

Study of Some Biozootechnical and Hereditary Characteristics of Black-and-White Dairy Cattle

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Abstract

The article investigates certain biozootechnical and hereditary characteristics of Azerbaijani Black-and-White cattle. The research was conducted on Black-and-White cattle raised in private farms located in the Samukh and Shamkir districts. **Problem and objective:** The study focuses on important productive and biological traits of this breed, particularly the relationship between live body weight and milk productivity. Another characteristic feature is the high milking rate during machine milking, expressed as milk yield per minute, which is of practical importance in dairy production systems. **Methods:** Through long-term selection, a reduction in calf birth weight has been achieved, which has helped to prevent difficult calving in the population. Under Azerbaijani conditions, animals of this breed reach approximately 340 kg live weight at 18–20 months of age, attain sexual maturity, and are inseminated. By 29–30 months of age, they enter the production cycle, allowing them to calve twice. Their service period and dry period remain within acceptable zootechnical standards. The average calving interval is 352 days, which ensures the production of approximately one calf per year under normal management conditions. **Result:** Research findings indicate that an increase in live body weight does not negatively affect milk production; on the contrary, it has a stimulating effect. Crossbreeding with local cattle breeds resulted in hybrid animals showing 25–30% higher levels of total protein, total globulins, and gamma globulins compared to purebred Black-and-White cattle. This demonstrates improved immune response and higher adaptive capacity, inherited from local breeds. **Conclusion:** The milk productivity index of Black-and-White cows raised in Azerbaijan is close to European standards of this breed. The results suggest that farmers should prioritize animals with higher body weight and better milk productivity. Scientifically based breeding programs that consider genetic and zootechnical characteristics contribute to higher efficiency and improved productivity in dairy farming systems.

Keywords: Black-and-White breed, milk productivity, milk fat content, live body weight, hereditary characteristics.

Introduction

In our republic, the population's demand for raw milk and dairy products is mainly met through cattle breeding. Therefore, in order to increase milk production in the country, priority should be given to improving the milk yield and quality of cattle. Accordingly, the heads of specialized dairy farms should focus on keeping cows of the Black-and-White breed, which has proven effective in global cattle breeding, is well adapted to the climate of our republic, and has a sufficiently developed breeding base in the country, as well as high productivity potential. In livestock production, the main products obtained are milk, meat, and hides and skins. The most valuable product of cattle breeding is milk and its derivatives, such as butter, cheese, sour cream, yogurt, cottage cheese, and others. Beef is highly nutritious and, at the same time, is cheaper compared to the meat of other animal species. High-quality footwear leather is produced exclusively from cattle hides [1,2].

Cattle herds in the country consist of 46.5% purebred and improved animals. Among them, 19.9% are purebred cattle, while 26.6% are crossbred (genetically improved) livestock. In the republic, 24.9% of the animals belong to the Brown Caucasian breed, 21.6% to the Black-and-White breed, 11.8% to the Holstein-Friesian breed, 6.2% to the Simmental breed, and 5% to the Swiss breed. The highest concentration of cattle in the country is found in the Sabirabad and Jalilabad districts. In Sabirabad district, there are 109,716 head of cattle (including 54,483 cows and buffaloes), while in Jalilabad district there are 98,968 head of cattle (including 49,969 cows and buffaloes). Overall, 38.7% of the national cow population is concentrated in the farms of the Aran economic region [3,4].

The selective breeding and maintenance of dairy types within Black-and-White cattle breeds is beneficial from both zootechnical and economic perspectives. In addition, in order to increase milk productivity and improve the economic efficiency of milk production in dairy cattle farms, special attention should be paid to the following zootechnical factors [5].



Materials and Methods

In order to meet the increasing demand of the population for milk and dairy products at a high level, large-scale importation of the world's most valuable dairy cattle breed, the Black-and-White cattle, was initiated into the country. Over the past 30–35 years, this breed has become the leading cattle breed in the republic. During this period, the breed has been developed in the country through two main approaches: pure breeding and crossbreeding. In the latter method, offspring of local and imported breeds have been crossed with Black-and-White sires. The resulting third-generation crossbreds have been bred “within themselves” over the last 10 years. It should also be noted that, at present, cattle farms belonging to farmers, private owners, and state breeding enterprises in the republic are largely composed of cattle imported from Europe. In these farms, purebred Black-and-White cattle, fully adapted to local conditions and obtained under domestic management, are being raised. Currently, the share of this breed in the national cattle population exceeds 60%.

In the last 10 years, the Black-and-White cattle breed has been successfully raised in practically all regions of the republic. The rapid dissemination of this breed across all regions is explained by its possession of a number of biological, genetic, zootechnical, and technological characteristics, many of which have already become hereditarily fixed traits.

