Unit - 5

Advances in Food Technology

Objectives

- To understand the importance and various types of packaging.
- To gain knowledge about the latest advances in packaging.
- To understand the tremendous opportunities in nano-techonology regarding the food processing and packaging.
- To create awareness about the functional food and its health benefits.

"The technological advances in the domain of food packaging and functional food in twenty first century are mainly chaired by nanotechnology."

Packaging of food is very important and essential operation in food processing, storage, distribution and marketing. It helps in preservation of valuable nutrients, extension of shelf life, reduction of handling losses, provide food safety, security and hygiene of the content. As the advancement of the time, food packaging plays a vital role in developing variety of foods such as ready-to-cook/ serve/ eat food items such as instant mixes, retortable pouch processed food, tetrapak processed food, vacuum and nitrogen flushed food items. Multilayer films, breathing films, antimicrobial, edible films, natural degradable films, etc. have made it possible to extend the shelflife of the highly perishable commodities.

In nanotechnology, advance food packaging technology offers tremendous opportunities for innovative development and packaging that can offer significant benefits to the consumers.

In recent years, advances in the functional food technology offers a better life style so as to minimize the health disorders through the product such as conventional modified, medical and special dietary foods.

14 Food Packaging Technology

Contents at a glance

The development of food packaging has evolved as man's life style has changed. The industrial revoluation brought the development of new manufacturing process and new packaging material.

14.1 Packaging developments - An histroical Perspective

The past two centuries most of the evolutions have been seen in food packaging. The change is from simply acting as a container to becoming an integral part of total product design e.g. presently, the tomato ketchup is packed in co- extruded multilayer plastic bottle instead of glass bottle. An overview of some developments in packaging is given below.

Do You Know?

Indian Institute of Packaging (IIP) is in Mumbai and sub-centers are at Kolkatta, Delhi, Hydrabad, Ahemadabad and Chennai. In these centers development of new packaging and its testing facilities are available.

- **Nicolas Appert, Scientist** preserved food in hermetically sealed glass jar in France during 1809. For this innovation he is known as the **"Father of canning".**

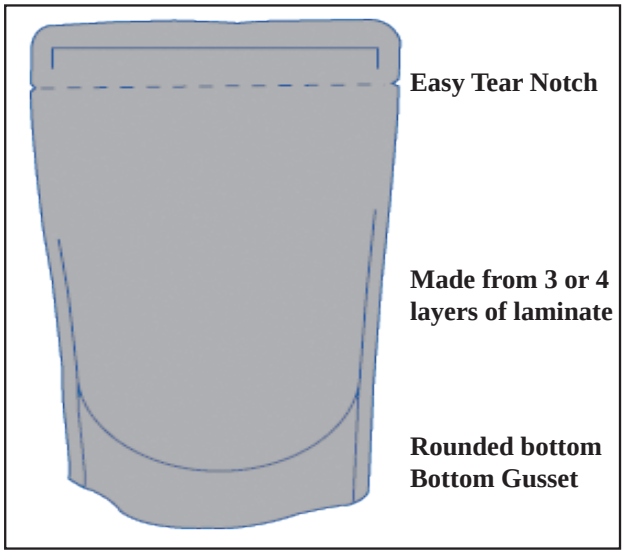

Fig. 14.1 : Retort pouch

- In 1950, US military developed a retortable pouch. Food product can be heated in packed condition. In 1956, Tetra Pak launched its tetrahedral milk carton.
- In 1970, the bar code system for retail packaging was introduced in the USA.
- In 1990, digital printing of graphics on carton sleeves and labels for food packaging was introduced in the UK.

Fig. 14.2 : Digital printing of graphic

Since the advent of the food can in the 19th century, protection, hygiene, product quality and convenience have been major drivers of food technology and packaging innovation. In recent years, there has been a rising demand for packaging that offers both ease of use and high quality food to consumers with busy lifestyles.

14.2 Types of packages

a) **Primary packaging:** These include the packages which come directly in contact with food materials e.g. tin can, pet bottles and LDPE pauches. etc.

