Agri Articles
(e-Magazine for Agricultural Articles)
Volume: 03, Issue: 05 (SEP-OCT, 2023)
Available online at http://www.agriarticles.com
©Agri Articles, ISSN: 2582-9882

MAP (Modified Atmospheric Packaging)

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Modified atmosphere packaging (MAP) is defined as the packaging of a perishable productin an atmosphere that has been modified so that its composition is other than that of air' (Hintlian& Hotchkiss, 1986).When food product is packed in package containing air, it can be spoiled by three main mechanisms- simple oxidation, bacterial action and mold growth. However, these spoilage mechanisms can be suppressed to a great by packing the food product in an appropriate modified atmospheric condition. The gases employed for Modified Atmospheric Packaging (MAP) include carbon dioxide (CO2), nitrogen (N2) and oxygen (O2).

Packing foods in a modified atmosphere can offer extended shelf life and improved product presentation in a convenient container, making the product more attractive to the retail customer. However, MAP cannot improve the quality of a poor-quality food product. It is, therefore, essential that the food is of the highest quality prior to packing in order to optimise the benefits of modifying the pack atmosphere. Good hygiene practices and temperature control throughout the chill-chain for perishable products are required to maintain the quality benefits and extended shelf life of MAP foods.

History - Application of MAP came into existence in 1927 in order to improve the shelf life of applebylessening their aging in an atmosphere having high in CO2and less O2. In 1930s, the technique was employed in transportation of fruits by enhancing CO2 levels (Davies A.R. et al 1995).

Commercial retailing of fresh meat in MAP tray systems was introduced in the early 1970s.European meat processing and packaging developed during the 1980s with centralized production of MAP meat in consumer packs for distribution to retail outlets. In the past few years, there has been a considerable increase in the range of foods packed in modified atmospheres forretail sale including meat, poultry, fish, bacon, bread, cakes, crisps, cheese and salad vegetables.

Principle – MAP is being successfully employed by several food processing companies worldwide to improve life of food product in shelf and to maintain its quality (Rao 2015 &Soltani M. et al. 2015).The atmospheric conditioning within the package can be adjusted by:

1. Direct injection of gases (usually CO2 and N2) into the package.
2. Expulsion of air from the package.
3. Interaction between the content of package that can cause alteration of the atmosphere within the package.

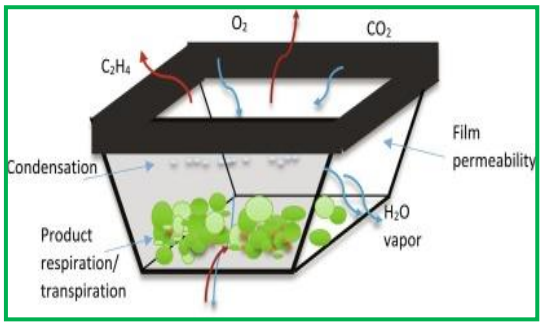
Factors Affect MAP –

The existence and quality of food items stored under MA condition is affected to a great extent by factors such as

- Nature of the food
- Gas composition used
- Nature of package
- Storage temperature
- Packaging process
- Packaging machine employed

Gases used in MAP –

The main effects of chief gases useable in this packing technique are:



1.Carbon dioxide (CO2) - It actively eliminates growth of bacteria and moulds.

2**. Oxygen (O2)** - It causes oxidation of oil/ fat present in food product. It also allows aerobic bacteria and mould to survive.

3. **Nitrogen (N2)** - It is essential inert. Presence of nitrogen gas prevents the package collapse that can take place because of high concentration of carbon dioxide. Therefore, whenever required, the balance of modified atmosphere is created with nitrogen.

4. **Carbon Monoxide (CO)** - Carbon monoxide (CO) is a colourless, tasteless and odourless gas that is highly reactive and very flammable. It has a low solubility in water but is relatively soluble in some organic solvents.CO is a fungistatic gas and a component of wood smoke; hence, foods have been exposed to this gas for hundreds of years. It has been used in the United States since the 1970s for the shelf-life extension of lettuce and for the MAP of meat and fish since 2002 (Cornforth & Hunt, 2008).