For example, milk fat content was increased in England from 3.63% to 3.86% over a 30-year period (by 0.23%), in the United States from 3.73% by 0.38% over 40–45 years, in Switzerland to 4.01% over 70 years (by 0.63%), and in Poland to 3.87% over 23 years (by 0.53%). Although the milk fat content of this breed under Russian conditions ranges between 3.2% and 3.6%, in the Republic of Azerbaijan this indicator reaches 3.9–4.21% and higher levels. One of the biological and economic advantages of the Black-and-White breed is that, alongside increased milk productivity, the fat content of milk also rises. Looking at the history of the breed, it can be seen that the milk yield of Dutch Black-and-White cattle increased from 4,001 kg in 1905 to 5,297 kg in 1976, accompanied by an increase in milk fat content from 3.17% to 4.23%. In Germany, the milk yield of this cattle breed increased from 4,158 kg in 1950 to 5,233 kg in 1976, while milk fat content rose from 3.45% to 4.03%. In the United States, over a 51-year period, milk productivity increased by 2,445 kg, while milk fat content increased by 0.38%. This positive relationship between milk productivity and milk fat content has been observed not only in Dutch Black-and-White cattle but also in more than 35 of its global derivatives.

Results and Discussion

One of the valuable characteristics of this breed is the positive correlation between live body weight and milk productivity. This trait also has a strong hereditary basis. In other cattle breeds, an increase in live weight above 450–500 kg often leads to a decrease in milk yield; however, in Dutch Black-and-White cattle and all its derivatives, an increase in live weight of cows up to 700 kg is accompanied by a corresponding increase in milk productivity. It is suggested that this characteristic is associated with the specialization of metabolic processes toward milk synthesis, resulting in the preferential utilization of nutrients from feed for milk production.

In addition to all these positive traits, Black-and-White cows are also characterized by a high milk flow rate during machine milking (the amount of milk obtained per minute). Another valuable feature of this breed is that, through long-term selection, a reduction in calf birth weight has been achieved, thereby preventing difficult calving in this cattle population. It should also be noted that calves born with a low live weight (18–20 kg) exhibit intensive growth after birth. Therefore, at 18 months of age, heifers reach about 70% of their mothers' live weight and, as a rule, attain 320–340 kg at 18–19 months of age. All these positive characteristics are also observed in Black-and-White cattle kept in peasant (farmer), private, and state farms of the Republic of Azerbaijan. Thus, this breed fully expresses all the advantageous traits it acquired in its country of origin under local conditions.

In connection with all the above, the generalized results of our long-term research conducted on Black-and-White cattle in farms located in different regions of the republic are presented in Table 1 below.

Table 1. Characteristics of reproductive ability of black-and-white female cattle

№	Indicators	On average M±m	Hesitation
1	Age at first conception (months)	19,5±2,26	18,3-20,8
2	Live weight at fertilization (kg)	340±3,34	325-355
3	Live weight at first birth (kg)	450±4,48	435-470
4	Duration of labor in hours	9±0,75	7,5-40
5	End of postpartum period (time of fall of the umbilical cord around the baby), in hours	3,2±0,09	2,8-3,6
6	Service period in I lactation, days	65±2,46	60-71
7	Drying period, days	60±2,67	56-64
8	Intercalation time, days	352±4,6	345-361
9	Factor of utilization of reproductive capacity of female calves, %	92,4±4,26	88-100



From the analysis of the figures presented in Table 1, it can be seen that the black-and-white Dutch cattle and its derivatives, which have gained fame all over the world, can also show their useful biological, genetic and zootechnical potential in our conditions. Thus, animals of this breed, even in Azerbaijani conditions, reach the age of 18-20 months, reach 340 kg of live weight, become fertile, and enter the production cycle by giving birth twice at 29-30 months. Also, their service period and drying period are within the zootechnical norm. The average intercalation period in this cattle is 352 days, which ensures that one calf is obtained from them per year. Most importantly, the coefficient of utilization of the reproductive capacity of female calves in cattle of this breed is high (92.4-100%).

The milk yield of those animals was as shown in Table 2, for the example of a collective farm in the Samukh region.

As can be seen from the figures in Table 2, black-and-white cows of Dutch origin, raised in the Ismayilli region of the republic under conditions of good and abundant feeding, are able to use their productive potential at a high level. Thus, the milk yield of the breed in middle-aged cows (III lactation) has reached a fairly high level for our republic (4260 kg). At the same time, the fat content of their milk is at the level of the fat content of the milk of Dutch cows, close to the level of local cattle breeds of Azerbaijan. It should also be noted that both in this farm where we conducted the research and in the black-and-white cattle herds in other intensive dairy farming zones of the republic, the weight of cow groups with milk productivity reaching 4500-5000 kg and milk fat content of 4.3-4.6% is quite high. On their basis, breeding groups and breeding centers are created, and selection work is aimed at increasing the number of their offspring and further improving the quality of breeding productivity. It should be noted that the milk index or milk yield coefficient of black-and-white cows bred in Azerbaijan is close to the corresponding indicator of the types of the breed bred in Europe.

