

## **MODERN PACKAGING TECHNOLOGIES THAT REDUCE THE USE OF CHEMICAL PRESERVATIVES**

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In the modern food industry, consumers increasingly prefer products with minimal chemical additives, particularly preservatives. Traditional preservation methods, though effective, often rely on resources or chemicals that raise health concerns. This has led to the advancement of innovative packaging technologies that enhance shelf life while minimizing chemical use.

Vacuum packaging and modified atmosphere packaging (MAP) significantly reduce oxygen levels, thereby limiting microbial growth and oxidation processes in food. These technologies are especially effective for oxygen-sensitive products such as meat, fish, and vegetables, offering extended shelf life without additional preservatives [1].

Bioactive packaging integrates natural antimicrobial agents directly into packaging materials. These substances inhibit the growth of harmful microorganisms, making such packaging suitable for meat, dairy, and fish products. Additionally, these materials are often biodegradable, aligning with sustainability goals [2].

Biopreservation relies on beneficial bacteria that naturally produce antimicrobial compounds. These substances can replace chemical preservatives by suppressing spoilage and pathogenic microbes. For instance, strains like *Lactobacillus rhamnosus* have shown effective inhibition of spoilage bacteria in dairy applications.

Together, these modern technologies support the production of safer, more natural food products while also contributing to environmental protection. Their adoption in the food industry represents a crucial step toward sustainable, consumer-oriented production.

### **References:**

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