

Overview of Packaging Materials and Importance of Packaging in Food Processing Industries

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ABSTRACT

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Modern packaging materials have been developed parallel to the development of technology. Most of the packaging materials are designed to use once. Shelf-life of food is defined as the time period during which the food is acceptable for consumption. Selection of packaging material not only depends on technical suitability but, also on the availability, cost, area, marketing aspects and also on environmental issues associated with packaging materials. The aim of this review paper is to describes different packaging materials available for different products. It also tells about different functionalities of packaging like containment, preservation, protection, providing information etc. This paper also talks about modern packaging systems like smart packaging, active packaging and intelligent packaging. Grouping packaging material into retail and container packaging. It also briefs about impact of packaging on maintaining food quality, reducing waste and price.

Keywords : Packaging material, smart packaging, intelligent packaging, shelf-life.

I. INTRODUCTION

Packaging generally refers to science, art and technology of enclosing or protecting the product for storage, distribution, sale and use. Apart from this they also protect the product from contamination and to display the nutrients, ingredients and other product details to consumer. Packaging seems to be more interesting aspect because of the effect it has on the supply chain and customer attitude on the product. However, it may also impact the company in

terms of presenting the product, protecting the product, waste management, cost, logistics and environmental issues. Food packaging is improved based on essential requirements corresponding to consumer priorities [1]. In order to give identity to the product produced production managers try to make difference in product packaging. Maintaining food quality and improving safety, and reducing postharvest losses waste are key objectives of a sustainable food system [2] The key objective of sustainable food system is to improve quality, safety

and reducing post harvesting losses. About 1.3 billion tonnes of food is wasted in distribution, production and households annually. In appropriate processing and packaging can cause 20-40 percent of food losses in developing countries. Packaging of industrial products has become more important with attention to health conditions, significance of satisfaction of consumers and mandatory protection of consumer rights [3]. About 10% of food and vegetables are discarded in European union due to spoilage and quality. As a result, the role of packaging becomes one of the main factor to reduce all these losses. Therefore, the objective of this paper is to discuss necessity of packaging in food industry mainly focusing on the impact of packing in improving safety, quality and reducing the spoilage of food. The importance of packaging increases as the standard of living increases with the development of technologies the mindset of consumer on packaging has been changed. Packaging has made peoples life easier in terms of identifying the product, easy of opening, increasing shelf-life, storage etc.

II. FUNCTIONS OF PACKAGING

Fundamental functions of packaging are as follows viz. containment, preservation, protection, information and convenience. Art from these they also play very important role in environment responsibility, product promotion, product presentation, product information and selling. In present state environmental issue is one of the major factor to be considered for packaging. Manufacturer should come up with packaging material that can be reused after unboxing the product from it.

- **Containment**

The role of the containment is to seal or conceive the product within the package. It ensures that there is no loss or spillage from the stage of packaging till the

product reaches consumer. this function of packaging becomes very important for products like chemicals and liquids. Also when a main parts have several sub parts it helps in containing them in a single packing system such that when it reaches consumer assembling becomes easy.

- **Protection**

Many products like food, cloths medicines requires safe transportation from production area to the consumer end, it has to be protected from several hazardous factors like dust, air, temperature and animals. Packaging protects the product from all these external factors. In some cases like drugs it is important to maintain the temperature within some range. In such cases understanding the product characteristics and selecting the suitable packaging material becomes vital.

- **Preservation**

It might not be important parameter for all the products but, when considered food products, medicines and other perishable products becomes necessary. Preservation helps in keeping the product safe and making it available for long duration of life. It is also important to pack the product when it is in safe condition.

- **Convenience**

The packed product should be convenient o carry, transport. And when it reaches to the consumer it should also be convenient to remove the product from the package. Best example for convenience is when a person buys drink packed in a can tin, he needs to consume the drink all at once, instead he can buy same drink packed in capped bottle so that he can consume it whenever required. Hence same product packed in different packaging system provides different convenience. It is for this reason

manufacturer produces product in wide variety of shape and size.

- **Information**

Every packaging contains different type of information they are product information, marketing and brand information and tracking information. Tracking information is usually contained in the form of bar, matrix and sometimes in radio frequency chips. Usually, this information is not required for the consumer but, it is required to reach the product to the consumer. The information is about manufacturer, dimension of packaging and product which does not change over a short period of time. This information is fetched using scanner and detectors.

