Meat Science Section
Department of Animal Science
Texas A&M University
2471 TAMU
College Station, Texas 77843-2471

Telephone: 979-845-3935
FAX: 979-845-9454
http://meat.tamu.edu

Technical Topics

Modified Atmosphere Packaging

Stacy Mueller
Senior Animal Science Major

Retail meat cases have changed dramatically over the past four decades. Retailers have implemented changes to reduce labor requirements and to ease the meat purchasing process for consumers. Polyvinyl chloride (PVC) overwrap has been the most common packaging material used at the retail store. However, PVC overwrapped meat packages lack consumer appeal because they are viewed as unattractive and often leak. Also, retailers desire greater shelf-life than what is typically achieved by PVC overwrap. To meet these needs, the meat industry has implemented a novel approach termed modified atmosphere packaging (MAP).

The MAP environment alters the color- and shelf-life properties of the product compared to traditional packaging methods, which utilize typical atmospheric gas combinations. MAP creates a functional environment within the package using different proportions of gases. The most commonly used gases are oxygen, carbon dioxide, and nitrogen. Oxygen aids in providing a desirable color, carbon dioxide retards the growth of spoilage bacteria, and nitrogen is used as an inert filler gas. Different percentage combinations of these gases will influence the shelf- and color-life of the meat, and thus the type of gas combination used will be determined by what the retailer values the most: shelf-life or color-life.

The two MAP systems that are most commonly seen are a high- and low-oxygen. Low oxygen MAP utilizes a mixture of carbon dioxide (20-40%) and nitrogen (60-80%) while virtually eliminating any oxygen that is present. Using a low-oxygen MAP system increases the shelf-life of products to 14-28 days. Because there is little oxygen present, the myoglobin (color pigment in muscle) is in the deoxymyoglobin state. In this state, the meat appears to be a purplish-red color, which is viewed as undesirable by consumers. For this reason, retailers store packages in this manner to maximize shelf-life, but expose the cuts of meat to oxygen to allow the meat to develop a normal cherry-red color before displaying in the retail case. For this reason, low-oxygen MAP has a shorter color-life (approximately 2-5 days) than high-oxygen MAP. When using a low-oxygen MAP system, it is critical to remove the oxygen quickly to ensure complete deoxygenation of the meat.

High-oxygen MAP uses high levels of oxygen (40-80%), intermediate levels of carbon dioxide (20-30%), and the remainder is filled with nitrogen (0-20%). Because high oxygen levels are present, there is a higher partial oxygen pressure, resulting in a deeper oxymyoglobin layer, which corresponds with the development of an appealing meat color. Because of this, high-oxygen MAP does not require additional packaging modifications before displaying in the retail case, unlike low-oxygen MAP. High-oxygen MAP results in an elongated color-life (7-10 days), however, high-oxygen MAP has a shorter shelf-life (8-12 days). This is a result of the high percentage of oxygen accelerating the oxidation of the lipids, that can produce off odors and flavors.

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Modified Atmosphere Packaging, continued

MAP systems are most often applied to case-ready packaging programs. Case-ready encompasses producing and packaging retail cuts at a centralized facility, and then distributing those packages to retail stores. Case-ready MAP programs benefit retailers by reducing operating costs via lesser labor requirements, minimizing inventory costs by eliminating out-of-stocks, and reduced shrink because of extended shelf-life. In addition, this packaging system has facilitated the introduction of branded products into the fresh meat case. Using MAP allows for an easier to stack-and-store, leak-proof, and more convenient package. Case-ready MAP systems also provide an added level of protection for food safety because products are minimally handled and the likelihood of cross-contamination with other products is reduced. However, there are some drawbacks to MAP systems. The distribution costs increase for processors because of the bulkiness of the packages, hence processors are unable to ship as much in one load and packages consume more storage and retail space. Also, packaging materials and the cost of the packaging process (gas and equipment) are more expensive. Clearly, MAP systems offer opportunities and challenges for processors and retailers and will likely serve as the next generation of retail packaging.