5. **Noble Gas** -The noble gases including helium (He), argon (Ar), xenon (Xe) and neon (Ne) are inert. In combination with other MAP gases, they have been found to have a beneficial effect on the shelf
life of fresh, meat, ready meals, fresh fruit and vegetables.

Gas composition for MAP (Blakistone BA., 1998)

Products	% of different gases		
	Oxygen (%)	CO_2 (%)	Nitrogen (%)
Bread	-	60-70	30-40
Non-dairy cakes	-	60	40
Dairy cakes	-	-	100
Pasts (fresh)	-	-	100
Fruits and vegetables	3-5	3-5	85-95
Dried/roasted foods	-	-	100
Hard cheese	-	100	-
Soft cheese	-	30	70
Poultry	-	25	75
Fish (oily)	-	60	40
Fish (white)	30	40	30
Red meat	60-65	15-40	-
Cooked or cured meat	-	20-35	65-80

Methods for creating atmospheric condition

Two main methods for creating modified atmosphere condition are discussed below:

Passive packaging -Modified atmosphere is passively generated inside a sealed package as a result of a product's respiration that is utilization of oxygen and release of carbon dioxide. Thus, passive packaging is also known as commodity generated MAP.

Active packaging - Modified atmosphere is generated by dragging a modest vacuum in a package and substituting the package atmosphere with required composition of gases. Active packaging can be established by using ethylene scavengers or emitters. Matching scavengers or emitters can quickly create modified atmosphere within sealed packages.

Packaging Materials - Selection of the most appropriate packaging materials is essential to maintaining the qualityand safety of MAP foods. Flexible and semi-rigid plastics and plastic laminates are the mostcommon packaging materials used for MAP foods. Plastic materials account for approximatelyone-third of the total materials demand for food packaging applications and their use is forecastto grow.

Plastic packaging for MAP applications is most commonly found in the form of flexiblefilms for bags, pouches, pillow packs and top webs in sealed tray systems, or as rigid andsemi-rigid structures for base trays, dishes, cups and tubs. Commonly used plastic flexiblelaminates are produced from polyethylene (PE), polypropylene (PP), polyamide (PA/nylons),polyethylene terephthalate (PET), polyvinyl chloride (PVC), polyvinylidene chloride (PVdC)and ethylene vinyl alcohol (EVOH). Rigid and semi-rigid structures are commonly producedfrom polypropylene, polyethylene terephthalate, unplasticized polyvinyl chloride and expandedpolystyrene (PS).

Modified Packaging Atmosphere Machines -The main machines used for creating MAP are:

Chamber Machines -For low production throughput, chamber machines are sufficient. These are generally usedwith pre-formed pouches, though tray machines are available. The filled pack is loaded intothe machine, the chamber closes, a vacuum is pulled on the pack and back flushed with themodified atmosphere. Heated sealing bars seal the pack, the chamber opens, packs are removedand the cycle continues. These machines are generally labourintensive and cheap, with a simpleoperation but are relatively slow.

Snorkel Machines - Snorkel machines operate without a chamber and use pre-formed bags or pouches. The bags arefilled and positioned in the machine. The snorkel is introduced into the bag, draws a vacuumand introduces the modified atmosphere. The snorkels withdraw and the bag is heat sealed. Bagin box bulk products and retail packs in large MAP master packs can be produced on thesemachines.

Form-fill-seal (FFS) machines- Form-fill-seal (FFS) machines form pouches from a continuous sheet of roll stock, or formflexible or semi-rigid tray systems comprising a thermoformed tray with a heat-sealed lid.FFS machines may be orientated in a vertical plane or a horizontal plane. Flow wrappingmachines are available in both vertical and horizontal formats. The type of format is dependenton the nature of the food product being packed.

Advantages of MAP

- Original quality of food product is retained.Texture, flavour and taste of food product are maintained.
- Hygienic stackable package which is free from product drip and smell are provided.
- Shelf life of the food item can be increased, retail waste is reduced and Chemical preservatives are not required.
- Presentation of food product is improved. It provides a limpid view of food product and an easy separation of sliced products is provided.

Limitations

- Gases and packaging materials used in MAP are expensive and Costly examination is used to calculate desired gas compositions required.
- Advantages of MAP are completely lost once the package or in case of leakage.

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