

# Advanced Food Packaging Technology

Prajakta Pritam Desai

*Assistant professor,*

*Department of Mechanical Engineering, School of Technology, Sanjay Ghodawat University, Kolhapur.*

## Abstract:

As food is a degradable and decaying element, it requires proper packaging to store within its prescribed shelf life. Recently advanced technologies are developed to meet the customer high quality and quantity demands for perishables. These include intelligent packaging, active packaging, MAP and CA etc. This technology not only packs the food but gives real time information about food freshness, colour, temperature, humidity levels etc. The advanced devices, sensors, scavenger elements, gas compositions are being used for food packages. The paper will overlook these new technologies for different food products.

**Key words:** Intelligent packaging, food packaging, MAP, packaging technology.

## Introduction:

The main role of food packaging is to give the protection against environmental influence, damage handling and storage safety. Another goal of food packaging is to provide the food ingredient, instructions for use information to customer. The aim of food packaging must be lie with achieving and maintaining food quality every time. Wisdom efforts taken by packaging industry, customers need and government to form and hold the food packaging regulations helps to form environment safety and food safety packaging [1]. The good packaging helps to avoid waste of food. Packaging is the processes of transportation, storage, and end use by preserving the quality of food products.

The food packaging industry works as a supply chain. The food quality loss in any stage of supply chain results into failure of end results. The malpractices and hiding of quality, safety data effects on losing of customer, reputation of Food Company, supply chain, sometimes hazardous to customers health. It degrades the food by chemically, biologically and physically too. To avoid all these possibilities, today need is to maintain transparency, traceability and direct customer involvement in supply chain and storage process. The intelligent packaging system fulfils these expectations.

## 2. Intelligent packaging

The main four packaging functions are to give protection, communication to customer by written information, use directions etc, convenience through package design, logo and containment. The food packaging designers has wide scope to design the package to convince/marketing easily by using different size, shape, colour, attractive taglines etc.

Indicators inform the customer about real time status of food quality. The indicators help to communicate the information temperature, humidity and shelf life of food packaging. The data carriers help for information storage, distribution and its traceability by using barcodes, RFID tags etc. Sensors allow for fast and define

quantification of analyses in foods. To operate on this terminology, an intelligent system consists of ON and OFF switching function on the food package [2]. This informs the internal and external changing status stimuli. It shows the quality decay by sensing the temperature, humidity and microorganism growth inside food. The three main technologies of intelligent system are;

i) Indicators- Generally time temperature indicators are used in intelligent food packaging system. This indicator shows that the product is heated above or below the critical temperature [3]. If it is heated or cooled then it becomes changed by either microorganism growth, colour change, flavour change etc. During entire supply chain process, need to control and maintain the temperature. A small variation in temperature along with time can cause the degradation of food quality. This can be easily traced by recording temperature indicators which track and record all time data history. This data recording is also visible to customers, dealers and supply chain people to develop the trust regarding the quality [4].

Freshness indicators are another indicator used to indicate the freshness and healthiness of food depending upon microbial growth or chemical changes.

The hydrogen sulphide is used to measure the quality of meat. During aging of meat, hydrogen sulphide is released by meat matrix is compared by the colour of myoglobin to represent the quality of meat product [4,5].

## **2. Active packaging**

Active packaging is an emerging field of food technology. Many companies commercially prefer this technology as this is more economic than other ones.

Active packaging is an advance packaging system used to keep the food fresh, odourless and with required moisture, carbon dioxide, oxygen level.

### **2.1 O<sub>2</sub>-scavenging technology:**

The main cause of food spoilage is due to presence of O<sub>2</sub> or by oxidation of food. The oxidation sensitive foods like cheese, meat, dairy products, eggs etc are packed by modified atmosphere technology. But this is costly technology and does not remove O<sub>2</sub> completely. Hence O<sub>2</sub> scavengers are more beneficial to remove residual O<sub>2</sub> after packaging of food [6]. The use of ascorbic acid oxidation, iron powder oxidation, photo-sensitive dye oxidation, enzymatic oxidation like glucose oxidase and alcohol oxidase, unsaturated fatty acids and immobilized yeast on a solid material helps to minimise the oxidation level in food.

### **2.2 Ethylene scavengers:**

The ethylene increases the respiration rate of the food along with softening and ripening of various fruits [6,7]. In cases of citrus fruits, ethylene is very useful to increase the shelf life of fruits and vegetables. This is available in sachet forms.

### **2.3 CO<sub>2</sub>-scavengers and emitters:**

Due to respiration process and deterioration, the CO<sub>2</sub> releases in fruits and vegetables. This formed CO<sub>2</sub> helps in decaying of food. To avoid all these effects, CO<sub>2</sub> scavengers are used in sachet form which removes all formed CO<sub>2</sub> and maintain the quality of fruits and vegetables.

In case of meat and poultry, high CO<sub>2</sub> levels i.e. 10±80% are desirable because these high levels inhibit surface microbial growth and thereby extend shelf-life [7].

