
UNIT 12 PACKAGING – NEED AND IMPORTANCE

Structure

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12.0 OBJECTIVES

After reading this unit, you should be able to:

- state the definition of food packaging;
- define the functions of packaging and its importance;
- explain the types of packaging;
- classify various packaging materials;
- describe the properties of packaging technology and its applications in processed food products; and
- design and develop the packages.

12.1 INTRODUCTION

The term food is defined as any substance containing nutrients such as carbohydrates, proteins, and fats that can be ingested by a living organism and metabolised into energy. Food is necessary for survival, growth of physical and mental ability and good health. The need and importance of food was known even to primitive men.

The nutritional status of a nation is complicated in nature as it depends on many inter-related set of factors such as food adequacy and its distribution, levels of poverty, level of literacy, status of women, rate of population growth and the extent of economic growth. In our country, the trend of nutritional level improvement for the last fifteen years has been gradual and modest despite steep rise in population.

The Indian economy is predominant agrarian. Agriculture constitutes 33% of our GDP, supports 64% of work force and earn 19% of our exports. The country produces 46 million tonnes of fruits and 96 million tonnes of vegetables and is the second largest producer next to Brazil and China, respectively. In spite of having such a good production, it incurs a loss of 25-30% every year. The spoilage of food products are due to improper infrastructure facilities for storage, handling, transportation and unscientific and inadequate packaging. India wastes more fruits and vegetables than are

consumed in a country like U.K. This indicates that there is an urgent need to give more emphasis on packaging of food.

The level of food processing in our country is very low which has to be considerably increased if losses are to be minimised and also to ensure marketing of good product in packaged form. The selling of loose and exposed product is unhygienic and affects the health of the common masses. There could be considerable amount of savings in this context if all surplus quantity of produce are processed and sold in the market in a packaged form. But, consumer awareness and education are extremely important if this has to be achieved.

Indian consumer prefers to buy fresh produce and cook at home. Generally, processed and packaged forms are less preferred and purchased by Indian consumer as compared to the market trend elsewhere in the world. The primary reason is a myth and an inertia. There is still a perception that processing reduces the nutritive value and add to the cost. This myth needs to be broken on an urgent basis. The fact is that packaging reduces waste, adds value and assures a product to the consumer.

In our country, any fresh produce fruits, vegetables or processed products have never been associated with packaging. It is only in the recent times that the importance of packaging has been accepted. This is mainly due to growing consumer awareness and their willingness to pay for quality and hygienic products. In addition, increase in growth of exports has also made it obligatory to pack the product in attractive and consumer friendly packages. Considerable amount of improvement and development in packaging has taken place, especially for food products, in the last one decade. However, these efforts need to be augmented and implemented effectively to minimise the problems and make the food available more easily and economically. It may be pointed out that there is a tremendous scope for further improvement and development of packaging. In fact, the per capita consumption of packaging materials in India is much lower as compared to other developed and developing countries. Many more food products are still available in Indian market in unpacked condition, particularly the fresh produce like fruits, vegetables, meat, fish, poultry, etc. In order to maintain the hygienic condition of these food products and also to ensure their assured quality, it would be desirable to sell these products in packaged conditions. This will also increase the consumption of packaging materials enormously.

The subject “Food Packaging” has been introduced to modern technology recently. But this technology was existent on earth without having any proper attention. Most of the fruits like coconut, orange, banana, etc., having a skin or peel are available to us in packaged form in hygienic conditions this type of packaging is considered to be natural packaging. Further, the use of dry leaves for wrapping meat, animal skin based bags for storage, etc., wherein vogue since long. But recently, the importance of packaging has been understood in the food supply chain.

Food packaging is defined as a mean or system by which a fresh produce or processed product will reach from the production centre to the ultimate consumer in safe and sound condition at an affordable price. In other words, packaging is a combination of science, art and technology. Packaging is an integral part of production, storage, handling, distribution, retailing and end-use. Packaging is also considered as the last output of production but the first

input of marketing. In other words, packaging acts as a tool or instrument for marketing.