Table 2. Milk yield of cows by lactation

Lactations	Milking days	Milk yield in lactation, kg	Milk fat content, %	Milk fat content, kg	Live weight, kg	Milk yield index, kg
I	297±3,61	3000±8,43	3,89±0,31	116±2,53	450±5,62	664±8,14
II	303±3,56	3510±7,56	3,96±0,19	139±2,18	503±6,12	691±9,26
III	305±3,59	4260±7,32	4,12±0,23	179±2,23	559±5,22	761±9,54

The milk yield of cows during machine milking on the farm is also quite high (2.5-2.95 kg/min), which corresponds to the breed standard. There is no doubt that targeted selection work carried out in the herds of this breed will increase productivity indicators in the near future. As we have shown above, one of the most valuable biozootechnical characteristics of this breed is that, unlike other breeds, the increase in live weight to the maximum limit does not have a slowing effect on milk production, but rather stimulates it. This is also evidenced by the results of our studies given in Table 3 below.

Table 3. Relationship between milk yield and live weight of black-and-white cattle

No	Cow groups by live weight	Milk yield per lactation, kg	Maximum-minimum	Milk fat content, %
1	451-480 kq	2700±6,18	2600-2900	3,82 ±0,31
2	481-510 kq	2850 ±6,25	2790-3700	3,86 ±0,28
3	511-540 kq	3200± 6,43	3100-3300	3,86± 0,31
4	541-570 kq	3360 ±6,51	3310-3400	3,88±0,27
5	571-600 kq	3600 ±7,11	3500-3710	3,89± 0,23
6	601-630 kq	3800± 6,83	2700-3850	4,00±0,26
7	631-660 kq	3980± 6,83	3860-3990	4,08 ±0,31
8	661-690 kq	4200 ±6,46	4000-4400	4,14 ±0,36
9	691-720 kg and above	4500 ±5,86	4400-4615	4,22 ±0,34

The drying period (the last month of calving) also plays a major role in increasing milk yield in cows. Thus, 2 months before calving, the cow is not milked, but is dried. At this time, the mother's body spends its strength and energy on the growth of the calf, the next calving and the favorable lactation. The normal and favorable drying period for the cattle of the breed we studied is on average between 55-65 days for our republic.

Conclusion

The results of our studies clearly show that the total protein globulin, including gamma globulin, in the blood of hybrids obtained from crossing black-and-white cattle with local breeds of cattle is 25-30% higher than in purebred black-and-white cattle. This trait is due to the fact that the hybrid black-and-white cattle have crossed with local breeds, and they have high resistance.





Relative traits such as high milk yield of black-and-white cattle, intensive growth rate in young animals, and milk yield rate have high heritability, and the heritability coefficient (h^2) for these indicators in their crossbreeding with local cattle is between 0.65-0.78%. The positive correlation between the live weight of black-and-white cattle and milk yield is also highly transmitted to the crossbreeds of black-and-white breed and local cattle. Of course, this was achieved through the scientific selection work carried out by specialists over many years. Summarizing all the above, it can be said that further improvement of feeding conditions in the conditions of the Republic of Azerbaijan and greater attention to selection work than at present will allow creating highly productive herds of Azerbaijani black-and-white cattle in the near future.

Declarations

Ethical Approval Certificate

Not applicable.

Author Contribution Statement

Ramil Mammadov: Conceptualization, methodology, data collection, formal analysis, writing – original draft, review & editing.

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Conflict of Interest

The author declares no conflict of interest.

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References

- Abbasov, S., Abbasov, R., & Mirzəyev, F. (2015). *Heyvandarlıqda biotexnoloji üsulların tətbiqi*. Bakı: Ağah nəşriyyat poliqrafiya müəssisəsi.
- Abbasov, S., Mehdiyev, M., Ruşanov, A., Turabov, U., & Nəcəfova, G. (2011). *Heyvandarlıq*. Gəncə: Gəncə Poliqrafiya ASC.
- Salmanov, Z. M., Vəliyev, Ş. A., Səfərov, X. M., & Əfəndiyev, Y. Ə. (2000). *Kənd (fermer) təsərrüfatında südlük qara-ala cinsli malın süd məhsuldarlığının yüksəldilməsinə və südün əmtəlik keyfiyyətinin yaxşılaşdırılmasına dair tövsiyə*. Gəncə.
- Gözəlov, Y. (2018). *Heyvandarın məlumat kitabı*. Gəncə: ATU nəşriyyatı.
- Куликова, Н. И., Еременко, О. Н., & Малахова, А. О. (2014). *Основы животноводства: учеб.-метод. пособие*. Краснодар: КубГАУ.