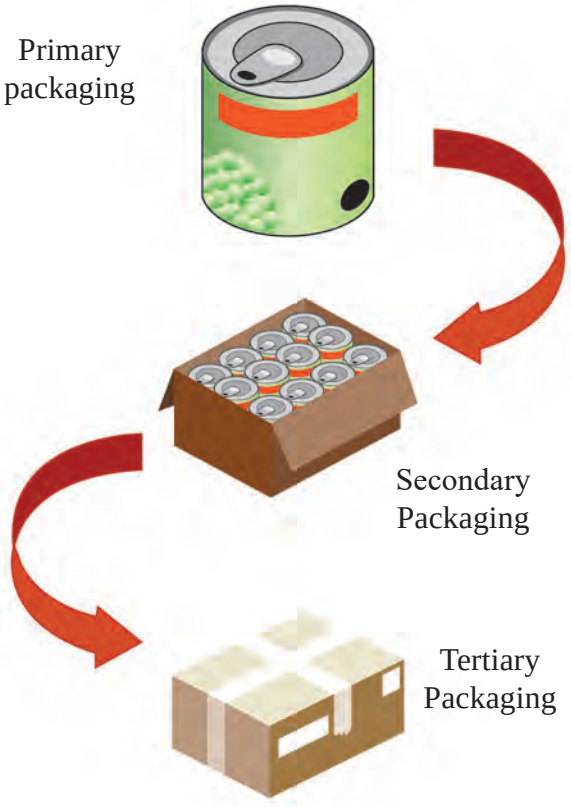

Fig. 14.3 : Primary, secondary and tertiary packaging

b) **Secondary packaging:** These packages hold primary packages to protect them from external damage. e.g. corrugated fibre box (cfb), cartons, plastic crates, etc.

c) **Tertiary packaging:** These hold secondary packages and give proper strength to the stored products e.g. wooden box, large size cb, cartons and containers.

14.3 Principles of food packaging

a) **Protection :** The package used for packaging material should protect product from physical, chemical and microbial hazards e.g. external scratches, oxidation and microbial spoilages like rotting or decay.

b) **Preservation :** It should act as preservative by retarding the entry of microorganisms.

c) **Presentation :** It should present the information about the content in the packet or can like nutritional value, manufacturing information, brand name, license numbers, date of expiry and other directives on labels.

14.4 Requirements of package

1. **Package should be non- toxic:** The package should not produce any toxic substance in the food during storage .

2. **Protect against microbial contamination:** Package should provide protection against microbial contamination in the food.

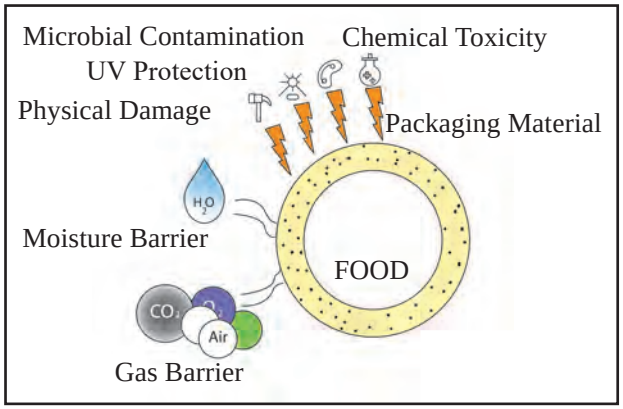

Fig. 14.4 Protection against contamination

3. **Act as moisture barrier:** Package should be barrier to moisture loss from the food.

4. **Act as gas barrier:** The package should protect the products from gas exchange.

5. **Protect against UV rays:** Package should provide protection to the processed food against UV rays of sunlight.

6. **Resistance to physical damage:** The package should protect the food products from physical damage and shocks arising from mishandling.

7. **Transparent:** The transparent packages are preferred to attract the consumers since it gives idea about product visual quality. Whereas colorful package give different perception regarding product appearance. and preference.

Fig. 14.5 : Different glass bottles

8. **Package should be tamper proof:** The tamper proof packages give confidence to the consumers regarding the quality of products as well as the product is free from the adulteration.

Fig. 14.6 : Tamper proof package

9. **Easy to open :** The package should be easy to open so that consumer can consume at any time and anywhere.

Fig. 14.7 : Easy to open package

10. **Dispensing and resealing :** The package should have the facility to reseal the products.