The functions of packaging is performed by 3 P's, i.e., Preservation, Protection and Presentation. The above three P's are applicable to consumer products. However, this has minor role to play in industrial products.

Packaging serves two basic objectives, i.e., marketing and logistics. In its marketing function

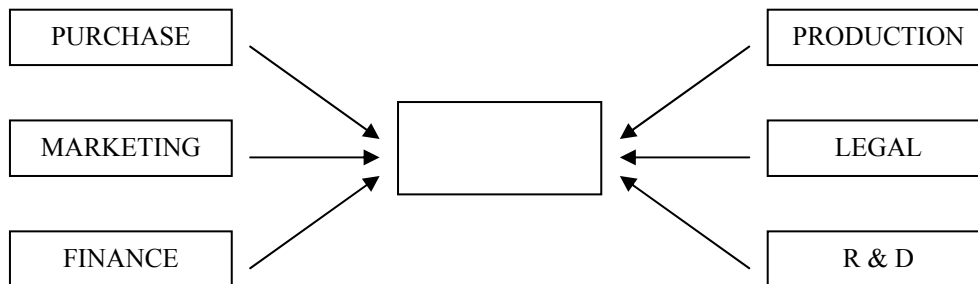
- it provides information about the product to customers,
- it promotes the product with attractive graphics and printing,
- it acts a medium of communication,
- it acts as a silent salesman and it is the final interface between the company and the consumers.

From the logistic perspective, the role of packaging is to ensure the safe delivery of a product to the ultimate customer at minimum cost.

In the logistic perspective, it performs six functions:

- Containment
- Protection
- Apportionment
- Unitisation
- Convenience
- Communication

The packaging function is closely associated with many other functions in an organisation. Effective communication is, therefore, important. In an organisational set up the packaging function is interrelated and this is illustrated below:



Due to this fact, packaging department is considered to be the nucleus in any FMCG (Fast moving consumer goods) company. The launch of any consumer product in a new package needs constant interaction among the inter departments of the company.

The package should be designed to provide efficient storage. However, its design is influenced by:

- Standardization
- Price or cost.
- Package or product adaptability.
- Protective level.
- Handling ability.
- Product packability
- Reusability or recyclability



Check Your Progress Exercise 1

Note: a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. How do you define “Food Packaging”?

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2. What are the important functions of packaging?

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3. What are the factors involved to make a good package design?

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12.2 TYPES OF PACKAGINGS

The container or the package serves mainly as a protectional device to avoid deterioration in the quality of contents against external agencies. However, in many instances, the packages are also designed taking into account the marketing considerations such as sales appeal, easy acceptability, handling convenience and distribution factors. Hence, it is desirable that you should know about the components of packaging or types of packaging available in the market.

12.2.1 Package Components

A broad classification of package components is given below:

- i) Unit pack
- ii) Intermediate pack
- iii) Outer or shipping container
- iv) Inner packaging components
- v) External reinforcements

i) Unit pack

It is considered to be a package containing single unit, e.g. a toffee or chocolate is wrapped, 200 ml beer is packed in metal container. Unit package should be able to protect the product against the deterioration of quality. Naturally, the material selected for unit pack should have adequate functional properties to serve such function. This package serves as a retail pack and thus the package should have good eye appeal, easy openability and easy to carry or handle. In short, the package should be customer friendly.

ii) Intermediate pack

The unit packs further unitised to satisfy the marketing requirement, are called intermediate packs. For example, 10 unit pack of 100 g of butter packed in paper board carton are unitised to facilitate handling and enhance display value.

iii) Outer or shipping container

The intermediate packs are further packed into corrugated fibre board boxes or wooden boxes or Jute bags or HDPE woven sacks to transport the products. These packages are also termed as transport packages. These packages provide protection to the contents from journey hazards such as shock, vibration, drops and climatic hazards like rain, dust, sea water, etc., during handling, storage and transportation from one place to another.

iv) Inner packaging components

These components are normally given to the transport package by way of providing the resistance of movement of contents during journey due to vibration. The materials like separators are used in package where glass bottles are packed. Cushioning materials like thermocole, expanded polystyrene (EPS), expanded polyethylene (EPE), paper cuttings, wood wool are used either to protect the product against the shock hazards or space fillers to prevent the movement of contents during journey.

v) External reinforcement

The shipping containers are further reinforced by means of either plastic straps or metal straps applied along the girth as well as the length in order to strengthen the shipping container. Reinforcement also helps to improve the stacking strength, avoid bursting in case of failure and increase weight carrying capacity.

