FOOD PACKAGING

Evolution:

PALEOLITHIC AGE	**Food was instantantly consumed.**
MESOLITHIC AGE	**Storage of surplus food in baskets made of grasses and rushes.**
NEOLITHIC AGE	**Pottery and metal containers were developed.**
200 BC	**Paper was made in china.**
160 BC	**Glass bottles were being made in Egypt.**
1200 AD	**Tin plating on the iron sheets were discovered.**

1825 AD	**Aluminium was extracted.**
1870	**Celluloid was the first man made plastic.**
1872	**First PVC was reported.**
1892	**Viscose was developed.**
1924	**Cellophane was first introduced in USA.**
1933	**Development of PE.**

1936	**Copolymer of VC and VDC (SARAN) was prepaired.**
1941	**Mylar(PE-G-T) became available.**
1956	**HDPE was commercialised.**
1958	**Heat shrinkable PVC film was introduced.**
1958	**Polyamides acquired the status of packaging film.**

Definition :

Packaging is the scientific method of containing food products against physical damage,chemical changes,further microbial contamination and to display the product in the most attractive manner for consumer preferences.

Functions:

1. It contains the food product for ease and safety during transport.

2. Protects against spillage, evaporation or pilferage losses.

3. Protection from contamination.

4. Prevention of degradation from exposure to environmental factors.

5.Convenient means of dispensing.

6.Attraction of consumer.

7.Identification of manufacturer’s brand, quantity, quality and type of product.

8. Educate the consumer.

Characteristics of package:

1.Colour:

- Blue: cleanliness and coolness
- Green: tranquility
- Orange: warmth
- Yellow: strength and cheerfullness
- white : mourning
- Cherry blossom: Japanese favour it.
- White and black: controversial

2.Shape:

- Rectangle
- Triangular
- Cylindrical
- Oval

Requirements of containers

- 1. Non toxic
- 2. Compatible
- 3. Sanitary protection
- 4. Moisture and fat protection
- 5. Gas and odour protection
  - Bad odour – out
  - Aroma - in

Strength properties

- 1. Tensile strength – Stretch the film to see the strength
- 2. Bursting strength
- 3. Tearing strength
- 4. Water vapour permeability
- 5. Grease permeability
- 6. Oil permeability
- 7. Heat sealibility

Food packaging materials:

Two broad categories:

- Rigid packaging materials
- Flexible packaging materials

Rigid packaging materials:

1.Metal cans:

- Primarily for heat sterilized food products.
- Made of tin plate, aluminium or tin free steel.

- Lacquers are applied to the tin for specific applications.
- Composition of lacquers depends on food stuff to be packed.
- Sulphur resistant internal lacquers usually zinc oxide oleoresins are used for meat products to check discolouration (sulphur staining).

- Aluminum cans not used extensively for heat sterilized food products. Internal lacquering is necessary.
- Shallow drawn cans are used for processed meat and fish products.
- Deep drawn cans are used for processed food products like powdered and condensed milk.

2.GLASS CONTAINERS:

- These are one of the most versatile packages used in food packaging.

Advantages:

- Chemically inert in nature.
- Excellent product visibility.
- Excellent barrier to solids, liquids and gases.
- Molded into various shapes and sizes.
- Withstand sterilization temperature.
- Refillable.

Disadvantages:

- Fragile.
- Heavy weight.
- Not easy to dispose of.

Packaging forms:

- Bottles
- Jars
- Tumbler (like jars but open ended)
- Jugs
- Carboys

3.RIGID PLASTIC PACKAGES:

- Therformed trays have many food applications ranging from meat trays to polystyrene foam trays for eggs.
- Plastics used are HDPE, PVC, PS and PP.
- Specific plastic selected depends on food packaged and storage requirements needed.

Advantages :

- Low cost
- Ease of fabrication

4. WOODEN BOXES AND CRATES

Wooden boxes are usually:

- Solid walled
- Rectangular
- Nailed containers
- Vary in size

Wooden crates are:

- Lighter in weight
- Spaces are left between board.