Fig. 14.8 : Reseal package

11. **Easy to dispose:** Packaging should be easily disposed without any environmental hazards

12. **Meet size, shape and weight requirements:** The package should fulfill all the regulatory requirements.

13. **Good appearance and printability:** The package should have good printability to attract the peoples.

Fig. 14.9 : Attractive package

14. **Low in cost:** It should be affordable to all and without increasing much of the product cost.

14.5 Packaging materials:

Various packaging materials such as glass, metal, paper, paper boards, plastics, wood, etc. are used in food packaging. However many packaging materials are used in different combinations at different proportions to improve barrier properties. These were also used in different forms of packages. The different packaging materials are as follows :

- Earthen pots
- Wood as packaging materials
- Glass
- Paper and paper based packaging materials
- Metal containers
- Plastic films
- Laminates
- Tetra brick aseptic packaging

Earthen Pots

The earthen pots are generally made by the combination of two types of mud clay: Mud from the surface of the earth and mud from 10 feet deeper into the earth are mixed together. The clay is mixed with water, shaped, finished, polished, dried and baked in a kiln. The earthen pots are commercially used for packaging of *dahi*, yogurt, ice cream and used as home water coder.

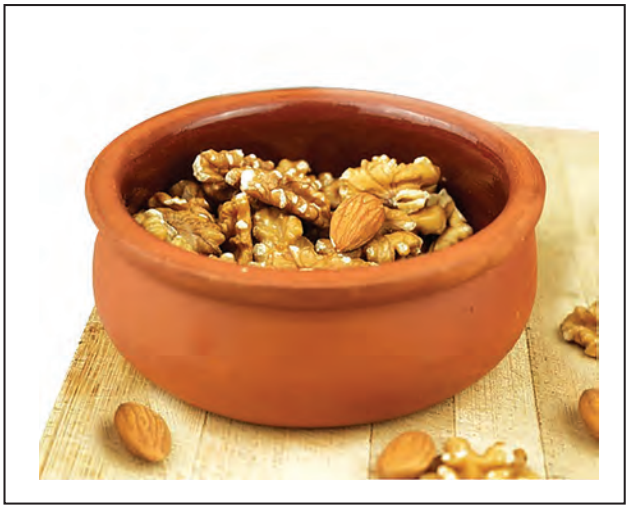

Fig. 14.10 : Earthen pots

Wood as packaging materials

Products derived from wood are widely used in the packaging of food. These are used for packaging of fresh fruits / vegetables as well as their processed products.

Fig. 14.11 : Wooden box

Glass

As related to food packaging, glass is chemically inert, therefore it is a safe packaging material. The glass is commercially used for many food products such as beverages, milk, ketchup, jam, etc.

Advantages

1. Inert in nature: It will neither react with food product nor food constituents.
2. Transparent in nature: The glass is crystal clear in nature so that one can see the inside product and assess quality of product.
3. Glass is resistance to high temperature and can sustain upto 500^0C temperature so that it can be utilized for the product where sterilization or processing is required after packaging e. g. canned products.
4. High strength

Disadvantages

1. Heavy in weight
2. High cost
3. Fragile in nature so break easily when used on high speed machines
4. Closures are main issue

Paper and Paper based packaging materials

The paper is obtained from the plant fiber (cellulose) and hence considered as renewable resource.

Types of papers

a) **Kraft paper :** It is strong paper and used for secondary and tertiary packaging. Generally it is brown in color.

Fig. 14.12 : Kraft paper

b) **Sulphited paper :** This paper is generally used for printing purpose as well as for the label preparation

Fig. 14.13 : Sulphited paper

c) **Grease proof or butter paper :** Butter paper is made from cellulose fiber. Butter paper is also resistant to absorb fats and oils. These papers can be used for the packaging of bakery products, butter, chocolates, pastries, etc.