12.2.2 Packaging Materials

Packaging materials are broadly classified into two major types.

- i) Primary packaging materials
- ii) Ancillary packaging materials

I) Primary packaging materials

a) Flexible packaging materials

- i) Cellulose based materials
- ii) Regenerated cellulose or cellophane

Food Packaging

- iii) Jute or hession materials
- iv) Aluminium foil
- v) Plastic films and laminates
- vi) Plastic woven sack

(i) Cellulose based materials

These materials are available in two forms, i.e., Paper and paper board. More than 180 gsm paper is generally termed as paper board.

- Paper: Different types of paper used in packaging are:

- Tissue paper
- Coated (varnish or wax coated)
- Butter paper
- Glassine paper
- Art paper
- Kraft paper
- VPI paper
- High gloss paper
- Vegetable parchment paper

- Paper Board : Different types of paper boards used are:

- Coated board
- Duplex board
- Triplex board
- Asphalted board
- Grey board
- Mill board
- Clay coated board
- Kraft board
- Chip board
- Straw board

(ii) Regenerated cellulose or cellophane

The most common types of cellophane used for packaging are:

- Moisture proof sealable transparent cellophane(MST)
- Moisture proof sealable transparent coloured cellophane (MSCT).
- Moisture proof sealable transparent anchored cellophane (MSAT)
- Moisture proof saran coated cellophane (MXXT)

(iii) Aluminium foil

Different thicknesses of aluminium foils are available for the packaging application.

(iv) Jute or hession materials

Jute fabrics of different types, like single warp and double, are used for making the jute bags. Sometimes, the jute fabrics are also made water proof either by lamination or coating with bitumen or plastic for packaging.

(v) Plastic films and laminates

There are various types of polymeric materials which are converted into plastic films and have got wide application in packaging.

Some of the important polymeric materials are as follows:

- *Polyethylene*
 - Low density polyethylene (LDPE)
 - High density polyethylene (HDPE)
 - High molecular high density polyethylene (HMHDPE)
 - Linear low density polyethylene (LLDPE)
 - Very linear low density polyethylene (VLLDPE)
 - Copolymers like surlyn or primacor (EAA)
- *Polypropylene*
 - Bioaxially oriented poly propylene (BOPP)
 - Cast poly propylene (CPP)
 - Tubular quenched poly propylene (TQPP)
- *Polyvinyl chloride (PVC)*
- *Polyethylene terephthalate (PET)*
- *Polystyrene (PS)*
- *Poly carbonate (PC)*
- *Poly amide or nylon (PA)*

Depending on the requirement, the plastic films are converted into composite structure either in co-extruded form or in laminated form. The packaging materials are available either as 3 layered or 5 layered coextruded film.

- LDPE/ HDPE/ LLDPE. (3 layered co-extruded)
- LDPE/ TIE/ NYLON/ TIE/ LDPE.(5 layers co-extruded)

These types of films have got extensive application for the packaging of fresh milk and edible oil.

But for the consumer products like bakery items, snack foods, pan masala, confectionary, etc., the plastic based laminate in three or four layer are commonly used in order to meet the requirement of barrier properties against moisture, oxygen and light.

