verim üzerine etkisinin önemli olduğunu bildirmiştir. Kullanılan gübre çeşidi x uygulama dozu kombinasyonlarında ise en yüksek biyolojik verim (1605 kg) ve tane verimi (627.6 kg) ile 12-15-5+(10 SO₃)+15 OM OMG uygulamasının 24 kg da⁻¹ N dozunda belirlenmiştir. Bu durum, OMG içerisinde bulunan organik maddenin vejetatif aksamı doğrudan etkisi olan azotun yıkanma ve volatilizasyon kayıplarının azaltmasından kaynaklanabilir. Süzer ve Çulhacı (2017) tarafından yapılan çalışmada, OMG uygulamasında, kimyasal gübre uygulamasına göre daha yüksek biyolojik verim ve tane verimi elde edildiği rapor edilmiştir.

Çizelge 7. Farklı çeşit ve dozda gübre uygulamalarının biyolojik verim (kg da⁻¹) ve tane verimi (kg da⁻¹) üzerine etkisi

Kullanılan Gübre Çeşidi (Ekim + Üst)	Biyolojik Verim (kg da ⁻¹)				Tane Verimi (kg da ⁻¹)			
	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.	0 kg da ⁻¹	16 kg da ⁻¹	24 kg da ⁻¹	Ort.
20-20-0+(25 SO ₃) + Üre	617.3c	1243ab	1544a	1134AB	201.4c	429.6bc	561.0a	397.4BC
(15-15-15+(20 SO ₃) +Üre	617.3c	1199ab	1412a	990B	201.4c	368.3c	531.6ab	367.1C
16-15-0+(10 SO ₃)+15 OM +%26 N+20 OM	617.3c	1437a	1528a	1194A**	201.4c	587.6a	623.0a	470.7A**
12-15-5+(10 SO ₃)+15 OM +%26 N+20 OM	617.3c	943bc	1605a*	1140AB	201.4c	531.0ab	627.6a*	453.4AB
Ort.	617.3C	1205B	1522A**		201.4C	479.2B	585.8A**	

OM:Organik Madde, *:p<0.05, **:p<0.01

Sonuçlar ve Öneriler

Bu çalışmada, taban gübresi olarak iki kimyasal ve iki OMG, üst gübre olarak bir kimyasal ve bir OMG uygulamasının buğday bitkisinin gelişimine ve verimine etkileri incelenmiştir. Araştırmada, bitki boyu, başak uzunluğu, başakta başakçık sayısı, başakta tane sayısı, başakta tane ağırlığı incelendiğinde farklı gübre uygulamaları arasında istatistiksel olarak önemli bir fark yoktur. Ancak, ortalama en yüksek değerler [(16-15-0+(10SO₃+ 15 OM) + (%26 N + 20 OM)] uygulamasında elde edilmiştir. Bin tane ağırlığı bakımından ise en yüksek ortalama değer [(15-15-15+(20 SO₃)+(Üre)] kimyevi gübre uygulamasında elde edilmiştir. Ortalama biyolojik verim en yüksek değeri [(16-15-0+(10 SO₃+ 15 OM) + (%26 N + 20 OM) OMG uygulamasında elde edilmiştir. Tanede protein oranı ortalaması en yüksek [(16-15-0+(10 SO₃+ 15 OM) + (%26 N + 20 OM)] OMG uygulamasında elde edilirken, samanda ortalama en yüksek protein oranı [(12-15-5+ (10 SO₃)+15 OM) + (%26 N + 20 OM)] ve [(16-15-0+(10 SO₃+ 15 OM) + (%26 N + 20OM)] uygulamalarında elde edilmiştir. Organomineral gübre uygulamaları ile kimyasal gübre uygulamalarından elde edilen tane verimleri incelendiğinde, OMG uygulamaları ile kimyasal gübre uygulamalarından elde edilen ortalamalar arasındaki fark istatistiksel olarak önemli bulunmuştur. Ortalama OMG gübre uygulamasında elde edilmiştir. Sonuç olarak, OMG uygulamalarının buğday bitkisinde verim ve kalite unsurları bakımından kimyasal gübrelerle oranla daha etkili olduğu söylenebilir.

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ID: 576

Review of Research on School Gardening

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Abstract

Early childhood education is critical and is an important process for developing habits and practices towards sustainability. It can be said that environmental education programs conducted outdoors, which provide the achievement of the goals of environmental education, have significant effects in order to promote sustainability. At this point, it is very important to develop environmental awareness in the school environment, especially in school gardens, through agricultural practices. Agricultural practices in schools need to be increased, and preschool agricultural practices need to be widespread and included more in research in order to become a part of teacher education and the applied curriculum. In order to achieve these goals, it is important to first determine the distribution of studies conducted at the international level. Based on this idea, this research aims to determine the development process of research conducted on agricultural practices in school gardens, which are considered innovative practices, and to discuss them in the context of early childhood education and child development. Since the research reveals the distribution of articles, it is descriptive and has a screening model type. Articles published on agricultural practices in schools with the keyword “school gardening” in the Web of Science database were included in the research. The articles were transferred to the computer and analyzed according to many variables such as the number of publications by year, the distribution of authors, countries and journals in which the articles were published, and the frequency of keywords. The data is in the analysis phase and will be discussed with the support of sources.

Key Words: School Gardening, Education, Child Development

Okullarda Tarım Uygulamaları İle İlgili Yapılan Çalışmaların İncelenmesi

Özet

Erken çocukluk eğitimi içinde bulunulan dönemin önemi noktasında, sürdürülebilirliğe yönelik alışkanlıkların ve uygulamaların geliştirilmesi için önemli bir süreçtir. Sürdürülebilirliğin teşvik edilmesinde, çevre eğitiminin hedeflerine ulaşmayı sağlayan açık havada yapılan çevre eğitimi programlarının önemli etkilere sahip olduğu söylenebilir. Bu noktada okul ortamında özellikle okul bahçelerinde tarım uygulamalarıyla çevre bilincinin geliştirilmesi çok önemlidir. Okullarda tarım uygulamalarının artması, okul öncesinde tarım uygulamalarının öğretmen eğitiminin ve uygulanan müfredatın bir parçası olabilmesi için yaygınlaşması ve araştırmalara daha fazla dahil edilmesi gerekmektedir. Bu amaçlara ulaşabilmek için öncelikle uluslararası düzeyde yapılan çalışmaların dağılımlarının belirlenmesi önemli görülmektedir. Bu düşünceden hareketle bu araştırmada yenilikçi uygulamalar olarak görülen okul bahçelerinde tarım uygulamaları ile ilgili yapılan araştırmaların gelişim sürecinin tespit edilmesi ve erken çocukluk eğitimi ve çocuk gelişimi bağlamında tartışılması amaçlanmaktadır. Araştırma, makalelerin dağılımlarını ortaya koyduğundan betimsel nitelikte olup, tarama modeli tipindedir. Araştırmaya Web of Science veri tabanında “school gardening” anahtar kelimesi ile okullarda tarım uygulamaları konusunda yayınlanmış olan makaleler dahil edilmiştir. Makaleler, bilgisayar ortamına aktarılarak yıllara göre yayın sayıları, yazarların, ülkelerin ve makalelerin yayınlandığı dergilerin dağılımı, anahtar kelimelerin sıklığı gibi birçok değişkene göre ayrılarak çözümlenmiştir. Veriler analiz aşamasında olup kaynaklarla desteklenerek tartışılacaktır.

Anahtar Kelimeler: Okullarda Tarım Uygulamaları, Eğitim, Çocuk Gelişimi





ID: 577

Evaluation of milk adulteration and mastitis in milk samples collected from selected regions in Punjab

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Abstract

Milk is a fundamental diet for all age groups, but in developing countries like Pakistan, milk adulteration is common due to poor transportation conditions. Milk contains a wide range of nutrients, but to increase its quantity, other adulterants are added. The research was done at Dairy Technology Laboratory (NARC). The samples were collected from selected regions from Punjab. Selected regions were Bhakkar, Layyah, Khushab, Rawalpindi, Faisalabad and Lahore. Samples were brought to the lab for analysis of composition and adulterants and mastitis tests were performed at the dairy forms. In composition fat 4.87%, protein 3.61%, total solids 11.92% and ash 0.61% were observed. Adulterants were H₂O₂, starch, skimmed milk powder, dalda ghee, water, vegetable oil, formalin, benzoic acid, salicylic acid, sugarcane, glucose, neutralizers, NaCl, pulverized soap and urea considered for analysis. Water was the most common adulterant observed with 89% of total samples and after that glucose was the second most adulterant observed with 8% of total samples. Mastitis observed highest in Rawalpindi region with 25% and lowest in Khuashab 15%. To ensure milk quality, quality tests was conducted at dairy laboratories and food technology labs to control adulteration and mastitis disease. This study aims to evaluate these issues and ensure the safety of milk consumption. Statistical analysis data showed that compositional, adulterants and mastitis parameters observed from selected regions were significantly different ($P < 0.05$).