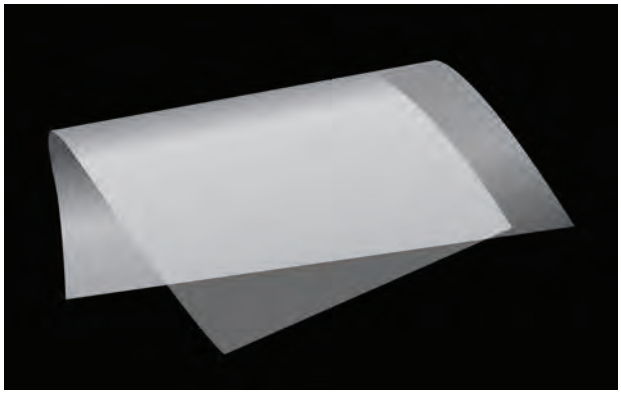

Fig. 14.14 : Grease proof paper

d) **Glassine paper :** The procedure for preparation of glassine paper is same as that of butter paper .

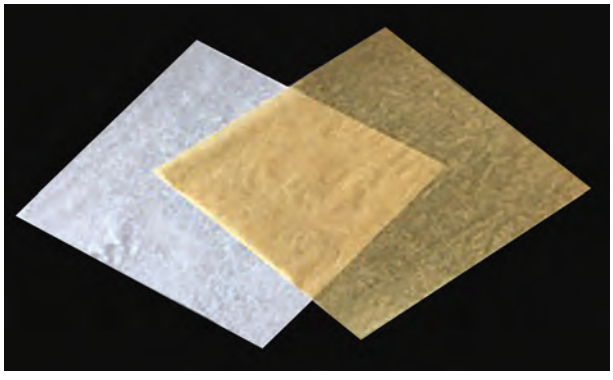

Fig. 14.15 : Glassine paper

e) **Parchment paper :** This paper is also called as vegetable parchment paper.

Fig. 14.16 : Parchment paper

f) **Corrugated fiber boards :** The paper having gram per square meter (GSM) more than 250 gms is generally called as paper boards. When these paper boards are lined with corrugated board then it is called as corrugated fiber board.

Fig. 14.17 : Corrugated paper board

Metal containers materials

In food packaging, four different metals i.e. Steel, Aluminum, Tin and Chromium, are commonly used. Aluminum is used in the form of purified alloys containing small and carefully controlled amounts of magnesium and manganese.

Fig. 14.18 : Metal container and can

Advantages

1. Light in weight
2. High mechanical strength
3. Low in cost
4. Can be used on high speed machine
5. Sustain high temperature
6. Environment friendly

Disadvantages

1. Rusting, denting, leakage and pinhole may occure.
2. Non visibility of the products.

Plastics

The word *"plastic"*is derived from the Greek *plastikos*, which means easily shaped or deformed. Basically plastics are petroleum by products of organic material of polymer group with long chain higher molecular weight compound.

The different plastics used for food packaging are as follows.

1. **Low density polyethylene (LDPE) -** LDPE film can be used for the packaging of milk, frozen foods, fresh fruits and vegetables, etc.
2. **Linear low density poly ethylene (LLDPE) :** These are used in preparing boil-in- bag pouches.

3. **High density polyethylene (HDPE) :** It is used as butter container, cereal boxes and bakery products, etc.

4. **Poly propylene (PP) :** PP bags are commonly used for packaging variety of food and food products including grain, spices, candied fruits, etc.

5. **Polyvinyl chloride :** It is used as a container (cup) for packaging of curd, ice-cream, spread, etc.

6. **Biaxially oriented poly propylene (BOPP) :** It is commonly used far packaging of bakery products, extruded food products, N_2 flushed and vaccum packaged products, etc.

Advantages

1. Durability.
2. Low cost.
3. Transperant / dark.
4. Used in combination with other layers.

Disadvantages

1. Plastic ability is to absorb flavours / odour.
2. Longevity / may get break / crack / tear during long period storage.
3. Create environmental pollution as they are not degradable.
4. Always use food grade plastic material.

Laminates

Combination of two or more webs by bonding them together are called **laminating** processes. These webs are comprised of films, papers, plastic aluminum foil, etc.

