Preservation Technique of Fruits and Vegetables: Modified Atmosphere Packaging (MAP)

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India is the second largest producer of fruits and vegetables in the world after China & accounts for about 15% of the world's total production. According to the National Horticultural Board of India, it produced 169.1 million metric tonnes of vegetables and 90.2 million metric tonnes fruits during 2016-2017. The area under cultivation of vegetables stood at 10.1 million hectares while in case of fruits was cultivated in 6.3 million hectares (APEDA, 2018). The differing agro-climatic zones and soil type of the nation make it conceivable to grow almost all of the horticultural crops. However, India accounts for only 2.2% of the total food processing in the world. Cultivation of fruits and vegetables play a significant role in the agricultural economy.

Modified atmosphere packaging (MAP) is a technique used for prolonging the shelf-life of fresh or minimally processed foods. In this preservation technique slows down the metabolic activity of a product and of the microorganisms present, both spoilage and pathogenic, by optimizing the gas composition (O_2 supply, applying an elevated level of CO_2 and balance of N_2).This way the initial fresh state of the product may be prolonged (Kargwal *et al*., 2020). It is the shelf life of perishable products like meat, fish, fruits and vegetables that will be prolonged with MAP since it slows the natural deterioration of the product. MAP is used with various types of products, where the mixture of gases in the package depends on the type of product, packaging materials and storage temperature. Two types of MAP are commonly used such as active packaging and passive packaging. The active packaging is a packaging material that interacts with the atmosphere or gas composition present inside the package by varying the headspace gas composition such as oxygen, carbondioxide and ethylene, or it contain additives which are incorporated into the package to modify the package headspace atmosphere (Mangraj, 2009). In passive MAP the gas composition is altered due to the combined effects of products respiration and permeability of packaging film.

Advantages of MAP

- MAP increases the shelf life of produce/commodity from several days to several weeks as compared to the traditional storage system.
- It extends the ripening process of agricultural commodity.
- MAP delays the softening and compositional changes.
- MAP reduces the fungal growth.
- Reduction of oxygen and elevation of carbon dioxide environment suppresses the rate of respiration of produce, thus slow vital process and prolongs the maintenance of post harvest quality.
- Map is excellent branding option.
- It transfers the quality advantages to the consumer.
- Reduction of handling and distribution of unwanted or low grade produce.
- Quality benefits like color, flavors, moisture and maturity retention occurs.
- Reduction of weight loss, desiccation/water loss and shriveling takes place in MAP.
- Provide clear visibility of product all around the package occurs.
- In MAP little or no chemical preservatives is used.

Disadvantages of MAP

- Additional investment in terms of machinery and labour is required which adds as additional investment in the packaging system.
- Plastic films used in MAP causes environmental degradation unless effective recycling is established.
- Improper packaging or temperature can cause spoilage of produce. Capital cost of gas packaging machinery.
- Cost of gases and packaging materials.
- Requirement of additional investment in machinery and labour in the packaging line.
- Plastic films may be environmentally undesirable unless effective recycling is arranged/ installed.

- There is no particular standard available for MA packaging, because the intrinsic properties of the commodity varies greatly with cultivar, maturity stage, place of cultivation etc. and the permeability of the films varies with the manufacturing company and process, etc.

Table 1. MA Potential benefits for Deciduous, Subtropical and Tropical Tree fruits

Horticultural Products	Temperature (°C)	MA Oxygen	MA Carbon dioxide	Benefits
Deciduous Fruits				
Apple	0-3	1-3	1-5	Excellent
Apricot	0-5	2-3	2-3	Fair
Fig	0-5	5-10	15-20	Good
Grape	0-2	2-5	1-3	Fair
Guava	10-15	2-5	2-5	Good
Kiwifruit	0-5	1-2	3-5	Excellent
Nectarine	0-5	1-2	3-5	Good
Peas	0-5	1-2	3-5	Good
Pear, Asian	0-5	2-4	0-1	Good
Pear, European	0-5	1-3	0-3	Excellent
Persimmon	0-5	3-5	5-8	Good
Plum and prune	0-5	1-2	0-5	Good
Raspberry	0-3	5-10	15-20	Excellent
Strawberry	0-2	5-10	15-20	Excellent
Sweet cherry	0-2	3-10	10-15	Good
nuts and dried fruits	0-25	0-1	0-100	Excellent
Subtropical and Tropical fruits				
Grape fruit	10-15	3-10	5-10	Fair
Lemon	10-15	5-10	0-10	Good
Lime	10-15	5-10	0-10	Good
Litchi	0-2	2-3	2-5	Good
Nectarine	0-5	1-2	3-5	Good
Olive	5-10	2-3	0-1	Fair
Orange	5-10	5-10	0-5	Fair
Mango	10-15	3-5	5-10	Fair
Papaya	10-15	3-5	5-10	Fair

Pineapple	8-13	2-5	5-10	Fair

Source : S. V. Irtwange, 2006, Mangraj, 2009, Kargwal *et al.*, 2020

Table 2. MA Potential benefits for vegetables.

Horticultural Products	Temperature (^oC)	MA Oxygen (%)	MA Carbon dioxide (%)	Benefits
Artichokes	0-5	2-3	2-3	Good
Asparagus	0-5	15-20	5-10	Excellent
Beans	5-10	2-3	4-7	Fair
Beets	0-5	2-5	2-5	Fair
Broccoli	0-3	1-2	5-10	Excellent
Brussels sprouts	0-5	1-2	5-7	Good
Cabbage	0-5	2-3	3-7	Excellent
Cantaloupes	3-7	3-5	10-15	Good
Carrots	0-5	3-5	2-5	Fair
Cauliflower	0-2	2-3	2-5	Fair
Celery	0-5	1-1	0-5	Good
Corn, sweet	0-5	2-4	5-10	Good
Cucumbers	8-12	3-5	0-2	Fair
Honeydews	10-12	3-5	0-2	Fair
Leeks	0-5	1-2	3-5	Good
Lettuce	0-5	1-3	0-3	Good
Mushroom	0-3	Air	10-15	Fair
Okra	8-12	3-5	0-2	Fair
Onions, dry	0-5	1-2	0-5	Good
Onions, green	0-5	1-2	10-20	Fair
Peppers, bell	8-12	3-5	0-2	Fair
Peppers, chili	8-12	3-5	0-3	Fair
Potatoes	4-10	2-3	2-5	Fair
Radish	0-5	1-5	2-3	Fair
Spinach	0-5	18-21	10-20	Good
Tomato	15-20	3-5	0-3	Good

Source : S. V. Irtwange,2006, Mangraj, 2009, Kargwal *et al.*, 2020

References

APEDA. Agricultural &processed Food Export Development Authority, 2018. http://apeda.gov.in/apedawebsite/six_head_product/FFV.htm

Irtwange SV. "Application of Modified Atmosphere Packaging and Related Technology in Postharvest Handling of Fresh Fruits and Vegetables." Agricultural Engineering International: The CIGR Ejournal. 2006; 7(4):1-13.

Kargwal, R., Garg, M.K., Singh, V.K., Garg, R. and Kumar, N. Principles of modified atmosphere packaging for shelf life extension of fruits and vegetables: An overview of storage conditions. International Journal of Chemical Studies 2020; 8(3): 2245-2252.

Mangaraj S andGoswami TK.,2009 Modified Atmosphere Packaging of Fruits and Vegetables for Extending Shelf-Life: A Review. Global Science Books, 2009.