Keywords: Milk Adulteration, Quality tests, Mastitis, SFMT, ANOVA



ID: 578

Potentials of *Senna tora* (L.) Roxb. as Source of Functional Food and Bioactive Compounds with Antioxidant, Antimicrobial and Anti-Inflammatory Activities

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Abstract

Senna tora (L.) Roxb. is an important ethno-medicinal plant from time immemorial. Different parts of the plant have found applications in Chinese and Ayurvedic medicine. There is a reputation for the food application and therapeutic properties of the plant's leaves and seeds. The purpose of this review is to ascertain the potential of *Senna tora* (L.) Roxb. as a source of functional food as well as drug candidates against oxidants, inflammation, and microbial infection. Based on the previous literature, the discoveries of bioactive compounds including phenols, flavonoids, tannins, terpenoids, saponins, steroids, alkaloids, glycosides and reducing sugar seem to rationalize the proposed use of *Senna tora* (L.) Roxb. as antioxidant, anti-inflammatory, and antimicrobial agents. Furthermore, the young leaves are cooked and eaten as a vegetable or cook with pulses while the roasted seeds are used as a substitute coffee, also, the seed gums are used as thickener in foods. It can be concluded that *Senna tora* (L.) Roxb. is rich in numerous bioactive compounds that have the potential to fight against oxidants, inflammation, and microbial infection as potential drug candidates. In addition due to its numerous bioactive compounds, *Senna tora* can find profound application in the development of functional foods and nutraceuticals.

Keywords: *Senna tora* (L.) Roxb. Antioxidant activity, Anti-inflammatory activity, Antimicrobial activity, Functional Food

Introduction

Nature bestows medicinal plants on humans as a gift to help them on their journey toward better health. Natural plant products have been identified and used by humans from time immemorial as food and a primary source of therapeutic medications (Adnan et al., 2021; Siddiqui et al., 2022). They continue to be an abundant source of well-known and potent bioactive compounds that are capable of being employed as medications right away (Siddiqui et al., 2022). There are numerous examples of plant-based medications, like antimicrobial as nicotine, antioxidant as nordihydroguaiaretic acid (NDGA), anticancer as vinblastine, bleomycin, paclitaxin, and taxol, and anti-inflammatory as aescin and capsaicin, cardiogenic as acetyldigoxin, and antiparkinsonism as L-dopa, etc (Adnan et al., 2021; Kabir et al., 2020). Their application is advocated within the frameworks of Ayurvedic, Unani, Siddha, Homeopathic, and other medical systems (Adnan et al., 2021). They have a significant impact on a great number of human lives as traditional treatments for many illnesses, including rheumatism, bronchitis, burns, itches, leprosy, colds, roundworm infection, hemorrhaging in wounds, diarrhea, and others (Adnan et al., 2021; Elsbali et al., 2022). Even though many pharmaceuticals derived from plants have been found, more research into novel bioactive compounds is still needed to increase the number of pharmacological alternatives accessible and find less harmful drugs with better efficacy (Alreshidi et al., 2020; Awadelkareem et al., 2022). In order to reduce the risk of cellular damage or tissue injury, inflammation, microbial infection, and related disorders caused by free radicals, one of the most active research areas is the search for highly antioxidant, anti-inflammatory, and antimicrobial phytochemical compounds. Although synthetic antioxidants are available for the treatment of oxidative stress-mediated oxidant-induced diseases and disorders, they have associated health risks and severe adverse effects (Lourenco et al., 2019). Nonsteroidal anti-inflammatory drugs (NSAIDs) are used for treating inflammation, but they have a number of negative side effects, such as heartburn, nausea, vomiting, and gastrointestinal ulcers (Sostres et al., 2010; Philipsborn et al., 2020). Antimicrobials are becoming less effective, which makes treating conditions like gonorrhea, pneumonia, TB, blood poisoning, and foodborne illnesses harder and often impossible. The emergence and global dissemination of new resistance mechanisms pose a danger to our ability to cure prevalent infectious diseases (Lomazzi et al., 2019). Furthermore, the bulk of antibiotics on the market today have dangerous side effects, such as anaphylaxis, dermatological cross-reactivity, life-threatening immune-related fallacious effects, hypersensitivity, and altering the body's normal microbiota, which can affect normal physiological processes and increase susceptibility to viral diseases like the flu (Bradley et al., 2019). As a result, the "back to nature" approach has been increasingly popular in recent years. Numerous compounds derived from plants have been developed and approved for use as antimicrobial, anti-inflammatory, and antioxidant potential therapeutics (Furst et al., 2014; Savoia, 2012; Subramani et al., 2017). Therefore, the continuous



exploration of antioxidant, anti-inflammatory, and antimicrobial phytochemicals plays a key role in finding a feasible course of action that is safe and that lowers the adverse effects induced by chemotherapy.

Senna tora (L.) Roxb. (Syn *Cassia tora*) is a yearly foetid herb that belongs to the family Fabaceae and commonly propagates in barren land as a monsoon wild plant in humid countries (Jain & Patil, 2010; Singh *et al.*, 2013; Maneenoon *et al.*, 2015; Pawar & Lalitha, 2015). It is known as foetid cassia/sickle pod/sickle senna in English (Jain & Patil, 2010; Maneenoon *et al.*, 2015; Pawar & Lalitha, 2015; Mishra & Moses, 2018). It is one of several wild medicinal food plants (Hanh *et al.* 2021). Though it is being consumed by several ethnic communities, it is still considered to be an unexplored plant group with potential health advantages. *Senna tora* (L.) Roxb. plant is still underexplored, and we need to document it to create livelihood options and fight against food and medicinal problems. Additionally, it is an ethno-medicinal herb used in traditional Chinese medicine and Ayurvedic medicine ((Jain & Patil, 2010; Maneenoon *et al.*, 2015; Pawar & Lalitha, 2015; Sultana *et al.*, 2018). This plant is used by traditional healers, rural and tribal people, to treat a variety of conditions including heart diseases, bronchitis, ulcers, ringworm, itching, appetizers, sleeplessness, liver disease and leprosy (Jain & Patil, 2010; Maneenoon *et al.*, 2015; Pawar & Lalitha, 2015; Sultana *et al.*, 2018). In folklore preparation, the leaves have antirheumatic activities, and the leaf essence is used as a laxative (Pawar & Lalitha, 2015). In addition to having hepatoprotective, anti-helminthic, and anti-inflammatory properties, it is helpful in treating skin diseases such ringworm, eczema, scabies, rheumatism, and asthma. Its therapeutic properties are probably caused by a variety of chemical compounds and elements. (Choudhary *et al.*, 2011; Mate *et al.*, 2013; Vijayalakshmi *et al.*, 2015). Because *Senna tora* (L.) Roxb. contains high content of different phytochemicals, such as tannins, saponins, reducing sugar, gum, steroids and alkaloids, different parts of the plant have been shown to exhibit antioxidant, antimicrobial, anti-inflammatory and analgesic activities both *in vitro* and *in vivo* (Murshid *et al.*, 2007).

Base on our literature search no previous review on the bioactive phytochemicals in *Senna tora* (L.) Roxb. that have reported the biological activity against oxidants, inflammation, and microbial infection, as well as the food value of the plant in a single write-up. Given this, the present article focused on the previous literature related to phytochemicals of the extract and *in vitro* antioxidant, anti-inflammatory and antimicrobial activities and food value of *Senna tora* (L.) Roxb. This will add to the literature on the plant's food and medicinal properties and provide background information for researchers who wish to carry out more advanced research on the pharmacological aspects as well as the use of the plant as functional food.

Botanical Description of *Senna tora* (L.) Roxb.

Senna tora is a small foetid, herb or undershrub weed species (Figure 1), growing in tropical and subtropical regions. It is a native of southeastern Asia and grows well in Nigeria, Malaysia, Japan, Burma, Bangladesh, India, *etc.* This species has also been referred to as a destructive weed throughout the country (Kabila *et al.*, 2017). The glabrous stem of the spreading plant body has branches on it. The leaves are lanceolate, membranous, linear, or long stipulate. Three pairs of obovate, approximately equal leaflets with pubescent, glabrous surfaces over the whole margin are present. The yellow colored gland is located between the lowermost pair of the leaflets. The inflorescence is an axillary raceme with bright yellow flowers, long-stalked in pairs with a short peduncle, linear bracts and acute pubescent. Ten stamens with three staminodes and seven antheriferous (three huge anthers with a beak at the apex and four with a rounded apex) are present in the five (bright yellow), subequal, oblong, and truncate top petals (Ingle *et al.*, 2012; Dubey & Sawant, 2015).



Figure 1: a) Whole Plant, b) Leaves, c) Seeds of *Senna tora* (Source: Kabila *et al.*, 2022)

Bioactive Compounds in *Senna tora* (L.) Roxb. Leaves

Phytochemicals

Plants produce secondary metabolites, which they use to protect themselves from potential threats and environmental hazards. Since the dawn of human evolution, these metabolites and their derivatives have been useful therapeutic agents and are important in the treatment of a wide range of diseases (Erb and Kliebenstein,



2020). Previous studies on *Senna tora* have revealed the presence of numerous phytochemical compounds from different extracts.

The presence of phenols, flavonoids, tannins, terpenoids, saponins, steroids, cardiac glycosides, alkaloids and reducing sugars were revealed in the ethyl acetate extract of *Senna tora* (L.) Roxb. leaves (Rahman *et al.*, 2023). In another study, using aqueous, ethanol, and hexane extracts, the whole plant, leaves, and seeds of *Senna tora* were subjected to phytochemical screening. In comparison to other extracts, the ethanol extracts of the whole plant, the seeds, and the aqueous extract of the seeds had the highest concentration of phytoconstituents. Carbohydrates were present in all the extracts.

Similarly, cardiac glycosides were also present in all the extracts except whole plant hexane extract. All the extracts, with the exception of hexane contain alkaloids, anthraquinones, coumarins, diterpenoids, flavonoids, phenolics, quinones, reducing sugar, starch and tannins (Kabila *et al.*, 2022).