- **Product information**

This information tells about the ingredients, nutritional quantity of food and also technical specifications of electronic goods. It also tells about manufacturer, origin of the country and distributor. For example, a biscuit package contains all the ingredients used, nutritional volume manufacturer and origin. this information helps in knowing about product without taking help from others or from shopkeeper.

- **Marketing and branding information**

Every company wants to sustain their product in market. We can see a single kind of product being produced by many companies. But they come up with different brand logo, brand slogan and product name. in some conditions packaging can be brand specific for ex pringles manufacturing potato crisp, pack them in a carton tubes compared to other potato crisp manufacturer pack them in a foil or plastic bags. Apart from this various sub category of the same product maintains different color code for easy identification. Nandini milk product has blue, orange

and green coloured packets indicating different fat content.

Selection of packaging material is one of the important factor that a food processing industry has to consider. Packaging material not only depends on the food being packed but, also on the availability of the packaging material, cost and some of the marketing considerations.

III. CLASSIFICATION OF PACKAGING MATERIAL

a. Shipping container

As the name tells this type of packaging material are used to protect the products during their shipment and distribution to the market. These materials do not add any marketing values to the product.

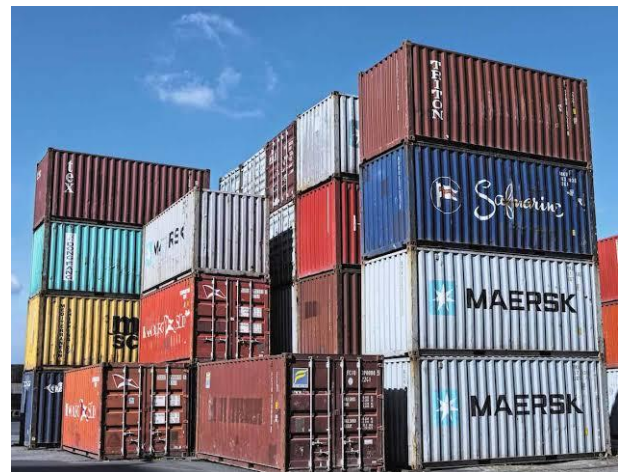


Figure 1 : Shipping containers for transportation

b. Retail containers

This type of packaging provides detail of the product. They also protect the product from being exposed to the atmosphere. Apart from this they add value to sales and advertising.

Many a times a single product is packed in retail container first and then into the shipping container for transportation and distribution. For ex coffee packets are usually packed in a plastic material or in a

glass. This product is further packed in a carton box for shipping them into the market.



Fig 2: Retail packaging kept in stores for marketing

c. Traditional packaging materials

Packaging is an art that has been followed since olden days. They are used only for the purpose of storing food for short period of time. The disadvantages of traditional packaging materials are, most of them have poor barrier properties except potteries. They does not provide any attractive looks for the product and hence they are not suitable for commercial purpose.

- **Leaves**

They are commonly used to pack the food items which are being stored for very short period of time. Advantages are they are readily available, eco friendly and cost effective.



Fig 3: Leaf packaging

- **Vegetable fibers and sacs**

Ropes made from vegetable fibres are used to store and carry hard fruits. Jute sac is one of the commonly used traditional packaging material. Major advantages of jute sacs are they are light-weight, reusable, does not worn out very quickly, more durability, eco-friendly. They are generally used to carry vegetables, fruits, grams and other food products from agriculture fields to marketing place.



Figure 4: Packaging using vegetable fibres

- **Potteries**

Potteries are mainly used to store liquid and solid food items. Potteries are enclosed with the help of wooden lid, cloth or by plastic stoppers. Food items like honey, butter and beer are stored in potteries. Galvanized potteries protect the food items from sunlight, moisture and harmful insects. Non galvanized potteries help to maintain the coolness of the product.

d. Industrial packaging materials: considering the safety aspects and marketing strategies of food products, packaging has come up with metals, glass, different types of plastic and paper cardboard.

- **Metals**

They are generally used for storing beverages like cold coffee, sprite, coco cola, milkshakes. They are also used to store solid food stuffs like milk powder, grains etc. metal container is usually made up of coated tin or by aluminium. Advantages of metal are they can withstand temperature variations, they are opaque and do not allow light, moisture and other harmful bacteria to enter into food. Apart from this they also have their own disadvantages like high cost of manufacturing, more weight compared to plastic and hence cost of transportation is also more.



