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Recent Advances in Shelf-Life Extension of Fresh-Cut Leafy Vegetables: Edible Coatings, Active Packaging, and Natural Sanitization Strategies

Alireza Mehregan Nikoo[1]*, Fatma Burcu Karakoç[2]

[1]Department of Food Science & Technology, Faculty of Agriculture, University of Guilan, Rasht, Iran.
Email: a.mehregan@guilan.ac.ir
ORCID ID: 0000-0002-9377-9441
[2]Osmaniye Korkut Ata University, Bahçe Vocational School, Food Processing, Osmaniye, Türkiye
E-mail: fatmaburcukarakoc@osmaniye.edu.tr

**Corresponding Author's Email: a.mehregan@guilan.ac.ir*

Abstract

Fresh-cut leafy vegetables are highly perishable products because cutting and minimal processing accelerate respiration, moisture loss, enzymatic browning, and microbial spoilage. In response to the growing demand for safe, convenient, and clean-label produce, this review explores recent advances in edible coatings, active packaging, and natural preservation strategies for extending shelf life and maintaining quality. Edible coatings based on polysaccharides, proteins, and lipids can act as semi-permeable barriers that reduce gas exchange and water loss while delivering antimicrobial and antioxidant compounds. Active packaging systems, including oxygen scavengers, moisture regulators, and antimicrobial materials, help slow senescence and suppress microbial growth during storage. In parallel, natural preservation approaches such as plant extracts, essential oils, organic acids, and biocontrol agents provide sustainable alternatives to synthetic preservatives and chlorine-based treatments. Although promising, these technologies still face challenges related to formulation stability, sensory acceptance, regulatory approval, and industrial scale-up. Overall, the integration of these hurdle technologies offers a practical and sustainable pathway to reduce postharvest losses and improve the commercial value of fresh-cut leafy vegetables.

Keywords: *fresh-cut leafy vegetables; shelf-life extension; edible coatings; active packaging; natural preservatives; postharvest quality*

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