Alkaloids, phenols, saponins, carbohydrates, glycosides, and protein were found in aqueous, ethyl acetate, and hexane extracts of *Senna tora* leaves and seeds, according to screening results for phytoconstituents (Sabyasachi *et al.*, 2016). Alkaloids, triterpenoids, steroids, and tannins were found in the aerial portions of *S. tora*, according to research done by Rao and Chatterjee (2016). Similarly, Asba and Meeta (2017) investigated various phytoconstituents in the roots, leaves, stem, flowers, and pods of *C. tora* using six different solvents; in comparison to other solvent extracts, most of the phytochemicals were found in the aqueous and methanol extracts. The presence of alkaloids, flavonoids, saponins, tannins, phenols, steroids in ethanol, aqueous and methanol extracts of the leaves was reported by Suradkar *et al.* (2017) and Sahu *et al.* (2017). Phytochemical screening of the seed extract of *Cassia tora* revealed the presence of carbohydrates, glycosides, saponins and triterpenes in petroleum ether, ethanol and aqueous extracts (Roopashree *et al.*, 2008).

Mazumder *et al.*, (2005) reported the presence of alkaloids and tannins in methanol extract, steroid in petroleum ether, and chloroform extracts from the leaves of *C. tora* (Mazumder *et al.*, 2005). The phytoconstituents of *Cassia tora* stem bark were investigated by Das *et al.*, (2011) in five different solvents. The results showed that methanol extract contained the maximum phytochemicals, such as alkaloids, flavonoids, tannins, protein, steroids, and glycosides, followed by diethyl ether and ethyl acetate. *Cassia tora* extracts in ethanol, methanol, and ethyl acetate contain proteins, carbohydrates, steroids, terpenoids, and cardiac glycosides whereas tannins and phlobatannins were only present in methanol and ethanol extracts (Veerachari & Bopaiah, 2012). John *et al.*, (2012) also observed that the *C. tora* leaf extracts in methanol and ethyl acetate contained tannins, anthraquinones, flavonoids, glycosides, and coumarins; however, the methanol extract only revealed steroids, cardiac glycosides, amino acids, and saponins. Alkaloids, anthraquinones, flavonoids, phenolics, and proteins were present in the methanol and aqueous extracts of *C. tora* leaves (Khan *et al.*, 2016). Ethyl acetate and methanol extracts of leaves indicated all the phytoconstituents under study among the leaves, bark, seeds, and pods (containing seeds), however, hexane extract revealed the presence of only steroids (Khatak *et al.*, 2014).

A comparative analysis of the seasonal variation of phenol, tannin and ascorbic acid contents was investigated from leaves, stem, root and seeds of *Senna tora*. The phenol contents revealed that the amount was higher in the leaves (5.740 to 6.408 mg/g dry weight) than in the stem (3.768 to 4.419 mg/g dry weight), root (1.284 to 1.828 mg/g dry weight), and seeds (3.873 mg/g dry weight). In terms of tannin concentrations, the amount was higher in the leaves (0.356 to 0.410 mg/g dry weight) than in the stem (0.300 to 0.356 mg/g dry weight), root (0.112 to 0.156 mg/g dry weight), and seeds (2.940 mg/g dry weight). In addition, ascorbic acid concentrations revealed higher amount in the leaves (range 3.011 to 3.620 mg/g dry weight) than in the stem (range 1.988 to 2.612 mg/g dry wt.), root (range 0.970 to 1.109 mg/g dry weight), and seeds (2.067 mg/g dry weight) (Gaykhe *et al.*, 2018).

Phytochemicals are nutritional or non-nutritional bioactive plant compounds found in fruits, vegetables, cereals, and other plant foods. They may have health advantages in addition to basic nutrition, such as lowering the risk of major chronic diseases (Kumar *et al.*, 2023). Phytochemicals, after extraction from various sources, find profound application in the development of functional foods and nutraceuticals.

Antioxidant Activity

ROS can be produced exogenously or endogenously in living organisms. In order to combat ROS, the external supply of antioxidants either scavenges ROS or stimulates the body's own (enzymatic and nonenzymatic) antioxidative systems. Natural antioxidants produced from medicinal and dietary plants are commonly used as therapeutic agents.

Rahman *et al.*, (2023) concluded that ethyl acetate extract of *Senna tora* (L.) Roxb. leaves scavenges H₂O₂ in a dose-related manner. The DPPH and H₂O₂ scavenging capacity of ethyl acetate extract of *Senna tora* (L.) Roxb. leaves may arise from the phenolics, terpenoids, vitamin C, vitamin E, and carotene (Rahman *et al.*, 2023). Nkwocha *et al.*, (2023) reported that phytochemical analysis of the methanolic fraction of *Cassia tora* leaves indicated the presence of saponins (71,760±943.2µg/ml), terpenoids (47,466.70±46.2µg/ml), tannins (21,253.30±46.2µg/ml), flavonoids (14,682.70±40.3µg/ml), phenols (30,986.70±46.2µg/ml), steroids (13,557.30±24.4µg/ml), alkaloids (9770.67±9.2µg/ml), glycosides (5434.67±139.8µg/ml). The methanolic fraction of *Cassia tora* leaves was found to have antioxidant properties. The higher the fraction's scavenging



power, the lower the standard (ascorbic acid) concentration. In comparison to the standard (ascorbic acid), the fraction had the maximum antioxidant capacity at 6.86mg/ml. The fraction's total antioxidant power varied from 1.78 mg/ml to 16 mg/ml.

Anti-inflammatory Activity

During inflammation, leukocytes discharge lysosomal enzymes, and proteases are part of their protective roles, causing more damage to the tissue (Erflle et al., 1997). Preventing hemolysis of the RBC membrane can provide insight into anti-inflammation because the RBC membrane and the lysosome membrane are identical. The firmness of such a plasma membrane can prevent or postpone cytolysis, preventing the liberation of cytosolic elements and, consequently, preventing tissue injury and the inflammatory reaction. Protein denaturation is one additional reason for inflammation (Oyedapo & Famurewa, 1995). An aid that can inhibit protein damage could be helpful in the treatment of inflammatory disorders. According to Rahman et al. (2023), ethyl acetate extract of *Senna tora* (L.) Roxb. leaves inhibited BSA protein denaturation and RBC lysis, demonstrating concentration-dependent anti-inflammatory action. The findings show that the ethyl acetate extract of *Senna tora* (L.) Roxb. leaves contains esters, phenolics, terpenes, hydrocarbons, ketones, and aldehydes, which may be responsible for this anti-inflammatory activity.

Antimicrobial Activity

The bacterial strains are contagious and have the ability to cause illness. For example, a newborn with sepsis was found to have *B. infantis*, and bacteremia and pneumonia are promoted by *Exiguobacterium* sp (Chen et al., 2017; Ko et al., 2006). According to Guo et al., (2020), *S. aureus* is one of the most common pathogens in humans, aggravating endocarditis, bacteremia, and infections of the soft tissues and respiratory tract. According to Davis et al., (2020), some *Streptococcus* sp. contributes to the pathogenesis of upper respiratory infections, while virulent *E. coli* hastens the development of urinary tract infections and gastroenteritis (Garretto et al., 2020). The enteric pathogen *V. cholerae* produces acute secretory diarrhea by releasing the cholera toxin (Satitsri et al., 2016). *S. typhi* is an MDR-resistant bacterial pathogen that usually causes typhoid and paratyphoid, and it has rapidly gained resistance to previously efficacious drugs, such as ciprofloxacin (Mannan et al., 2014). By impairing the immune systems of afflicted individuals, *P. aeruginosa* can cause serious, potentially fatal infections (Moradali et al., 2017). *H. influenzae* is the main bacterial agent that spreads diseases in the respiratory and sensory systems of the body (Wajima et al., 2016). The antibiotic activity of ethyl acetate extract of *Senna tora* (L.) Roxb. leaves was assessed against these bacteria (Rahman et al., 2023). The presence of bioactive compounds such as phenolics, esters, terpenes, hydrocarbons, aldehydes, and ketones were reported to account for this antibacterial action (Rahman et al., 2023).

Mohhite et al., (2018) evaluated the *in vitro* effect of aqueous leaves extract of *Cassia tora* on *Escherichia coli*, *Staphylococcus aureus*, *Bacillus* spp., *Pseudomonas aeruginosa*. The results demonstrated that *Cassia tora* leaves had antibacterial activity. In a different investigation conducted by Das et al. (2010), it was discovered that the leaves of *Cassia tora* L. exhibited antibacterial activity (0-5000 µg/ml) against 38, 58, and 29 different bacterial strains, respectively, out of 120 total bacterial strains. Additionally, methanol extracts demonstrated antifungal activity (0-64 mg/ml) against three out of four strains. Three *Escherichia coli* bacteria, four *Staphylococcus aureus* strains, and five *Shigella dysenteriae* strains have demonstrated sensitivity to the methanol extracts up to a 2000 µg/ml concentration when treated *in vitro*. For dermatophytes, the minimum inhibitory concentration (MIC) values vary from 2 to 64 mg/ml. Minimal Bactericidal Concentration (MBC) value lies in the range of 2000-2500 µg/ml against *Escherichia coli* ATCC25938 and *Shigella dysenteriae*.

Bhalodia et al., (2011) reported the antibacterial activity of leaf extracts on a range of human diseases. Mukherjee et al. (1996) observed that leaf extract had antifungal activity.

Food Values

Leaves and seeds are edible. While the roasted seeds are used as a substitute coffee (Hanh et al., 2021), young leaves can be cooked as a vegetable. In Sri Lanka the flowers are added to food. It is made into tea; this tea has been referred to as coffee-tea, due to the taste and aroma of coffee (Das et al., 2012). Moreover, the seed gums are used as thickener in foods (Cunningham and Walsh, 2001). Santhal tribes of Odisha state, in India collect the leaves and dry them and cook with pulses (Mety et al., 2024).