Figure 5: Metal containers

- **Glass**

They are generally used to store things which require regular inspections usually syrups, juice, jams and other drug items. Like metals they are rigid, reusable, does not allow rodents and bacteria to enter food stuff. Unlike metals they are transparent and hence allow sunlight to pass through them. Glass bottles can be moulded into different shapes and dimensions. Main disadvantages are they are more expensive compared to plastic and easily breakable when they are carried in rough roads and hence safe transportation becomes very important.



Figure 6: Glass bottles

- **Paper and cardboard**

They are made with the residuals of wood like wood pulp. In order to add some of the properties some additives are added. Clay is added to provide better surface smoothness. Resins are added to avoid penetration of liquid into it. Binders are added to provide good strength. Colours added to make it attractive for marketing. Papers are used to wrap chocolates and dairy products, vegetables and fruits. Their main function is to protect the product from dust, water, microbes. Cardboard or paperboard contains three layers of paper. The top layer is used to print the information, bottom layer provides strength and the middle layer helps to glue top and bottom layer by providing extra strength to the structure. Small cardboards are used to pack salts, nuts, snacks etc. larger cardboard lined with polyethylene can be used as a replacement of metals and plastic by improving its strength. Corrugated boards are used for packaging coffee sachets, peanut butter, frozen products and dairy products. Corrugated boards are also used as the shipping containers since they can withstand compression and impact.



Figure 7: cardboard packaging

- **Plastic**

They are one of the commonly seen material used in primary secondary and tertiary packaging. Advantages of plastic are cost effective, fits correctly to the shape of product, light-weight, resistant to light, temperature and various harmful microbes. The main concern over plastic is they are not eco-friendly. This has led to the development of bio-plastics. However, their availability in developing nation is very less. Different plastic polymers are available like polyethylene, polypropylene and polyester. Coated polypropylene (2 layers) is used in packing crisps, snacks food, ice cream, biscuits, chocolates. coated polypropylene-polyethylene is used in packaging cheese, dried fruits, frozen vegetables etc. Cellulose-polyethylene-cellulose is used in packaging bread, coffee, cheese and meat. Table 1 describes some of the products and associated packaging materials.



Figure 8: Plastic packaging

IV. PACKAGING AS AN EXAMPLE IN CHOCOLATE INDUSTRY.

Chocolates are one of the products under FMCG. They are susceptible to the environmental factors and hence packaging becomes very important. To protect the shape of chocolate and avoid them from melting due to sunlight are the functions of packaging. Chocolates are packed mainly by four packaging materials. Soft paper and aluminium foil, Hard paper and aluminium foil, plastic wrap, and waxed paper.

- **Plastic wrapping**

It is one of the olden packaging methods used for chocolate packing. It only covers about 10% of the total cost of packaging. One can see many companies uses this system as it is cost effective method. But coming to the disadvantage is plastic wrap is not eco-friendly and the reusability is very less. Plastic wrap can be seen in low priced chocolates.

- **Aluminum foil along with paper**

This proves eco-friendly method except little high cost compared to plastic wrap. High cost is due to the use of aluminium foil. Aluminium foil provides better protection of chocolate from sunlight helping to maintain its shape and rigidity (avoid melting). this foil is wrapped around the paper. It also possible to vary the thickness of the paper depending on the requirement. They can be made as soft paper or multiple layers of soft paper leading to hard paper. This type of packaging is seen in Dairy milk chocolates, KitKat and other high-cost chocolates.

- **Wax paper**

Can be produced either by mineral oil or by vegetable oil. Both these types are suitable for food packaging. Additional material is added to enhance the performance of packaging. One of the advantage is it provides grease barrier and hence used in inner layer of chocolate packaging.

Table 1: products and their packaging materials

Modern Packaging material	Packed products
Glass	Syrups, sauces, juices, beer, wine, spirit etc..
plastic	Milk and milk products, water bottles etc
paperboard	Fruit juices, biscuits, chocolates, sweets, vegetables food items for delivery
metals	Soft drink cans like coco-cola, oil cans etc

V. TYPES OF PACKAGING

To meet the required functions of packaging, selection of suitable packaging material becomes very important. While selecting the packaging material aspects like its efficiency, ease of recycle, shape and form factors are considered. Along with engineering and cost aspects environmental issues are also important.

