



Modified Atmosphere Packaging for Extending the Shelf Life of Fresh Foods

Marco Deluca*

Center for Food Preservation and Quality, Italian Institute of Food Sciences, Genoa, Italy

DESCRIPTION

Modified Atmosphere Packaging (MAP) is a food-packaging technology designed to extend the shelf life of perishable products by changing the composition of gases surrounding the food inside a sealed package. Unlike conventional packaging, which generally retains normal atmospheric air, it replaces or modifies the internal atmosphere to slow microbial growth, respiration, oxidation, enzymatic reactions and other deterioration processes. The technology is widely investigated for fresh produce, meat, poultry, seafood, bakery products, dairy foods and prepared meals.

The effectiveness of MAP depends on selecting an appropriate gas composition for the specific food product. The major gases used in MAP are oxygen, carbon dioxide and nitrogen. Oxygen can influence respiration, oxidation and the color of certain foods. Carbon dioxide has antimicrobial properties and can inhibit the growth of several spoilage microorganisms. Nitrogen is relatively inert and can be used as a filler gas to reduce package collapse and displace oxygen.

Fresh fruits and vegetables present special challenges because they remain biologically active after harvesting. Plant tissues continue to respire, consuming oxygen and releasing carbon dioxide. If the package atmosphere is not properly controlled, excessive respiration can result in oxygen depletion, undesirable fermentation, off-flavors, discoloration and tissue deterioration. Therefore, for fresh produce must consider respiration rate, product temperature, package volume and the gas permeability of the packaging film.

Meat products require different atmospheric conditions. Oxygen concentration can influence the appearance of fresh meat, while carbon dioxide can contribute to microbial control. Vacuum packaging and high-carbon-dioxide atmospheres are used for different meat applications depending on whether color retention, shelf life, or storage requirements are prioritized. The selected atmosphere must therefore balance microbiological stability with the desired visual and sensory characteristics of the product.

Seafood is another important application of MAP because fish and shellfish are highly perishable. Microbial activity, lipid oxidation, enzymatic reactions and temperature abuse can rapidly reduce quality. Carbon dioxide-rich atmospheres can help suppress certain spoilage microorganisms, while nitrogen can provide package volume. However, excessive carbon dioxide absorption may cause package collapse or undesirable changes in product appearance.

The material must provide an appropriate barrier to oxygen, carbon dioxide and water vapor while maintaining adequate mechanical strength and seal integrity. If gas transmission is too high, the desired atmosphere may disappear during storage. Conversely, excessively low permeability can result in undesirable gas accumulation or depletion, particularly in respiring products.

Temperature management remains essential even when MAP is used. Modified atmospheres do not make perishable foods shelf-stable. Microorganisms can continue to grow when storage temperatures are inappropriate and some foodborne pathogens may remain a concern under modified atmospheric conditions. Consequently, it should be combined with refrigeration, hygienic processing and appropriate food-safety controls.

The sealing process also affects package performance. Incomplete seals, microscopic leaks, or damaged films can allow external air to enter the package and alter the internal atmosphere. Quality-control procedures should therefore include seal-strength testing, leak detection and monitoring of gas composition when appropriate.

This can contribute to food-waste reduction by slowing quality deterioration and extending commercially useful shelf life. Longer shelf life can provide additional time for transportation, retail display and household consumption. However, the environmental impact of packaging materials must also be considered. The benefits associated with reduced food waste should be balanced against material use, recyclability, package design and end-of-life management.

Successful MAP development requires an integrated understanding of food composition, microbial ecology,

Correspondence to: Marco Deluca, Center for Food Preservation and Quality, Italian Institute of Food Sciences, Genoa, Italy. Email: marco.deluca@92.com

Received: 21-Nov-25, Manuscript No. JFPT-25-32882; **Editor assigned:** 24-Nov-2025, Pre QC No. JFPT-25-32882 (PQ); **Reviewed:** 08-Dec-2025, QC No. J FPT-25-32882; **Revised:** 15-Dec-2025, Manuscript No. JFPT-25-32882 (R); **Published:** 22-Dec-2025, DOI: 10.35248/2157-7110.25.16.1196

Citation: Deluca M (2025). Modified Atmosphere Packaging for Extending the Shelf Life of Fresh Foods. J Food Process Technol.16:1196.

Copyright: © 2025 Deluca M. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

respiration, gas permeability, packaging engineering and storage conditions. A gas mixture that works effectively for one product may be unsuitable for another. Product-specific testing is therefore necessary to determine appropriate gas ratios, packaging materials, sealing conditions and storage temperatures.

In conclusion, modified atmosphere packaging represents an important technology for maintaining the quality and safety of

perishable foods. By controlling the gaseous environment around food, it can slow several deterioration mechanisms and support longer shelf life. Continued development of recyclable packaging materials, optimized gas formulations, intelligent monitoring systems and sustainable packaging designs could further increase the usefulness of MAP in modern food-processing and distribution systems.