Conclusion and Further Research/Future Studies

The review concluded that *Senna tora* (L.) Roxb. contain antioxidant, anti-inflammatory, and antimicrobial activities due to the presence of some biologically active phytochemicals, viz., phenolics, flavonoids, terpenoids, tannins, vitamin C, vitamin E, saponins, steroids, cardiac glycosides, alkaloids. Moreover, the young leaves can be cooked as a vegetable while the roasted seeds are used as a substitute coffee. Thus, the present review has explained the potentiality of *Senna tora* in the pharmaceutical sector and in the development of functional foods.



This species can provide raw materials for the preparation of new or alternate medicine and functional foods. Research gaps in information concerning isolation of these phytochemical compounds with fascinating *in vitro* and *in vivo* pharmacological properties and to assess their safety and bioavailability in *in vivo* animal models to aid in developing drugs against oxidants, inflammation, and microbial infection is warranted.

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ID: 579

Seasonal soil respiration in burned and unburned black pine forests as affected by compound effects of fire types and aspect

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Abstract

Climate change impacts increased occurrences of wildfires worldwide, accelerating the release of large quantities of CO₂ sequestered in the aboveground biomass and forest litter. Mitigating the CO₂ emissions after wildfires requires a detailed understanding of the different components of carbon cycling, particularly soil respiration (Rs) rates, the main pathway through which the stored C in the belowground biomass and soil returns into the atmosphere. Despite much research on Rs, the compound effects of multiple factors affecting Rs remain uncertain. Whether the seasonal Rs in the post-fire areas significantly change as affected by fire intensities and aspects is a critical question that needs to be better understood. This study aims to determine the effects of crown fire, surface fire, aspects, and their combined effects on seasonal Rs rates. We established a field experiment in a three-year-old post-fire black pine (*Pinus nigra* Arnold) forest at the Taskopru Forest Directorate, Türkiye. We measured Rs in a 15-day interval for a year using an automated soil respiration machinery (Li-Cor BioSciences, NE, USA). We also measured the air and soil temperature and moisture contents with the Rs. Results revealed that irrespective of factor combinations, the Rs ranged from 0.41- to 1.19- $\mu\text{mol s}^{-1} \text{m}^{-2}$ in winter, 1.06- to 2.07- $\mu\text{mol s}^{-1} \text{m}^{-2}$ in spring, 2.71- to 3.27- $\mu\text{mol s}^{-1} \text{m}^{-2}$ in summer, and 1.20- to 2.00- $\mu\text{mol s}^{-1} \text{m}^{-2}$ in autumn. The proportional percentages contribution of each season to the total cumulative annual CO₂ emissions were 12.7 %, 23.2 %, 42.7 %, and 21.4 % for the winter, spring, summer, and autumn seasons, respectively. The crown fire exhibited the lowest Rs during winter but the highest during summer. Our study highlights the importance of analyzing multiple factors affecting Rs to increase the accuracy of analyzing the impacts of wildfires on Rs rates.

Keywords: Climate change, wildfire, north-facing slope, south-facing slope, CO₂ emissions



ID: 580

Studies on the Composition and Biological Activity of Bee Pollen from Sivas Province

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Abstract

Bee pollen is an important nutrient for bees, especially for meeting the needs of adult and larval bees in terms of protein, vitamins, and minerals. Since the protein content of pollen meets the essential protein requirements for bees' nutrition, it should be collected in sufficient quantities for the hive and stored under appropriate conditions. Similarly, bee pollen has nourishing and therapeutic properties for human health. Various studies have been conducted in different countries to evaluate the physicochemical properties and determine the physicochemical composition of bee pollen, which is widely used in apitherapy, the pharmaceutical industry, the food industry, and the cosmetics industry. However, it has been observed that bee pollens obtained from hives can differ in terms of physical properties such as color and odor, as well as content profiles such as ash, moisture, cellulose, protein, sugar, carbohydrate, fat, vitamins, and minerals, depending on the climate, and floral structure conditions of the beekeeping region. Additionally, it has been found that the biological activity characteristics of bee pollen, as determined by various in vitro and in vivo studies, can also vary based on its content values. In this study, bee pollen samples were collected from certain districts of Sivas Province. The aim was to investigate the physical characteristics of the pollen samples, such as color properties, and to investigate their chemical contents like cellulose amounts, and their biological activity features, such as antioxidant activity. According to the results of the study, it was determined that bee pollens collected from different districts within Sivas Province showed differences both in terms of content and antioxidant activity.

Key Words: Antioksidant activity, Bee pollen, cellulose amount, Sivas.

Sivas İli Arı Polenlerinin İçerik ve Biyolojik Aktivite İncelemeleri

Özet

Arı poleni, arılar için önemli bir besin maddesidir, özellikle ergin, yaşlı ve larva dönemindeki arıların beslenmesinde protein, vitamin ve mineral madde gibi ihtiyaçlarının karşılanması için kullanılmaktadır. Polen içerisindeki protein oranı ile arıların beslenmesinde temel protein ihtiyacını karşıladığı için kovana yeterli düzeyde alınmalı ve uygun şartlarda depolanmalıdır. Aynı şekilde arı poleni insan sağlığı için besleyici ve terapötik özelliklere sahiptir. Apiterapide, ilaç sanayinde, gıda endüstrisinde, ve kozmetik sanayinde geniş bir kullanıma sahip arı poleninin, fiziksel- kimyasal özelliklerinin değerlendirilmesi, fizikokimyasal kapsamının belirlenmesi konusunda farklı ülkelerde çeşitli çalışmalar yapılmıştır. Ancak arıcılık yapılan bölgenin koşullarına, iklim ve floral yapısına göre, kovanlardan elde edilen arı polenlerinin renk, koku gibi fiziksel özellikleri bakımından ve kül miktarı, nem, selüloz, protein, şeker, karbonhidrat, yağ, vitamin, mineral gibi içerik profilleri bakımından farklılıklar gösterdiği görülmektedir. Ayrıca arı polenlerinin çeşitli in vitro ve in vivo çalışmalardan elde edilen biyolojik aktivite özelliklerinin de taşıdığı içerik değerlerine göre de değişebildiği görülmektedir. Bu çalışma ile, Sivas ilinin bazı ilçelerinden arı poleni örnekleri toplanmıştır. Polen örneklerinin renk özellikleri gibi fiziksel nitelikleri, selüloz miktarı gibi kimyasal içerikleri ve antioksidan etkinlikleri gibi biyolojik aktivite niteliklerinin araştırılması amaçlanmıştır. Çalışma sonuçlarına göre Sivas ili içerisinde farklı ilçelerden toplanan arı polenlerinin gerek içerik ve gerekse antioksidan etkinlikleri bakımından farklılıklar gösterdiği tespit edilmiştir.

Anahtar Kelimeler: Antioksidan aktivite, arı poleni, selüloz miktarı, Sivas.

Introduction

Today, the side effects of chemically produced drugs, the resistance of diseases to drugs and the rapid increase in diseases such as cancer, which are very difficult to treat, have increased people's orientation towards complementary and traditional medicine, including Apitherapy (Sorucu, 2019). In Türkiye, with the adoption of the "Regulation on Traditional and Complementary Medicine Practices" in 2014, Apitherapy courses and centers have started to be established (Sorucu, 2019; Ekici & Gölge, 2021). The desire to meet the food and food



supplements needed to maintain healthy life and well-being from natural and/or organic sources has led to a better understanding of the importance of beekeeping activities and increased interest in beekeeping and apitherapy. Although Turkey ranks first in the world in honey production, it lags behind in the production of other by-products of beekeeping and is not successful enough in their production (Burucu & Gülse Bal, 2017). Honey bees collect pollen from flowers and deposit it in pellets in pollen baskets (corbicula) on their hind legs to feed their young and young bees. Bee pollen is a mixture of these pellets. Honey bees moisten these pellets with their mouth secretions in order to compress them on their hind legs and to hold them together. These oral secretions contain enzymes such as amylase, catalase. The pollen pellets also contain some nectar. The nectar is used to bring the pollen together (Silici, 2020). Protein and amino acids play an important role in bee nutrition and pollen is their only source of protein. Arginine, histidine, lysine, tryptophan, phenylalanine, methionine, threonine, isoleucine and valine, which are essential amino acids that honey bees need for growth and development, are present in pollen. The high quality of pollen increases the resistance of the honey bee against pathogens (Silici, 2020). The chemical, biological and physical properties of bee pollen vary depending on the plants from which it is collected, the soil characteristics and geographical location of the region where it is collected, climatic characteristics, the way it is collected and even its packaging (Silici, 2015; Akyol et al., 2015; Selamoglu et al., 2016).

Bee pollen can be recommended as a healthy and balanced nutrient with its sugar concentrations, essential amino acids, saturated and unsaturated fatty acids, Zn, Cu, Fe and high potassium/sodium ratios. Bee pollen has many biological activities such as antioxidant, anti-aging, antibiotic, antifungal, probiotic, anticarcinogenic, etc. depending on the source of collection (Sorucu, 2019; Dogan et al., 2014; Selamoglu et al., 2016). According to current literature, it has been determined that pollen eliminates the damaging effects of free radicals and some substances known to be carcinogenic with oxidant properties in the cell. It has also been shown that various pollen samples have antimicrobial, cell regenerating, appetite-enhancing effects and support the treatment of colds, osteoporosis, headaches and ulcers (Karlıdağ & Keskin, 2020; Hegazi, 2012). In clinical studies, it has been observed that it has the effect of regulating the functions of the intestines (Hegazi, 2012). It has also been found that pollen supplements used regularly contribute to the normalization of cholesterol and triglyceride levels in the blood (Hegazi, 2012; Aydın & Tekeoğlu, 2018). It has also been observed that bee pollen is effective in skin smoothing, moisturizing, spot removal, removal of wrinkles around the eyes and melanin index (Silici, 2020).