Some of the important structure of plastic laminates are given below:

Food Packaging

Spices	:	BOPP film/ Adhesive/ LDPE. Metallised PET/ Adhesive/ LDPE. BOPP/ Adhesive/ PAPER/ LDPE.
Snack foods	:	Oriented PET/ Adhesive/ Met PET/ Adhesive/ LDPE. Oriented PET/ Adhesive/ Met PET/ Adhesive Aluminum foil/ LDPE.
Mouth refresher	:	Oriented PET/ adhesive/ Opaque BOPP/ adhesive/ Met. PET/ adhesive/ LDPE.

(vi) Plastic woven sack

Available in laminated or non-laminated forms.

b) Rigid packaging materials

The packaging materials are available in following types:

- (i) Metal container – Drum, barrels, tin containers
aluminium containers
TFS Containers (Tin free steel)
- (ii) Glass container – Glass bottle, glass jar carboys, ampules
- (iii) Plastic containers – Plastic bottles, drum, barrels, jerrycan
- (iv) Plastic crate
- (v) Wooden containers – Box, crate
- (vi) Corrugated fibre board boxes
- (vii) Fibre drum
- (viii) Ply wood container

c) Semi rigid packaging materials

The important types of packaging materials are as follows:

- i) Aluminium collapsible tube
- ii) Plastic collapsible tube
- iii) Composite container
- iv) Paper based carton

II) Ancillary packaging materials

The important types of materials which have got application in packaging are as follows:

- (i) Printing ink – Flexo ink, gravure ink, offset ink
- (ii) Adhesives – Lamination adhesive, pasting adhesive,
corrugation adhesive
- (iii) Labels – Self adhesive pressure sensitive

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|---------------------------------|--|
| (iv) Cushioning materials – | Resilience, non-resilience and space fillers |
| (v) Strapings – | Plastic metal, |
| (vi) Tapes – | Paper tapes, plastic tapes |
| (vii) Nails, hooks, clips, etc. | |

Check Your Progress Exercise 2



- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. How do you classify the package components?

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2. What are the three important types of packaging?

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3. Fill up the following blanks:

- a) Full form of PET is _____
- b) CPP means _____
- c) MAP means _____
- d) '3P' stands for _____
- e) Cushioning materials are _____

4. Tick (✓) the correct answer:

- a) Cellophane is
- | | |
|----------------------------|--------------|
| i) Paper | ii) Plastics |
| iii) Regenerated cellulose | |
- b) Corrugated fibre board boxes are considered to be
- | |
|-----------------------------------|
| i) Primary packaging materials |
| ii) Ancillary packaging materials |

12.3 PROPERTIES OF PACKAGING

Packaging is an integral part of product processing and preservation. It has a direct influence on the system in respect to physical and chemical changes. The barrier properties and packaging materials play a significant role in preservation and thus, extension of shelf life of processed food product.

With the advancement of preservation technologies for food products coupled with the introduction of newer packaging materials and systems, it has been possible to introduce new generation products into the market.

Almost all types of packaging materials are used by food industry. Metal cans made of tin plate have been used by the canneries over the years. However, the thin wall tin containers, welded or cemented joint cans with lead free solders and 2 piece tin plate cans are recently introduced in the market for the packaging of fresh produce. The food products are processed at high temperature and pressure to make containers hermetically sealed. These type of containers provide about one year shelf life to the processed food.

Despite of having the difficulties of breakage and more tare weight, the glass bottles are used extensively for packaging of the processed food products. This material is non-toxic, non-reactive and high temperature resistant. The processed food like tomato ketchup is normally hot filled in glass bottles.

The use of paper board cartons as bag in box for packaging of liquid products like edible oil is widely accepted. Paper board carton with appropriate liner is used for packaging tea.

Plastic containers, because of light weight, easy availability, economical, diversified sizes and shapes and recyclability property are widely used for food packaging.

Dual ovenable containers made of C-PET (Crystalline PET) have a high heat resistance up to 230°C. These trays can be frozen and then directly heated in the oven and, therefore, are used for packaging of ready to eat products.

High gas barrier plastic bottles are produced by co-extrusion blow moulding process or co-injection blow moulding process have got wide application in food packaging. The polyolefin materials like PE/PP bottles are commonly used.

