



MODIFIED ATMOSPHERE PACKAGING (MAP) AND VACUUM PACKAGING

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Introduction

Modified Atmosphere packaging (MAP):

The packaging of a perishable product in an atmosphere which has been modified so that its composition is other than that of air.

- It is used to extend the shelf life of fresh foods such as meat, fish and cut fruit, as well as of various bakery products, snack foods and other dried foods.
- In this method of packaging, air in a package is replaced with a gas composition that will retard microbial growth and slow down chemical deterioration of the food.
- MAP is the alteration of the gaseous environment produced as a result of respiration (passive MAP) or by the addition and removal of gases from food packages (active MAP) to manipulate the levels of O₂ and CO₂.

Historical Development

- The **first commercial application** of modified gas atmospheres was for **Controlled Atmosphere Storage (CAS)** of fruits and vegetables.
- Commercial **retailing of fresh meat in MAP tray systems** (CO₂ atmosphere) was **introduced in European market in the early 1970s**.
- In the past few years, there has been a considerable increase in the range of foods packed in modified atmospheres for retail sale including meat, poultry, fish, bacon, bread, cakes, and cheese products.
- The **three main gases** used in MAP are **O₂, CO₂ and N₂**. The choice of gas is totally dependent upon the food product being packed.
- Used singly or in combination, these gases are commonly used to balance extension of shelf life with optimal organoleptic properties of the food.

- The **exact composition of the gas** used will depend entirely on the type of food being packaged and the biological process being controlled.
- Modified atmosphere packaging is generally used **in combination** with **refrigeration** to extend the shelf life of fresh, perishable foods.
- **Depleted O₂ and/or enriched CO₂ levels** can **reduce respiration, delay ripening, decrease ethylene production, retard textural softening, slow down compositional changes associated with ripening, thereby resulting in extension of shelf life.**
- Generally, **3–8% CO₂ and 2–5% O₂** are recommended for fruits and **vegetables** for MAP storage (Farber, 1991).

Gaseous atmosphere is modified by

1. **Direct injection of gases** (often CO₂ or nitrogen) into a package,
 2. **Evacuating air from the package and filling with required gas.**
- Modified atmosphere packages have an atmosphere different from ambient air but, that **atmosphere can change over time**. In the case of produce, package atmosphere is affected by the transmission rates of the packaging material and changes in storage temperatures. Higher temperatures lead to **higher respiration rates, creating lower O₂ levels in the package atmosphere and higher concentrations of CO₂**. Hence, **the atmosphere inside the package is modified but not controlled**.
 - Most **MAP** foods are **packaged in transparent film** to allow the retail customer **to view the food**. One of the most widely used packaging film for MAP is **low density polyethylene (LDPE)**.

Packaging materials used in MAP

- Ethylene vinyl alcohol (EVOH)
- Polyethylenes (PE)
- Polyamides (PA)
- Polyethylene terephthalate (PET)
- Polypropylene (PP)
- Polystyrene (PS)
- Polyvinyl chloride (PVC)
- Polyvinylidene chloride (PVDC)

Criteria for selection of plastic packaging materials

- Food contact approval
- Gas and vapour barrier properties
- Optical properties
- Antifogging properties
- Mechanical properties
- Heat sealing properties

Advantages of MAP

- 1. Fresh appearance
- 2. Potential shelf life increase by 50-400%
- 3. Product can be distributed to long distances
- 4. High quality product
- 5. User friendly

Disadvantages of MAP

- 1. Added cost
- 2. Temperature control is necessary during storage.
- 3. Special equipment is required

Dairy Products Packed by MAP

- MAP has the potential to increase the shelf life of a number of dairy products like **fat-filled milk powders, fat spreads and cheeses**.
- Whole milk powder is particularly susceptible to the development of off-flavours due to fat oxidation.
- Commercially, the **air in the pack is removed under vacuum and replaced with 100% N₂ or N₂/CO₂ mix** and the powder is hermetically sealed in metal cans where in product will have low levels of **residual O₂ (<1%)**. Use of O₂ scavengers may also be used.