Material and Method

Collection of Pollen Samples

Bee pollen samples were taken from beekeepers in Yıldızeli, Zara, Gürün, Divriği, Doğanşar, Hafik/Tozanlı and Merkez districts of Sivas province during the 2022 harvest period. The samples were brought to the laboratory and analyzed by taking the samples in appropriate storage environments.

Physical Evaluation of Pollen Samples

The physical properties of pollen such as shape and color vary according to the plant species from which they are collected (Özkök, 2018). The physical appearance and morphological shapes of pollen samples were examined under a microscope and photographs were taken.

Determination of Cellulose

Weigh approximately 1.0 g of pollen sample into a 250 mL beaker. Add 100 mL of 1.25% sulfuric acid solution and heat. After boiling, add 2-3 drops of antifoaming agent (silicone, amylalcohol, etc.) and boil for 30 minutes. To keep the volume constant during boiling, the beaker is covered with a cooling device (such as a 500 mm round bottomed balloon with cold water circulating in it) or a watch glass. After the end of the time, add 10 mL of 28% potassium hydroxide solution and boil for another 30 minutes. On the other side, a glass strainer is filled with quartz sand to a height of 8 - 10 mm. Before straining, the quartz sand is thoroughly moistened with hot distilled water and sucked with a water trumpet or vacuum pump to form a tight layer of quartz sand. The boiled sample is filtered hot through a prepared glass strainer. During the filtration process, raw cellulose particles may cause clogging. To prevent this, the vacuum is broken and the quartz sand layer is gently stirred with a glass baguette. The residue on the quartz sand layer is filtered twice with hot pure water, 10 mL of 1% sulfuric acid solution, hot pure water again, then 10 mL of 1% sodium hydroxide solution, hot pure water again and 10 mL of 1% sulfuric acid solution, and finally hot pure water twice more. Finally, it is washed again with acetone. During the different washing processes, the vacuum must be interrupted so that the crude cellulose residue can be well moisturized (Figure 1). After washing and filtering, the residue in the glass filter is dried in a drying cabinet at 130 °C for 1 hour. After cooling in a desiccator, it is weighed. The weighed glass strainer is placed in the incinerator and burned at 550 °C - 600 °C for 30 minutes and weighed. Cooled in a desiccator and weighed.





Figure 1. Device used in cellulose determination

Antioxidant Activity Determination

Antioxidant, oxidant levels and oxidative stress indices of the isolates were determined using commercially available Rel Assay diagnostic kits with an accuracy rate of 99.9%. Total antioxidant status (TAS), total oxidant status (TOS) and oxidative stress index (OSI) of the extracts obtained by different methods were evaluated with commercially available Rel Assay Diagnostic kits. (Erel, 2004; 2005). Trolox and hydrogen peroxide standard were used as reference for TAS and TOS analysis. In TAS analysis method, the change in absorbance at 660 nm depends on the total amount of antioxidants. Antioxidants in the sample reduce the dark blue-green ABTS radical to the colorless reduced ABTS form. The change in absorbance at 660 nm is related to the total antioxidant level of the sample. Fully automatic colorimetric measurement method is also used in TOS analysis method. Oxidants present in the reaction oxidize the iron ion to the iron ion-o-dianisidine complex. Oxidants present in the sample oxidize the ferrous ion-chelator complex to ferrous ion. Oxidative Stress Index (OSI) is found by proportioning the values obtained from TAS and TOS analysis. As a matter of fact, there is a net oxidative stress capacity obtained depending on the total antioxidant capacity (TAS) and total oxidant capacity (TOS) provided by the plant extract.

Result and Discussion

According to the Pollen Communiqué of Turkish Standards Institute, pollen should have a distinctive color, smell and flavor. The shapes of pollen can vary greatly. When examined visually, they can be morphologically wrinkled, thorn-like protruding, oily, shiny, and sticky in appearance. The size of the pollen grains depends on the source plants from which the bee collects pollen, but generally the diameter should be between 10 μm - 100 μm . The diameter of the pollen pellets collected by the bee should be between 1 mm and 4 mm (Özkök & Sorkun, 2021; Demirci & Durna Daştan, 2022). They are generally roundish and can range in size from a minimum of 6 μm to a maximum of 300 μm (Knox, 1979). In terms of color, pollen can be in various colors and shades such as yellow, black, purple, blue, green, red (Figure 2). Below are photos of the bee pollen we collected (Figure 2).



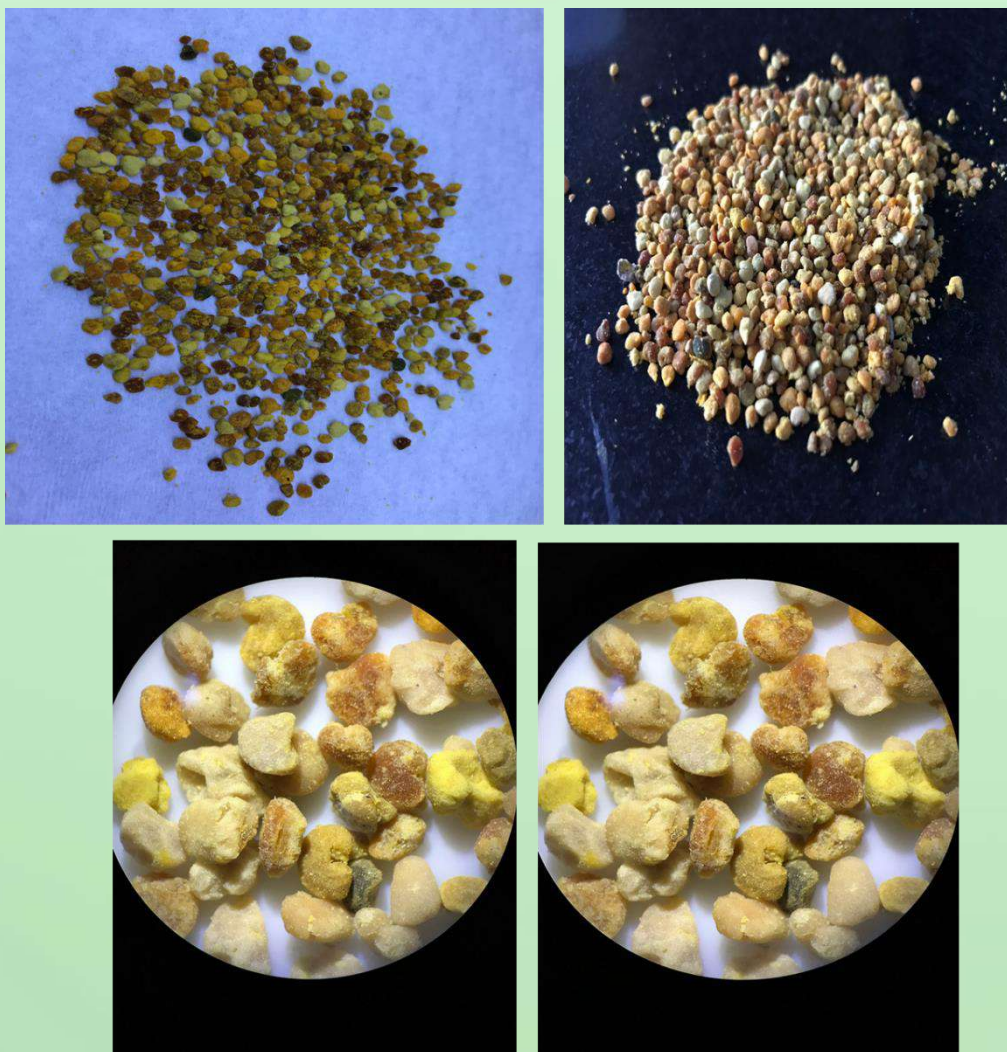


Figure 2. Photographs of some pollen samples collected

Bee pollen has been reported to be a very good source of antioxidants due to its bioactive components (Tutun et al, 2021). It has been stated that the main antioxidant components in bee pollen are carotenoids and phenolic compounds, and vitamins A, C and E in its structure also contribute as antioxidants (Asmae et al, 2021; Eşerler et al., 2023; Koçyiğit, 2021). The TAS and TOS values obtained for the determination of antioxidant and oxidant levels of pollen and the oxidative stress index (OSI) values obtained by proportioning these values to each other are given in Table 1.

Table 1. TAS, TOS and OSI values of pollen extracts (Values given as Mean $\pm$ SD).