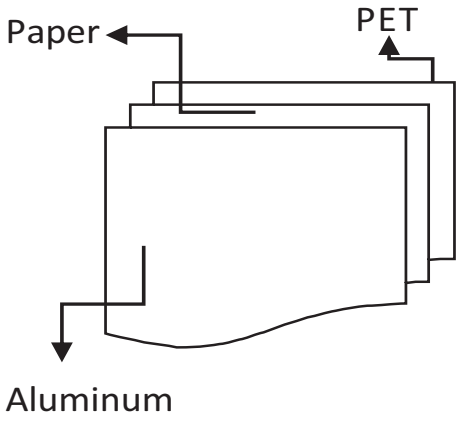

Fig. 14.19 : Laminating material

Tetra brik aseptic packaging

Aseptic packaging can be defined as the filling of a commercially sterile product into a sterile container under aseptic conditions and hermetically sealing the containers. This results in a product, which is shelf-stable at ambient conditions. The term "aseptic" is derived from the Greek word "septicos" which means the absence of putrefactive micro-organisms.

These pack consist of 6 layers such as polyethylene / polyethylene / aluminium – foil/ polyethylene/ Paper/ polyethylene.

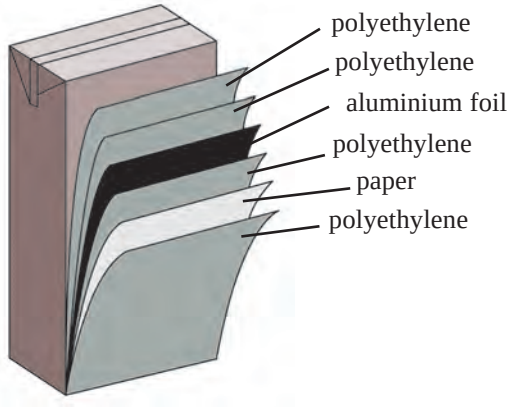

Fig. 14.20 : Tetra brik aseptic package

Advantages :

- Prevent spoilage due to aseptically processing.
- Extend the shelf-life of products at ambient.

Disadvantages :

- Expensive
- Special machine is required.

Edible Packaging

Edible films and coatings are those materials which can be directly consumed along with the fruit. They provide barrier and protection along with enhancing quality and safety of food products. The main advantages of edible packaging systems are integral part of the food product; they can be eaten, without the need to unpack or throwing the coated layer.

Edible films are in general good moisture barrier, able to inhibit moisture and gas exchange between food product and atmosphere. e.g. Bees wax, starch, alginate, gluten and casein based edible films.

Advantages :

1. Environment friendly, as fully consumed or biodegradable. Reduce the waste and solid disposal problem
2. Enhances nutritive values by supplementation of nutrients.
3. Individual packaging is possible for delicate fruits like strawberry, apple, etc.
4. Film can work as carrier of antimicrobial or antioxidant agents

Do You Know ?

Edible coatings are soluble formulations applied on food surfaces such that a thin layer of edible film is formed directly on the food surface or between different layers of components to prevent the migration of moisture, oxygen and solute into the food.

Drawbacks of edible packaging

1. The edible wrappers should not be used alone where unsanitary conditions during handling and processing may occur.
2. They would be used to wrap food inside a secondary synthetic packaging during distribution and storage.
3. Poor mechanical properties
4. High in cost than synthetic packaging