- **Smart packaging**

With the advancement in sensor and communication technology packaging companies have adopted such system in packaging. This system provides better interaction between product and package, and also better transformation of information like quality and safety of the product in the package. Such system is called smart packaging. They make use of smart devices of mechanical and electronics and also chemicals to improve life of the product. They display information and condition of the products like temperature, expiry date and nutritional contents of the product.



Figure 9: Smart packaging showing product information

- **Active packaging**

It is a type of packaging where components are added or removed into or from packaging system to improve the shelf-life, quality and sensory aspects of the product. Active packaging has two types, active scavenging system and active releasing system. In active scavenging system undesirable elements like oxygen, ethylene and excess moisture content that are responsible for decaying of food products are removed from the packaging system. In active releasing system agent will add essential components like carbon-dioxide and antioxidants to the packaging system.

- **Intelligent packaging**

Here the packaging material acts a medium to provide information regarding the product. They provide information like product integrity, temperature and microbial growth. Presently freshness indicator and temperature indicator are available to detect the quality of the food.



Figure 10: Intelligent packaging for fruits to check its freshness

VI. IMPACT OF PACKAGING ON FOOD PRODUCTS

• Sensory and nutritional quality

Selection of suitable packaging system becomes very important to maintain the quality aspects of the food like nutritional and sensory qualities. From the study it is found that table grapes packaged in perforated plastic bags has more sensory and nutritional qualities like crispiness and juiciness compared to that stored in non-perforated plastic bags. Form of packaging materials also plays important role in maintaining nutrients value. From the studies it is identified that citrus juices stored in polyethene cardboard losses its aroma content compared to other forms of packaging system.

• Shelf-life

It is defined as the time period during which the food is acceptable for consumption. It means during this period the quality and safety of the food is in the acceptable range for consumption. Shelf-life depends on factors like method of processing the product, storage condition and packaging. Packaging can become one of the important factor to extend shelf-life. Unpacked fruits and vegetables are exposed to various micro-organisms in the atmosphere there by reducing the water content and shelf-life. From the studies it is found that fruits and vegetables stored in polyethylene bags reduces the loss of water content.

• Food quality

Food products which are exposed to atmosphere or which are not properly packed when consumed by human can lead to food poison in some cases it may also lead to death. Proper food packaging leads to safety of the consumer health while the effective packaging of food leads to increase the shelf-life, quality of food and reduce the spoilage and wastage of food.

• Price of food product

Packaging enhances the shelf-life, quality and safety of the product. While it reduces the spoilage of food. On the other hand packaging also adds additional cost on the product price. From the studies it is evident that packaging material cost is about 17% of the total product cost. It also depends on the type of material. For ex: juice packed in glass bottles will cost more compared to that packed in plastic bottles. The weight of packaging material also adds extra cost to the product price. Higher the weight of packaging material higher will be the transportation cost. When the packaging is done in attractive ways, consumer will be attracted towards the product and high price of packaging will not bother him. The advances in bio-technology, nano-technology has led to the development of cost-effective sensors and variety of material that can be used in intelligent and smart packaging system.

VII. ROLE OF PACKAGING IN REDUCING THE WASTAGE OF FOOD

About 25-30 percent of food produced in developed and developing countries are spoiled. This is due to the improper post-harvest technologies and cold-chain conditions. One can reduce this losses by making use of effective packaging technology. About one third of the rice grains produced in Asian countries are wasted due to the rodents and pests due to poor packaging and storing methods. From the studies it is found that decay of strawberries was about 85% when it was in unpacked condition was reduced to 33% when it was packed in polypropylene layer. Thus, selecting packaging materials becomes one of the prime deciding factor to reduce spoilage and wastage of food.

VIII. CONCLUSION

Changes in technology has affected our life styles and also the food processing industry. By choosing suitable packaging material and packaging system one can reduce various aspects like spoilage, waste and can increase shelf-life. However, packaging is also a major contributor on cost, and recycling of packaging material is a serious issue. Advances in packaging materials has led to improve food quality and safety. Innovations in nanotechnology has led to Developments like smart packing, intelligent packaging and active packaging system to provide the suitable atmosphere for products contained in packaging. Most of the changes in packaging is driven by costumer preference.

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