Pollen sample	Extracts	TAS (mmol/L)	TOS(μ mol/L)	OSI
Yıldızeli	water extract	5.0 $\pm$ 1.0	2.1 $\pm$ 0.4	0.04 $\pm$ 0.01
	ethanol extract	9.2 $\pm$ 2.0	2.6 $\pm$ 0.5	0.03 $\pm$ 0.01
Zara	water extract	6.6 $\pm$ 1.3	2.5 $\pm$ 0.6	0.04 $\pm$ 0.02
	ethanol extract	9.6 $\pm$ 1.5	2.1 $\pm$ 0.5	0.02 $\pm$ 0.01
Gürün	water extract	4.0 $\pm$ 1.1	2.7 $\pm$ 0.3	0.07 $\pm$ 0.01
	ethanol extract	10.2 $\pm$ 2.2	2.9 $\pm$ 0.4	0.03 $\pm$ 0.01
Divriği	water extract	6.9 $\pm$ 1.5	2.5 $\pm$ 0.5	0.04 $\pm$ 0.02
	ethanol extract	10.8 $\pm$ 1.4	3.1 $\pm$ 0.7	0.03 $\pm$ 0.01
Hafik-Tozanlı	water extract	7.5 $\pm$ 1.7	4.5 $\pm$ 0.7	0.06 $\pm$ 0.02
	ethanol extract	11.4 $\pm$ 1.6	4.1 $\pm$ 0.6	0.04 $\pm$ 0.01
City Center	water extract	7.3 $\pm$ 1.1	4.9 $\pm$ 0.7	0.07 $\pm$ 0.03
	ethanol extract	9.3 $\pm$ 1.0	5.7 $\pm$ 0.8	0.06 $\pm$ 0.02



The highest total antioxidant activity was obtained from the ethanol extract of pollen collected from Hafik region. In terms of antioxidant content, ethanol extracts generally showed higher activity. TOS values were very close to each other in all regions. In terms of OSI values indicating the oxidative stress load in pollen extracts, it is seen that pollen extracts collected from all regions have very similar values (Table 1). It has also been reported that bee pollen contains approximately 3.72% crude cellulose (Anđelković et al., 2012; Eşerler et al., 2023). According to TS 10255 Pollen Standard, the crude cellulose content in pollen should be above 0.9% (Anonim 2006; Eşerler et al., 2023). In this study, cellulose contents of bee pollen collected from different regions are given in the Table 2.

Table 2. Pollen cellulose contents

Pollen sample	Cellulose quantity
Yıldızeli	1.8%
Zara	1.6%
Gürün	2.0%
Divriği	2.2%
Hafik-Tozanlı	2.7%
City Center	2.4%

Conclusion

Standardization of bee products on international and national platforms is ongoing. Legislative work on bee pollen is also in progress and TSE standard no. 102551 is used to determine quality criteria (Özkök & Sorkun, 2021). Pollen with clearly defined properties such as total moisture content, total protein, total carbohydrates, etc. should be preferred by consumers and pollen with clearly defined content and quality criteria should be used by experts, especially in Apitherapy applications.

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ID: 583

Type Traits of Primiparous Holstein-Friesian and Red-Holstein Cows Raised Together in a Farm in Aydın Province

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Abstract

The aim of this study was to compare the type traits of Holstein-Friesian (HF) and Red-Holstein (RH) cows that are in their first lactation and reared mixed in a private farm in Aydın province, Türkiye. In this study, 120 heads composed of HF and RH primiparous cows were used and the effects of breed, calving year (2023 and 2024) and calving age (<26 mo and 26 mo $\leq$) on type traits were also investigated. Five non-linear 100 score traits and 18 linear type traits were measured. The effect of breed on Chest Width (CW; $P<0.01$), Rump Angle ($P<0.05$), Body Condition Score ($P<0.01$), Rear Legs Set Angle (RLA; $P<0.01$), Rear Legs Knee Structure ($P<0.05$), Rear Udder Width ($P<0.01$), Udder Depth (UD; $P<0.01$), Central Ligament ($P<0.05$), Rear Udder Height ($P<0.01$), Fore Teat Length ($P<0.05$) and Mammary Acuity ($P<0.01$) were found statistically significant and the overall mean scores for these traits were 5.32 ± 0.13 , 6.97 ± 0.17 , 4.83 ± 0.09 , 4.87 ± 0.08 , 5.04 ± 0.09 , 5.74 ± 0.09 , 4.73 ± 0.04 , 5.37 ± 0.08 , 8.35 ± 0.08 , 5.38 ± 0.08 and 7.32 ± 0.17 , respectively. Also, the effect of calving year on Body Depth ($P<0.01$), UD ($P<0.05$) and Rear Teat Placement ($P<0.05$) and the effect of calving age on CW ($P<0.05$), RLA ($P<0.05$) and Rear Teat Placement ($P<0.05$) were found statistically significant. For non-linear 100 scores, the breed effects on Dairy Strength (DS; $P<0.01$), Foot & Legs (FL; $P<0.05$), Udder ($P<0.01$) and Total Score (TS; $P<0.01$) were significant and the means were 82.30 ± 0.17 , 83.12 ± 0.15 , 81.63 ± 0.11 , 83.98 ± 0.09 and 83.03 ± 0.07 , respectively. As result, the significant breed effect found in some type traits shows that HF and RH genotypes, which differ only in color genes, have been considered and reared as different breeds since the 1950s, causing significant differences in some type traits of these two genotypes.

Key Words: Dairy cattle, Linear type traits, Body condition score, Udder depth, Mammary acuity

Aydın İlinde Bir İşletmede Birlikte Yetiştirilen İlk Laktasyondaki Siyah-Alaca ve Kırmızı-Alaca Sığırların Dış Görünüş Özellikleri

Özet

Bu çalışmada ilk laktasyondaki SA ve KA ırklardan oluşan toplam 120 baş inek kullanılmış olup, ırk, buzağılama yılı (2023 ve 2024) ve buzağılama yaşının (<26 ay ve 26 ay $\leq$) dış görünüş özellikleri üzerine etkileri araştırılmıştır. Tip özelliklerinin değerlendirmesinde doğrusal (lineer; DTÖ; 1-9 puan) ve doğrusal olmayan (100 puan) olmak üzere iki yöntem kullanılmıştır. Yüz puan sisteminde 5 özellik, doğrusal tip özelliklerinde ise 18 özellik değerlendirilmiştir. Göğüs Genişliği (GG; $P<0.01$), Sağrı Eğimi ($P<0.05$), Vücut Kondisyon Puanı ($P<0.01$), Arka Bacak Açısı ($P<0.01$), Arka Bacak Duruşu (ABD; $P<0.05$), Arka Meme Genişliği ($P<0.01$), Meme Taban Yüksekliği (MTY; $P<0.01$), Meme Merkez Bağı ($P<0.05$), Arka Meme Yüksekliği (AMY; $P<0.01$), Ön Meme Başı Uzunluğu ($P<0.05$) ve Meme Arılığı ($P<0.01$) üzerine ırk etkisi önemli bulunmuş, bu özelliklerin genel ortalaması sırasıyla 5.32 ± 0.13 , 6.97 ± 0.17 , 4.83 ± 0.09 , 4.87 ± 0.08 , 5.04 ± 0.09 , 5.74 ± 0.09 , 4.73 ± 0.04 , 5.37 ± 0.08 , 8.35 ± 0.08 , 5.38 ± 0.08 ve 7.32 ± 0.17 dir. Ayrıca, buzağılama yılının Beden Derinliği ($P<0.01$), AMY ($P<0.05$) ve Arka Meme Başı Yerleşimi (AMBY; $P<0.05$) üzerine, ilkinde buzağılama yaşının da GG ($P<0.05$), ABD ($P<0.05$) ve AMBY ($P<0.05$) üzerine etkisi önemlidir. Buzağılama yılı etkisi Beden Derinliği ($P<0.01$), MTY ($P<0.05$) ve Arka Meme Başı Yerleşimi ($P<0.05$), buzağılama yaşı etkisi da GG ($P<0.05$), ABD ($P<0.05$), Arka Meme Başı Yerleşimi ($P<0.05$) için önemlidir. Doğrusal olmayan 100 puan özellikleri için ise ırk etkisi Süt Tipi ($P<0.01$), Ayak & Bacak (AB; $P<0.01$), Meme ($P<0.01$) ve Toplam Puan (TP; $P<0.01$) için önemli bulunmuş ve bu özelliklerin ortalaması ise sırasıyla 82.30 ± 0.17 , 83.12 ± 0.15 , 81.63 ± 0.11 , 83.98 ± 0.09 ve 83.03 ± 0.07 dir. Sonuç olarak bazı dış görünüş özelliklerinde ırk etkisinin önemli bulunması, sadece renk genleri farklı olan SA ve KA genotiplerinin 1950'li yıllardan itibaren farklı ırk olarak yetiştirilmelerinin bazı tip özelliklerinde de önemli farklılıklara yol açtığını göstermektedir.

Anahtar Kelimeler: Süt sığırı, Doğrusal tip özellikleri, Vücut kondisyon puanı, Meme taban yüksekliği, Meme arılığı



ID: 508

Innovative Approach in Cracker Formulation: Fortification with Cherry Laurel (*Laurocerasus officinalis*) Seed Powder

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Abstract

Cherry laurel, cultivated in the Black Sea Region, is a popular fruit with nutritional value and is a good source of antioxidants that can be used in food and food supplement formulations. In Turkey, the fruits, leaves and seeds of cherry laurel are widely used as a folk remedy for stomach and digestive system disorders, bronchitis, skin disorders and hemorrhoids. In this study, the powder of conical hard seeds of cherry laurel (*Laurocerasus officinalis*) was substituted for wheat flour at 0, 10 and 20% in the formulation of cracker production. Cracker samples were evaluated for physical (color properties, diameter, thickness and spreading rate) and textural (hardness and fracturability) characteristics. A lower L^* (brightness) value and a higher a^* (redness) value were found in the crackers containing 20% cherry laurel seed powder compared to other crackers. Control crackers showed the lowest b^* (20.99) value. The saturation index and hue angle values of crackers with increased seed powder ranged from 21.04 and 94.31 to 25.90 and 75.37, respectively. Crackers with seed powder showed better qualitative properties compared to the control sample. While the thickness value of the control sample was 3.65, this value was determined as 3.20 with the use of 20% powder. Increasing the substitution rate decreased the thickness value of the crackers. The hardness value of crackers varied from 1474.16 to 2165.29. Cherry laurel seed powder decreased the hardness value of crackers. High substitution levels of seed powder increased the fracturability value of the samples. This value was determined as 16.54 in the control sample and 18.98 in the sample with 20% seed powder substitution. The addition of 10% seed powder increased the general acceptance of the crackers. The findings indicated that cherry laurel seed powder can be used as a functional ingredient in cracker formulations.