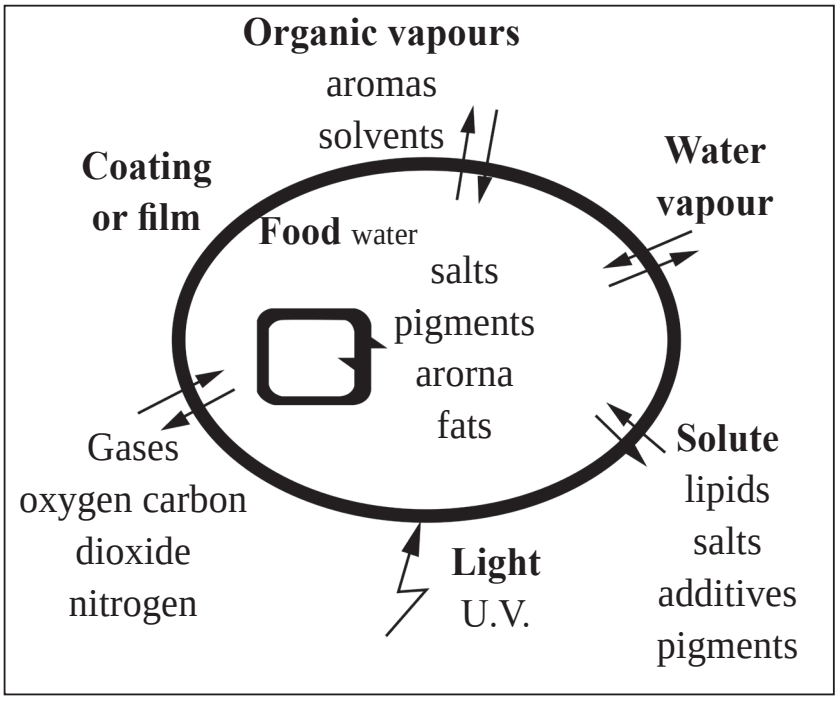

Fig. 14.21 : Functions of edible films

14.6 Bar coding

A barcode is a visual, machine-readable representation of data. The data usually describes something about the object that carries the barcode. Traditional barcodes systematically represent data by varying the widths and spacings of parallel lines, and may be referred to as linear or one-dimensional (1D). Later, two-dimensional (2D) variants were developed, using rectangles, dots, hexagons and other geometric patterns, called *matrix codes* or *2D barcodes*, although they do not use bars as such.

Benefits

In point-of-sale management, barcode systems can provide detailed up-to-date information on the business, accelerating decisions and with more confidence. For example:

- Fast-selling items can be identified quickly and automatically reordered.
- Slow-selling items can be identified, preventing inventory build-up.
- The effects of merchandising changes can be monitored, allowing fast-moving, more profitable items to occupy the best space.
- Historical data can be used to predict seasonal fluctuations very accurately.
- Items may be repriced on the shelf to reflect both sale prices and price increases.

Besides sales and inventory tracking, barcodes are very useful in logistics and supply chain management.

Commonly used barcodes are :

Name of Barcode	Example	Name of Barcode	Example
Linear Barcode	1. Codbar  2.  3. Universal Product 	Matrix (2D) barcodes	Aztec Code  QR Code  Data Matrix 

Points to remember

- Nicholas Appert is known as 'father of cannery'.
- The three main principles of packaging are : 1. Protection, 2. Preservation, 3. Presentation.
- There are three types of packaging : Primary, secondary and tertiary.
- There are various packaging material like - earthen pots, wood, glass, paper, metal containers, plastic, films, laminates, tetra brick aseptic packaging, etc.
- Bar-coding is visual machine readable representation of data.

Exercise

Q.1 (a) Select the most appropriate option:

i. _____ is fragile in nature.
(Glass, paper, metal)

ii. When two or more than two webs are combined then that film is termed as _____
(Laminates, edible film, earthen pot)

iii. _____ is the main function of packaging food.
(Protection, gurantee, reuse of packaging.)

iv. _____ is a visual machine readable representation of data.
(Code, barcode, edible film)

v. _____ layers are present in the tetrapak.
(6, 8, 10)

(b) Match the following:

A		B	
i.	Paper board	a.	Dahi
ii.	Barcodes	b.	Bonding of two or more web
iii.	Laminating	c.	More than 250 GSM
iv.	Wooden boxes	d.	Juice
v.	Earthen pots	e.	Fresh fruits
		f.	Machine - readable data

(c) State whether the following statements are true of false :

i. Nicholas Appert is known as father of canning.

ii. Protection, preservation and presentation are the main principles of food packaging.

iii. A package can be toxic.

iv. Earthen pots are suitable for all type of packaging.

v. LLDPE is used in preparing boil-in-bags pouches.

Q.2 Write in brief

i. Define packaging.

ii. Explain the types of packaging.

iii. Give any five requirements of packages.

iv. List the packaging materials

v. Explain earthen pot as packaging material.

vi. Give advantages of glass as packaging material.

vii. What are the advantages and disadvantages of plastic?

Q.3 Short answer question

i. Give advantages of metal as packaging material.

ii. Explain Tetra Brik Aseptic packaging with diagram

iii. Give advantages of edible films.

iv. Explain laminates.

Q.4 Long answer questions

i. Explain the principles of food packaging.

ii. Explain the types of paper

iv. Define barcode and give its benefits.

❖ Projects :

i. Preparation of album of different packaging material specimens.

ii. Preparation of label for any food products.