However, the new development of co-extruded bottle made of PE or PP/ tie/ EvoH/ tie/ PE or PP are used for the packaging of edible oil, tomato ketchup, mayonnaise and salad dressings. PVDC coated PET bottles with improved gas barrier properties are used for beer and wine.

The flexible packaging materials having number of advantages are suitable for the packaging of processed food items. A wide variety of combination of packaging materials are developed to improve the barrier properties of moisture, oxygen, CO₂, and light and thus help to enhance the shelf life of food product. Recently, the application of flexible packaging materials have gone up tremendously due to their light weight, high barrier properties and cost effectiveness. These materials are used as monolayers like PE, BOPP, CPP or as composite structure like 3 layered/4 layered laminated form or 3 layered/5 layered coextruded film for the application of packaging of liquid milk, edible oil, spices, snack food, tea, coffee, etc.

In addition, there are certain innovative technologies like retort packaging, aseptic packaging which play a great role in enhancement of shelf life of processed food product. A retort pouch, made of polyester film/ aluminium foil/ cast polypropylene combination has got the property of with standing high temperature and pressure, while sterilized in the retort. This technology is very common in developed countries but in India this has recently been introduction for ready to eat products.

The introduction of aseptic technology to the Indian market has revolutionised the packaging of liquid food products like milk, fruit juices, etc.

Moreover, vacuum packaging and gas flushing techniques are very common in food packaging. Food products rich in fat tend to get rancid due to oxidation and get spoiled. However, evacuation of air from the package and introduction of inert gas like nitrogen inside the package not only retains the shape of the content but also protects from oxidation. This type of packaging is mostly used for snack food items like chips, namkeen, bhujia, etc. However, the products like tea, coffee, spices, etc., could be packed by using only vacuum packaging as the products are powder in nature to extend the shelf life at ambient conditions.

This clearly stated that different types of packaging materials and systems have got unique properties and these are to be chosen depending upon the requirement and application in packaging of various types of processed food products.

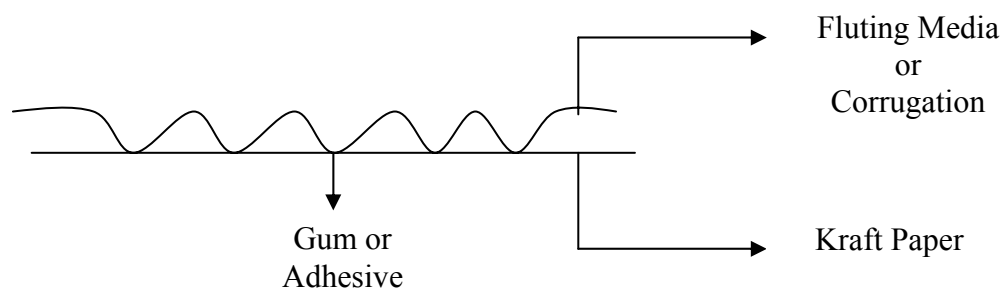
12.4 IMPORTANCE OF SUCCESSFUL PACKAGE

It is strongly desirable to keep the food products as fresh as possible for a longer duration so that these products can be distributed to a longer distance. At the same time, it is also necessary that the package has adequate strength so that the products can be transported without any breakage.

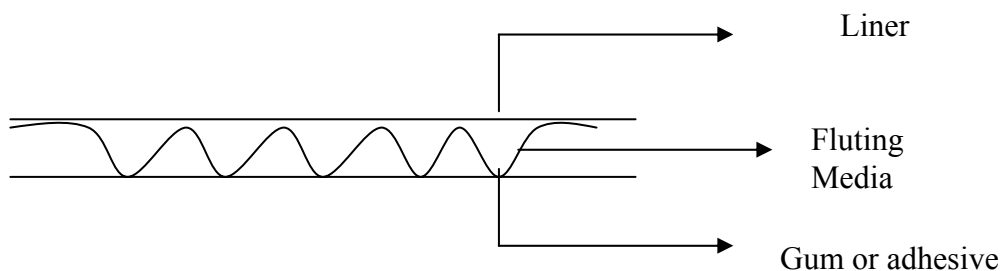
Fresh fruits and vegetables remain biologically alive even after harvest. The physiological function like respiration continues even after the supply of nutrition is cut off. The stored nutrition then begins to be consumed and gets depleted. The metabolic activity of ripening and aging also continues. Due to these facts, it is necessary to make proper ventilation in the package so that the respiration process continues, otherwise the produce will rot or spoil within a short period of time. The use of traditional packages like jute bag and bamboo basket for packaging of fresh fruits and vegetables is now being discontinued as these packages are unable to provide adequate protection to the produce during handling, storage and transportation.