Key Words: Cherry laurel, cracker, seed powder, sensorial properties, quality properties

Kraker Formülasyonunda Yenilikçi Yaklaşım: Karayemiş (*Laurocerasus officinalis*) Çekirdek Tozu ile Zenginleştirme

Özet

Karadeniz Bölgesi'nde yetiştirilen karayemiş meyvesi, besin değeri yüksek olan, gıda ve gıda takviyesi formülasyonlarında kullanılabilen iyi bir antioksidan kaynağıdır. Türkiye'de karayemiş meyvesi, yaprakları ve tohumları mide ve sindirim sistemi rahatsızlıkları, bronşit, cilt rahatsızlıkları ve hemoroid gibi rahatsızlıklar için halk ilacı olarak yaygın bir şekilde kullanılmaktadır. Bu çalışmada, karayemiş (*Laurocerasus officinalis*) çekirdek tozu, kraker üretimi formülasyonunda buğday unu yerine %0, 10 ve 20 oranlarında ikame edilmiştir. Kraker örnekleri fiziksel (renk özellikleri, çap, kalınlık ve yayılma oranı) ve tekstürel (sertlik ve kırılabilirlik) özellikler açısından değerlendirilmiştir. %20'lik karayemiş çekirdeği tozu içeren krakerlerde diğer krakerlere kıyasla daha düşük L^* (parlaklık) değeri ve daha yüksek a^* (kırmızılık) değeri bulunmuştur. Kontrol krakerleri en düşük b^* (20.99) değerini göstermiştir. Artan ikame oranıyla krakerlerin doygunluk indeksi ve renk açısı değerleri sırasıyla 21.04 ve 94.31 ile 25.90 ve 75.37 arasında değişmiştir. Çekirdek tozu içeren krakerler kontrol örneğine kıyasla daha iyi kalitatif özellikler göstermiştir. Kontrol örneğinin kalınlık değeri 3.65 iken, %20 toz kullanımı ile bu değer 3.20 olarak belirlenmiştir. İkame oranının artması krakerlerin kalınlık değerini düşürmüştür. Krakerlerin sertlik değeri 1474.16 ile 2165.29 arasında değişmiştir. Karayemiş çekirdek tozu krakerlerin sertlik değerini düşürmüştür. Çekirdek tozunun yüksek ikame seviyeleri örneklerin kırılabilirlik değerini artırmıştır. Bu değer kontrol numunesinde 16.54, %20 tohum tozu ikameli numunede ise 18.98 olarak tespit edilmiştir. %10 çekirdek tozu ilavesi krakerlerin genel kabulünü artırmıştır. Bulgular, karayemiş çekirdek tozunun kraker formülasyonlarında fonksiyonel bir bileşen olarak kullanılabileceğini göstermiştir.

Anahtar Kelimeler: Karayemiş, kraker, çekirdek tozu, duyuşal özellik, kalite özelliği



Giriş

Karayemiş (*Laurocerasus officinalis*) Roseaceae ailesine ait, dört mevsim yaprak dökmeyen bir ağaçtır. Karayemiş ağaçları genel olarak Doğu Karadeniz Bölgesi'nde yetişmektedir. Aynı zamanda bu ağaçlar Doğu Marmara ve bazı Akdeniz ülkelerinde, Balkanlar, İran, Kuzey İrlanda Batı Avrupa, Güney ve Batı Kafkasya gibi bölgelerde de yetişmektedir (Ayaz et al., 1997; Kolaylı et al., 2003; Karataş & Uçar, 2018). Karayemiş meyvesi, güneşli, ılıman, nemli iklim bölgelerinde, killi-kumlu, humuslu ve nemli topraklarda büyümektedir (İslam, 2005; Karataş & Uçar, 2018). Şekil 1'de görüldüğü gibi Karayemiş ağacının meyvesi 8-20 mm çapında, oval, koyu mor ve olgunlaştığında siyahtır (İslam, 2002). Renk ve şeklinden dolayı kiraz meyvesine benzetilmektedir. Yabani türleri buruk bir tada sahip olduğundan tüketici tarafından pek tercih edilmemektedir. Fakat, ekimi yapılmış ve aşılınmış türleri iri ve tatlı olduğundan daha fazla tüketilmektedir (Ayaz et al., 1997; Kolaylı et al., 2003). Karayemiş ağacı, ortalama 6 m'ye kadar uzayabilmekte, yaprakları koyu yeşil, ince ve 16.3 cm uzunluğundadır (İslam, 2012).

Karayemiş, besin değeri yüksek olan, yapısında mineral maddeler, organik asitler ve değerli yağ asitlerini barındıran bir meyvedir (Tablo 1) (Karahalil & Şahin, 2011; Karataş & Uçar, 2018). Karayemiş meyvesini değerli kılan en önemli etkenlerin başında içerdiği fenolik bileşikler ve bu bileşiklerin antioksidatif kapasitesi gelmektedir (Vahapoğlu et al., 2018). Karayemiş meyvesinin sindirimi kolaydır. Meyvenin reçel, tuzlaması, turşusu, pekmezi yapılmakta veya taze, kurutularak ve kavrularak tüketilmektedir. Karayemiş meyveleri, pasta, kek, hoşaf ve kompostolara koku ve tat kazandırmak için kullanılmaktadır. Tokluk hissi verdiğinden diyet gıda maddesi olarak da kullanılmaktadır (İslam, 2002; Çalışır & Aydın, 2004; Karataş & Uçar, 2018).

Karayemiş'in yağ aside bileşiminde palmitik asit (C16:0), stearik asit (C18:0), oleik asit (C18:1) ve linoleik asit (C18:2) yer almaktadır. Yapılan çalışmalarda bu yağ asitlerinden miktarda en yüksek olanın %48 ile linoleik asit olduğu bildirilmiştir (Ayaz et al., 1997; Karataş & Uçar, 2018). %18.3 oranında yağ içeriğine sahip karayemiş çekirdeğinde baskın yağ aside oleik asittir. Aynı zamanda çekirdekte palmitik asit, linoleik asit, tokoferol ve sitosterol da bulunmaktadır (Özgül Yücel, 2005; Alaşalvar et al., 2006; Karataş & Uçar, 2018).



Şekil 1. Karayemiş Meyvesi

Tablo 1. Karayemiş Meyvesinin Besin Bileşimi

Besin Bileşimi	Miktar	Besin Bileşimi	Miktar
Enerji (kkal)	75	P (mg)	21
Su (g)	79,85	Na (mg)	3
Protein (g)	1,40	Mg (mg)	24
Yağ (g)	0,54	Ca (mg)	45
Karbonhidrat (g)	14,72	Zn (mg)	0,26
Glikoz (g)	5,09	C vitamini (mg)	2,3
Fruktoz (g)	6,36	A vitamini (RE)	2
Lif (toplam)	2,81	B karoten (mcg)	19
Fe (mg)	0,55	Lutein (mcg)	29



Günümüzde, insan beslenmesinde önemli bir yere sahip olan tahıl ürünlerinin fonksiyonel açıdan geliştirilmesi yönünde çalışmalar dikkat çekmektedir. Çünkü fonksiyonel ürün ve sağlık arasında kurulan ilişki her geçen gün artmaktadır. Fonksiyonel gıdalar beslenme şeklinde sağladığı iyileşmeye ek olarak fiziksel ve ruhsal sağlık üzerinde de pozitif etkiler yaratmaktadır. Gıdaların görünümü ve duyuşsal özellikleri tüketici için en önemli özelliklerdendir. Bu nedenle fonksiyonel gıdaların geliştirilmesinde renk, tekstür, tat, ve ağız hissi gibi özellikler önem arz etmektedir (Menrad, 2003; Day et al., 2009; Konak et al., 2015).

Fonksiyonel gıdalar neredeyse tüm gıda pazarlarında geliştirilmiş olmasına rağmen temel olarak bebek maması, şekerleme, içecekler, süt ürünleri ve fırıncılık pazarlarında piyasaya sürülmüştür (Konak et al., 2015). Çalışmamızda, her yaştan insan tarafından sevilerek tüketilen, pratik bir atıştırmalık olan krakerin karayemiş meyvesi çekirdek tozu ile zenginleştirilerek fizikokimyasal ve duyuşsal özellikleri üzerindeki etkilerinin belirlenmesi hedeflenmiştir.

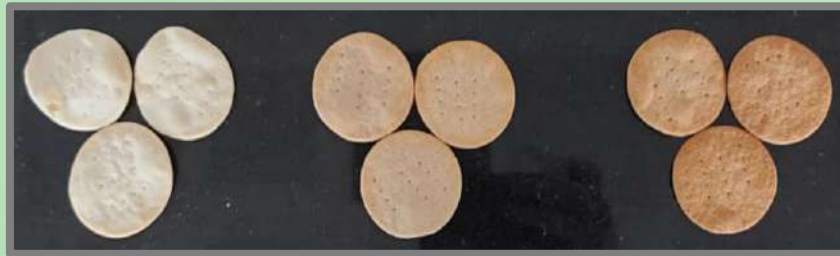
Materyal ve Yöntem

Materyal

Buğday unu, şortening, pudra şekeri, tuz, kabartma tozu ve maya yerel bir marketten satın alınmıştır (Konya, Türkiye). Karayemiş meyvesi Trabzon, Türkiye'den yerel bir üreticiden satın alınarak çekirdekleri ayıklanmış, 50°C'de 24 saat boyunca etüvde kurutulup öğütülmesi ile elde edilmiştir. Öğütülen çekirdek tozu 1 mm' lik elekten geçirilerek kraker üretiminde kullanılmıştır.