#### 2.4 Moisture Absorbent:

There are main 3 reasons for use of moisture absorbent.

- i) If the moisture content in food increases, it enhances the micro bacterial growth and spoilage of food.
- ii) If Moisture content reduces below certain level, may favour lipid oxidation. Hence, maintaining of required humidity the manufacturers can use moisture controlling sachets.
- iii) To prevent the condensation during respiration of fresh horticultural produce, moisture absorbent sachets are useful.

There are wide applications of moisture absorbent in poultry, fruits and vegetables, basically consist of a superabsorbent polymer in between two layers[7]. The preferred polymers like polyacrylate salts and graft copolymers of starch are use for absorbing water.

### 3. MAP

The modified atmosphere packaging (MAP) is an advance packaging technology used to prevent the food with fresh, safe, nutritive value within its prescribed shelf life.

The MAP technology is achieved by altering the composition of gases like Nitrogen, Oxygen and carbon dioxide without using preservatives [8]. Because, each gas has its advantages and disadvantages. The MAP consist of main 3 gases namely Nitrogen, Oxygen and carbon dioxide. The normal composition of

atmospheric air is 78.1% N<sub>2</sub>, 20.9% O<sub>2</sub> and 0.03% CO<sub>2</sub>. The MAP technology is achieved by altering the composition of gases like Nitrogen, Oxygen and carbon dioxide. Because each gas has its advantages and disadvantages. The presence of oxygen helps to increase the microbial growth, rapid ripening and senescence of fruits and vegetables, colour change etc. On other hand it's useful in fruits and vegetables common aerobic respiration process, to maintain natural colour of meat, fish etc. Nitrogen is chemically inert gas, not soluble in water. Its presence helps in preserving the food by displacing the oxygen and saves the package. The carbon dioxide reduces the respiration process. It is soluble in water as well in lipids. Its solubility increases with decreasing temperatures. The dissolution of CO<sub>2</sub> in the product can result in package collapse.

The MAP works on three principles;

- It reduces undesirable physiological, chemical/biochemical and physical changes in foods
- It prevents product contamination
- It prohibits the microbial growth.

The MAP techniques work on Active and passive atmosphere modification.

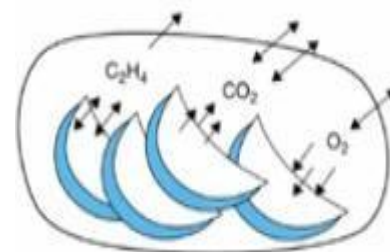


Fig.No.1.1 modified atmosphere packaging [7]

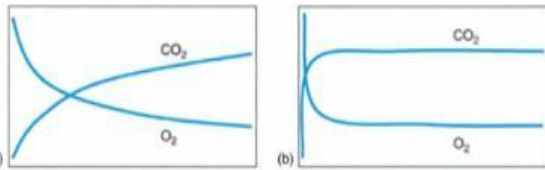


Fig. 1.2  
packaging [9]

The above 1.1 shows the gas exchange between a product and its surrounding atmosphere in a permeable package. The Figure 1.2 represents the passive and active atmosphere modification [9].

The active atmosphere modification is done by creating vacuum in packaging techniques such as canning, or bottling in glass containers. This vacuum eliminates the residual oxygen in packages and prevents the microbial growth and preserves the food. Once the vacuum is created and the required composition gas is filled, these alterations become non-modified to end stages. The vacuum should be maintained to storage rooms, containers within the supply chain.

MAP is used for a wide range of foods such as cheeses, salads, fruits, and vegetables, meat, poultry, fish, bakery products, potato chips etc [10]. Commercially, to increase the quality of food, the various scavenger sachets and pads are added in MAP packaging [11].

#### 4. Controlled Atmosphere

The controlled atmosphere (CA) storage is commonly uses less oxygen levels and high carbon dioxide levels in the storage conditions combined with refrigeration.

The storage room is occupied with controlled gas composition with close tolerance. The main advantage over MAP is to CAP can alter the gas composition at

various stages of storage as per requirement. This is mostly preferred for long term storage produce like apples, kiwi, pear etc [12].

The CA storage was used mostly for the apples but later was proven commercially for other fruits, cut fruits and vegetables. It also promotes the disinfection and insect control.

#### 5. Conclusion

Due to high demand of food produces, the need of packaging technology for storage, handling, transportation increases day by day. To fulfil this high demand, the perishables need not only refrigeration system but advanced packaging technology which provides the quality of food, commercially easily manufacturable and economic. The intelligent system provides this requirement by giving the real time status to each element in supply chain and to customers. The use of advanced machineries, devices helps to maintain the food quality and to properly communicate with customers. These devices are added inside the packages, labelled, and inbuilt in packaging materials. Active packaging is commercially easy to produce and economic. The MAP and Cap technology provided the long term storage of foods without or very less use of preservatives. This saves the human health.

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