- Cheddar cheese is traditionally vacuum packed while MAP is being used with high concentration of CO_2 gas mixes and it is important to maintain the balance of correct CO_2 level in the gas mix so as to avoid excessive pressure being put on the pack seal.
- The cottage cheese is a high-moisture, low-fat product that is susceptible to a number of spoilage organisms including *Pseudomonas spp.* Use of N_2/CO_2 atmospheres showed significant extension of the shelf life of cottage cheese.
- Gas mixtures containing $\text{CO}_2:\text{N}_2$ in the proportion of 40:60 can increase the shelf life of cottage cheese significantly.

Vacuum Packaging

- Vacuum means simply absence of air
- An alternative to controlling or modifying the atmosphere is vacuum packaging, where all of the gas in the package is removed.
- This can be a very effective way of retarding chemical changes such as development of oxidative rancidity, but care needs to be taken to prevent the growth of the pathogen, *C. botulinum*, which grows under anaerobic conditions.
- A specific pasteurisation process, referred to as the psychrotrophic botulinum process, is applied to the packaged food to reduce its numbers to commercially acceptable levels.
- By using vacuum packaging, and chilled storage, greatly extended shelf-lives have been achieved.



Types of vacuum packaging machine

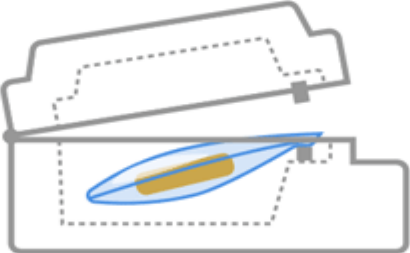

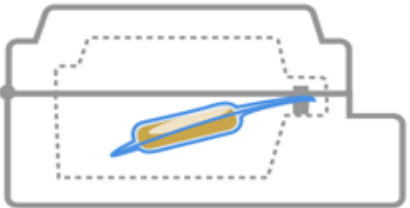
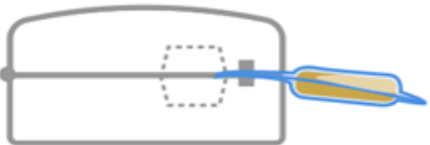
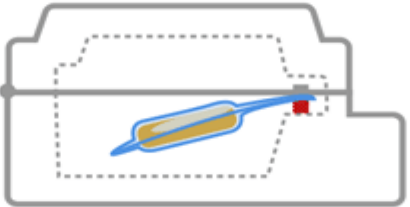
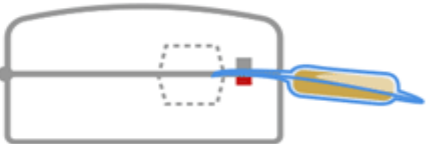
1. External bag machine:

- External vacuum sealers involve a bag being attached to the vacuum-sealing machine externally.
- The machine will remove the air and seal the bag, which is all done outside the machine.
- A heat sealer is often used to seal the pack.

2. Vacuum chamber machine:

These machines resemble a stainless steel box into them vacuum pouch and contents are placed and the lid closed over them. The entire chamber is then vacuumed and the pouch is heat sealed.

Vacuum sealing process

Sealing Process	Chamber Vacuum Sealer	External Vacuum Sealer
<p>1 Align the bag with the seal bar</p>		
<p>2 Air is drawn out of the bag</p>		
<p>3 The seal bar fuses the bag together for a tight seal</p>		

SINGLE VACUUM CHAMBER MACHINES



DOUBLE VACUUM CHAMBER MACHINES



AUTOMATIC BELT VACUUM CHAMBER MACHINES



THERMOFORMING (ROLLSTOCK) VACUUM PACKAGING MACHINES



GAS FLUSH CHAMBER MACHINES



Shelf life of vacuum packaged foods

Food	Stored In	Normal Shelf Life	Shelf Life of Vacuum packaged product
Cheese	Refrigerator	1-2 weeks	4-8 months
Cookies, crackers	Room temperature (periodically opening)	1-2 weeks	3-6 weeks
Flour, sugar, rice	Room temperature	6 months	1-2 years
Nuts	Room temperature	6 months	2 years
Oils with no preservatives, like safflower, canola, corn oil	Room temperature	5-6 months	1-1.5 years

THANK YOU