Yöntem

Kontrol kraker örneği için; 100 g buğday unu, 20 g şortening, 1.6 g tuz, 1.5 g pudra şekeri, 1.5 g kabartma tozu ve 0.2 g maya yoğurma makinasında (Hobart N50, Offenburg, Germany) karıştırılmıştır. Hamur 30°C sıcaklıkta, %75-80 bağıl nemde 20 dakika boyunca fermentasyona tabi tutulmuştur (Fimak FMD16, Konya, Turkey). Hamur, iki cam levha arasında 1 mm kalınlığında açılarak 50 mm çapındaki bisküvi kalıbıyla şekillendirilmiştir. Kraker hamuru 180°C'de 11 dakika boyunca fırında (Fimak Rokon Classic FRN10G, Konya, Turkey) pişirilmiştir. Diğer kraker örnekleri buğday ununun %10 ve %20 karayemiş çekirdek tozuyla ikame edilmesiyle üretilmiştir. Kraker örnekleri Şekil 2'de gösterilmektedir.



Şekil 2. Karayemiş Çekirdek Tozu İkameli Kraker Örnekleri

Bulgular ve Tartışma

Bu çalışmada, karayemiş (*Laurocerasus officinalis*) çekirdek tozu, kraker formülasyonunda buğday unu yerine %0, 10 ve 20 oranlarında ikame edilmiştir. Kraker örnekleri fiziksel (renk özellikleri, çap, kalınlık ve yayılma oranı) ve tekstürel (sertlik ve kırılabilirlik) özellikler açısından değerlendirilmiştir.

Tablo 2. Karayemiş çekirdeği tozu ikameli krakerlerin renk değerleri^{1,2}

İkame Maddesi	İkame Oranı (%)	L*	a*	b*	SI	Hue angle
	0		-			
Karayemiş çekirdek tozu	0	80.87±1.08a	1.58±0.01c	20.99±0.54b	21.04±0.54b	94.31±0.07a
	10	68.07±0.66b	4.24±0.04b	24.96±0.25a	25.31±0.25a	80.36±0.00b
	20	60.98±1.00c	6.55±0.33a	25.06±1.07a	25.90±1.12a	75.37±0.11c

¹Aynı harfle işaretlenen ortalamalar istatistiksel olarak birbirinden farklı değildir (p<0.05).

²Ortalamaların karşılaştırılmasında Tukey HSD testi kullanılmıştır.



Tablo 2 incelendiğinde %20'lik karayemiş çekirdeği tozu içeren krakerlerde diğer krakerlere kıyasla daha düşük L^* (parlaklık) değeri ve daha yüksek a^* (kırmızılık) değerinin tespit edildiği görülmüştür. Kontrol krakerleri en düşük b^* (20.99) değerini göstermiştir. Karayemiş çekirdek tozu ilavesinin artmasıyla birlikte krakerlerin renklerinin koyulaştığı görülmektedir. Artan ikame oranıyla krakerlerin doygunluk indeksi ve renk açısı değerleri sırasıyla 21.04 ve 94.31 ile 25.90 ve 75.37 arasında değişmiştir. Karayemiş çekirdek tozu içeren krakerler kontrol örneğine kıyasla parlaklık değerlerinin düşmesine yol açsa da daha iyi renk özellikleri göstermiştir.

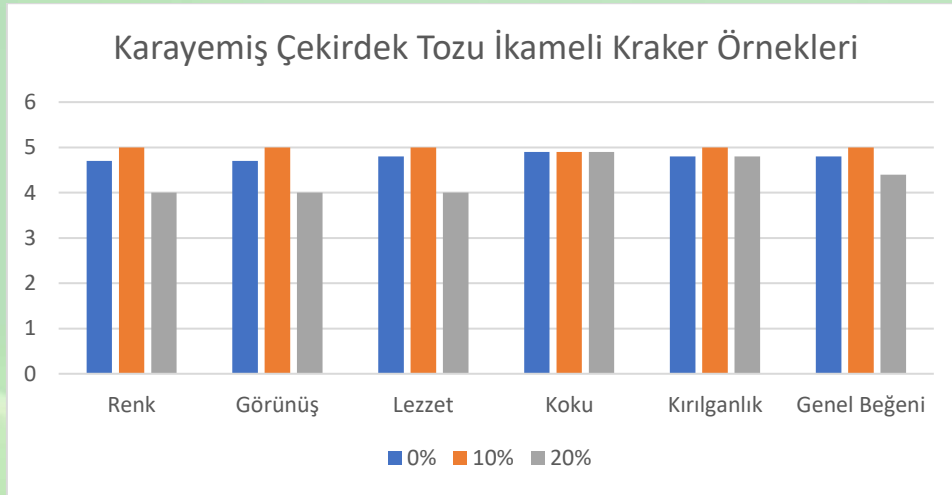
Tablo 3. Karayemiş çekirdek tozu ikameli krakerlerin fiziksel ve tekstürel özellikleri ^{1,2}

İkame Maddesi	İkame Oranı (%)	Çap (mm)	Kalınlık (mm)	Yayılma oranı	Sertlik (g)	Kırılabilirlik (mm)
Karayemiş çekirdek tozu	0	48.05±0.35a	3.65±0.21a	13.19±0.86a	2165.29±171.32a	16.54±0.70b
	10	47.95±1.20a	3.20±0.14a	14.99±0.29a	1475.04±441.91a	18.18±0.22ab
	20	48.00±0.99a	3.10±0.14a	15.49±0.39a	1474.16±474.26a	18.98±0.25a

¹Aynı harfle işaretlenen ortalamalar istatistiksel olarak birbirinden farklı değildir ($p < 0.05$).

²Ortalamaların karşılaştırılmasında Tukey HSD testi kullanılmıştır.

Tablo 3'e göre çekirdek tozu içeren krakerler kontrol örneğine kıyasla daha iyi kalitatif özellikler göstermiştir. Çap, kalınlık, yayılma oranı ve sertlik değerleri üzerinde istatistik olarak bir farklılık gözlenmemiştir ($p > 0.05$). Kontrol örneğinin kalınlık değeri 3.65 iken, %20 toz kullanımı ile bu değer 3.20 olarak belirlenmiştir. İkame oranının artması krakerlerin kalınlık değeri deskriptif olarak düşmüştür. Krakerlerin sertlik değeri 1474.16 ile 2165.29 arasında değişmiştir. Karayemiş çekirdek tozu krakerlerin sertlik değerini deskriptif olarak düşürmüştür. Çekirdek tozunun yüksek ikame seviyeleri örneklerin kırılabilirlik değerini artırmış, daha kırılğan kraker örnekleri elde edilmiştir.



Şekil 3. Krakerlerin Duyusal Analiz Sonuçları

Şekil 3'e göre %10 ikameli kraker örnekleri genel beğenirlik açısından en yüksek skoru almıştır. %20 ikame oranı, kontrol ve %10 çekirdek tozu içeren kraker örneklerine göre daha düşük genel beğeni skoru almıştır. İkame oranının artmasıyla genel beğenin düşmesi çekirdekte bulunan glikozitlerden kaynaklı acı tat varlığından kaynaklandığı düşünülmektedir.

Konak et al. (2015), karayemiş meyvesinin kek ve kurabiyelerin fiziksel, tekstürel ve fonksiyonel özellikleri üzerine etkisini incelemiştir. Çalışmada kurutulup öğütülmüş karayemiş farklı oranlarda kek (%0, 10, 20, 40) ve kurabiye (%0, 5, 10, 20) formülasyonlarına dahil edilmiştir. Çalışma sonucunda artan ikame oranının kekleri sertleştirdiği, kurabiyeyi ise yumuşattığı belirtilmiştir. %40 meyve içeren keklerin kontrol örneğine kıyasla elastikiyetinin azaldığı tespit edilmiştir. Duyusal analiz sonuçlarına göre yüksek ikameli ürünlerinde panelistler tarafından daha çok beğenildiği belirtilmiştir.



Tarakçı et al. (2013), karayemiş pulpunu tarhanaya ilave etmiştir. Çalışmada tarhananın fizikokimyasal, fonksiyonel ve duyuşal özellikleri değerlendirilmiştir. Tarhana örnekleri %0, 5, 10, 15 ve 20 oranlarında karayemiş pulpu içerecek şekilde üretilmiştir. Duyusal analizde en kabul edilebilir skorları %5 ve %10 karayemiş pulpu içeren örneklerin aldığı ifade edilmiştir.

Sonuçlar

Geçmişten günümüze karayemişin meyve ve tohumları mide ülseri, egzama, şeker hastalığı, hemoroid ve bronşit tedavisinde sıklıkla tercih edilmektedir. Aynı zamanda karayemiş içerik özellikleri ile değerli bir gıda ürünü olarak bilinmektedir. Meyve, tohum ve yaprakları başta gıda formülasyonlarında yenilikçi bir ürün olarak kullanılmasının yanı sıra eczacılık, çiçekçilik gibi farklı alanlarda da kullanım imkanı bulunmaktadır.

Sonuç olarak, karayemiş çekirdek tozunun kraker formülasyonunda kullanımının ürünün hem kalite özellikleri hem teknolojik özelliklerini olumlu yönde etkilemiştir. Çekirdek tozu kullanımı, krakerlerin duyuşal özelliklerine belirgin bir şekilde katkıda bulunarak lezzet bakımından farklı bir aroma kazandırmıştır. Bu çalışmada karayemiş çekirdeğinden elde edilen çekirdek tozunun, gıdanın fonksiyonel olarak zenginleştirilmesinde etkili bir bileşen olarak kullanılabileceği kanısına varılmıştır.

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