The traditional packages are being slowly replaced by the use of corrugated fibre board boxes. These boxes are made from die-cut corrugated fibre board where the craft papers are passed through corrugating machine to get the fluting media or corrugation and finally stuck into a plain layer of craft paper by means of adhesives or gum to form 2 layer or 2 ply corrugation roll.

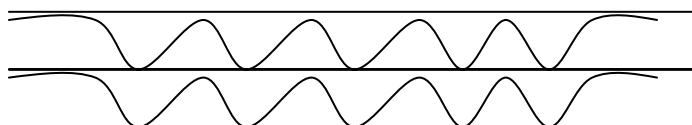
In the same manner, 3 or 5 ply corrugated fibre board boxes can be made by pasting the adequate number of craft liner or facing material. This could be illustrated by the following diagram (Figure 12.1).



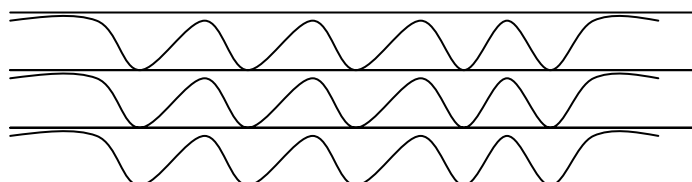
2 ply corrugating roll



3 ply or single wall corrugated fibre board



5 ply or double wall corrugated fibre board



7 ply or triple wall corrugated fibre board

Figure 12.1: Diagram illustrating different plys in a corrugated fibre board

The use of jute or gunny bag for packaging of apples is completely replaced by corrugated fibre board boxes. Similarly, the use of the bamboo basket for packaging of grapes has been discontinued and the fresh grapes are packed only in corrugated fibre board boxes. The new developed boxes are made from die-cut corrugated board with proper ventilation. The boxes are not only having adequate compression strength to prevent the crushing of fruits in stacked condition during storage and transportation but also enhance eye appeal to the consumer through attractive graphics and printing on the outer surface of the packages. The changing trend has substantially reduced the loss of fruits due to damage in transit. These examples clearly indicate that there is an urgent need to have proper package for all types of fresh produce to

distribute at distant places by retaining the freshness of the produce. These are easily available, accepted internationally and can be recycled and thus considered to be environment friendly. Sometimes, the outer surface of the boxes are given adequate coating to provide moisture proofness so that packages will not be damaged even after exposing to the high humid condition.

The use of modified atmosphere technology has led to the introduction of newer plastic films, such as OPP (Oriented polypropylene) film, coated by interfacial active agent (such as charcoal) for absorbing water vapour. The other films are:

- PE (Polyethylene) film blended with microporous materials absorbing ethylene gas.
- LLDPE (Linear low density polyethylene) film blended with anti-microbial materials, preventing the growth of bacteria and mould.
- PVC (Polyvinyl chloride) film blended with silver ions for anti-microbial properties.
- Antigas barrier film having micropores which allows oxygen to enter inside the package for respiration and for prolonged shelf life.

There is a wide variety of fresh commodities and each has a different respiration rate and requirements for storage. A judicious selection of the packaging medium is thus very significant to make a successful package for fresh produce.

Similarly, there is a wide variety of processed food products which are produced by using number of ingredients and different processing technologies. This has resulted into wider variation in requirement of packaging for longer shelf life.

You know that shelf life is the time between the production and packaging of a product and the point at which it becomes unacceptable under defined environmental conditions. It is a function of the product, package and the environment through which the product is transported, stored and sold.

The bakery products like bread and biscuit, both made from maida, require different packagings to satisfy the consumer.

Bread has got moisture content of 38 to 40% due to which the crumb of bread is soft in nature and preferred by the consumer. Whenever bread is kept outside, it starts losing moisture and becomes dry and unacceptable to consumers. Hence, bread is to be packed where the packaging materials should have low water vapour permeation or high barriers to moisture content. On the other hand, biscuits are crispy in nature due to low moisture content of about 2 per cent. When the biscuits are kept outside, the product intends to pick up moisture from the environment and becomes soggy and should unacceptable to the consumers. So, the packages for biscuits also have high moisture barriers property where moisture should not move from outside to inside. The properties of foods like ghee, butter or snacks are likely to get changed during storage. The products are fried in oil and when exposed to environment, react with atmospheric oxygen and undergo oxidation. The product becomes rancid resulting into the changes in taste. Moreover, UV light also plays a role to accelerate the oxidative reaction. Hence, the packaging requirement for these items are high barriers to light and oxygen.

Aroma loss in freshly ground spice or stimulating product like tea, coffee is very common. The packaging materials for these items should have high aroma resistance property.

The requirement of packaging for different processed food is required to be understood by you prior to decide the selection of packaging materials. This is possible only by understanding the critical characteristics of the products that means how the product gets spoiled or changes its characteristics or original properties during storage.

Hence, the selection of proper packaging materials with required quality depends upon the requirement of individual variety of processed food product. Considering this, the materials are to be selected so that products can be packed to maintain the quality of food during storage. A successful package can only meet the requirement of desired shelf life of a product.



Check Your Progress Exercise 3

- Note:** a) Use the space below for your answer.
b) Compare your answers with those given at the end of the unit.

1. What are the important packaging materials used for processed food products?

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2. What are the different types of innovative packaging systems for extending shelf life of food products?

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3. What kind of packaging materials used for fresh produce in place of traditional packaging materials?

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4. Why the processed food products have got different packaging requirements?

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12.5 LET US SUM UP



Food is considered to be one of the basic need of human being for survival, growth of physical and mental ability and good health. This has always played an important role in the rise or fall of economy of the nation because of its effect on the health of population.

It has been reported that there has been an average loss of 25 to 30 per cent of fresh produce in our country which is mainly due to improper handling and inadequate packaging. This has forced us to understand about the importance of packaging and its needs to prevent the material loss.

Food packaging is a system by which the fresh produce or processed one will reach from the production centre to the ultimate consumer in safe and sound condition at an affordable cost. It serves two basic objectives, i.e., marketing and logistics.

The different types of packaging materials have been discussed in detail in this chapter. For processed food, the important packaging materials like metal cans, paper board carton, plastic container and plastic bottle, and flexible packaging materials with different combinations are used. Similarly, the traditional packaging materials like gunny bags or bamboo baskets are being replaced by the introduction of corrugated fibre board boxes with proper ventilation and strength for packaging, handling and transportation of the fresh produce.

In addition, the innovative packaging technologies like aseptic packaging, retort packaging, gas flushing and vacuum packaging for processed food and modified atmosphere packaging for fresh produce have also been discussed. Shelf life is the time between the production and packaging of a product and the point at which the produce first become unacceptable under defined environmental conditions.

The requirement of packaging for different processed food products varies depending on the critical factors of different products. The product requires packaging materials of having moisture barriers, gas barriers, aroma barriers or digest barrier which ultimately play a key role in determining its the shelf life.

12.6 KEY WORDS

LLDPE : Linear low density polyethylene – a polymeric material.

Food Packaging	MAP	:	Modified atmosphere packaging – a packaging system for extending shelf life of fresh produce.
	C-PET	:	Crystalline polyster – a polymeric material.
	PVDC	:	Poly vinylidene chloride – a coating is given to a polymeric materials to improve the barrier properties.
	TFS	:	Tin Free Steel – the base plate is coated with chromium than tin.
	Resilience	:	A cushioning material like sponge; it means after pressing it will come back to its original position.
	Non-resilience	:	A cushioning material like expanded polystyrene or thermocole, which does not come back after releasing the pressure.
	Space filler	:	Cushioning materials like paper cutting, shredded wood wool, used to fill up the space in the package.
	Duplex board	:	Two layer of pulp is used to make the paper board
	Triplex board	:	Three layers of pulp is used to make the paper board.
	Composite container	:	A container where the body is made from paper and the ends are made from either metal or plastics.
	Chip board	:	A board made on continuous machine mainly from low grade waste papers. It has got extensive use for making sweet box.
	Grey board	:	A board made from mixed waste pulp with or without screenings and having the thickness less than 1 mm, used for packaging of shoes.
	Clay coated board	:	High grade bending board, the top of which has been coated with fine clay to produce a surface for printing, mainly used for gift items.
	Mill board	:	A homogeneous board made usually of mixed waste papers with or without screenings and mechanical pulp on an intermittent board machine and having thickness not less than 0.5mm.
	Straw board	:	A board made from partially cooked straw, bagasse or grass or a mixture of these.
	Glassine paper	:	Grease proof and translucent paper.
	Waxed paper	:	Dry or wet waxing is done on paper to obtain the resistance to moisture and oil.

Food Packaging

2.
 - Flexible packaging materials
 - Rigid packaging materials
 - Semi rigid packaging materials
3.
 - a) Polyethylene terephthalate
 - b) Cost poly propylene
 - c) Modified atmosphere packaging
 - d) Protection, preservation and presentation
 - e) Resilience, non-resilience and space fillers
4.
 - a) Regenerated cellulose
 - b) Primary packaging materials

Check Your Progress Exercise 3

Your answer should include the following points:

1.
 - Metal cans made of tin plate mainly either 3 piece or 2 piece can.
 - Glass bottles as they are non-toxic, non-reactive, and high temperature resistant.
 - Paper board carton like bag in box and lined cartons.
 - Plastic containers as they are light in weight, easily available, economical, and recyclable.
 - Flexible packaging materials like laminated film or coextruded film.
2.
 - Retort packaging for ready to eat products.
 - Aseptic packaging of liquid food products which have got about one year shelf life.
 - Vacuum and gas packaging for fatty foods in order to prevent oxidation process and thus extends shelf life.
 - Modified atmosphere packaging for extending shelf life of fresh fruits and vegetables.
3.
 - Dic-cut corrugated fibre board boxes made of either 3ply, 5 ply or 7ply.
 - Boxes should have proper ventilation to facilitate respiration process of fresh produce.
 - Adequate compression strength to resist crushing during handling, storage and transportation.
4.
 - Processed food products are made of different ingredients.
 - Products have got different initial moisture content (IMC) and critical moisture content (CMC).
 - Critical characters of the products are different like moisture sensitive resulting into the spoilage of products during storage.
 - The packaging materials are chosen depending on the requirement of products to prevent the spoilage and thus to enhance the shelf life.

12.8 SOME USEFUL BOOKS

1. Brody Aaron L. and Marsh Kenneth S. (1986) The Wiley Encyclopedia of Packaging Technology. John Wiley & Sons. Inc., New York.
2. Modern Food Packaging, Indian Institute of Packaging, E-2, MIDC Area, Chakala, Andheri (East), Mumbai, 1998.
3. Packaging of Food Products, Indian Institute of Packaging, E-2, MIDC Area, Chakala, Andheri (East), Mumbai, 1986.
4. Packaging Technology Educational Volumes (Part-2), Indian Institute of Packaging, E-2, MIDC Area, Chakala, Andheri (East), Mumbai, 2001.
5. Sacharow Stanley and Griffin, Jr. Roger C. (1970) Principles of Food Packaging. AVI Publishing Company, Westport, Connecticut.