5.FIBRE BOARD AND CARD BOARD BOXES

Fibre board boxes:

- Used to make shipping cases exclusively in bulk packaging.

Advantages:

- Versatility
- Light weight
- Disposability
- Low cost

Major disadvantage :

- Low wet strength

FLEXIBLE PACKAGING MATERIALS

1.Aluminum foil:

- Thickness is 0.025-0.15 mm.
- Flexible pouches of these laminates are used for packaging dehydrated meat.
- Provides colourful and decorative printing base in package labeling.
- Excellent all barrier properties.

2. Plastics:

(a) Polyethylene:

- Obtained by polymerisation of ethylene.

2 grades:

- High and low
- LDPE is obtained by exposing ethylene to high pressure of 1200 atm. at temp. 150-200 deg C in presence of traces of oxygen.
- HDPE 40 at. pr.,60-150 deg C, in presence of metal catalysts.

Density range:

- LDPE: 0.910-0.925 g/cu cm.
- MDPE: 0.926-0.940 g/cu cm.
- HDPE: 0.941-0.965 g/cu cm.
- Density grades doesn’t differ chemically .
- Physical properties vary to some extent.
- PE is inert chemically .
- Insoluble in all organic solvents upto 60 deg C.
- Tasteless, odourless and nontoxic.

- Good impact and air resistance.
- Softening pt. 99.9 deg C.
- Melting pt. 110-115 deg C.
- Heat sealability is best with liquid tight seals.
- Very low permeability to water vapour.
- Very high permeability to oxygen and carbon dioxide.
- HDPE 3 times less permeable to water vapour than LDPE.

B.POLYPROPYLENE

- Produced by polymerization of propylene at low pressure in presence of catalysts.
- High flex strength, resistance and a good gloss surface.
- Softening pt is 150 deg C.
- Melting pt is 170 deg C.
- Low water vapor permeability.
- Good oil and grease resistance.
- Poor gas barrier.
- Co-extruded with PE to impart desired sealing and barrier characteristics.

C.PVC

- Prepared by polymerization of VC in presence of suitable catalysts.
- Hard and brittle.
- Used in packaging pickles and edible oils.

D.PVDC :

- Clear and non toxic.
- Very low permeability to gases and water vapours.
- Used for packaging of meat, sausages and cheese.

E.POLYAMIDE:

- Usually called nylons in trade, are combinations of diamines and diacids.
- Inert, heat resistance due to high softening and melting pt.
- Excellent mechanical strength.
- Grease resistant.
- Low permeable to gases.
- Fairly permeable to water vapours.
- Nylon 6, Nylon 11, Nylon 12 have found use in packaging.

- Nylon 6 films are tasteless, odourless.
- Nylon 6 films can be sterilized by steam/gas or gamma radiation technique.
- Can also be used for boil in bag processing of convenience foods.
- Excellent gas barrier properties.
- Major use of nylon-6 is in packaging of bacon.

F.POLYESTER

- Condensation product of poly alcohal with di acids or its anhydride.
- Most important in food packaging is polyethlene terepthalate (PET) ,a condensation product of ethylene glycol and terephthalic acid (Mylar).
- Can be molded in any shape.
- Excellent gas barrier properties.
- Almost unbreakable.

G.CELLOPHANE:

- Made from natural polymer cellulose.
- Suitably coated on one or both sides to impart desired functional properties.
- Usual coatings are nitrocellulose, PVDC,PE.

Advantages:

- Low cost
- Heat resistance
- Good mechinability
- Dimensional stability

H. **EVA COPOLYMERS**

- ✓ Obtained by copolymerization of LDPE and vinyl acetate (upto 20%).
- ✓ Far superior to PE in:
- ✓ Clarity
- ✓ Flexibility
- ✓ Resistance

Demerits:

- ➢ Unstable at high temp.
- ➢ Higher water and gas permeability.

I.POLYSTYRENE:

- Transparent
- Brittle
- Copolymerized with AN and butadiene to make it flexible.
- Can be thermoformed as cups for yoghurt, ice cream, cheese etc.
- Expanded polystyrene can be thermoformed as meat trays.

J. RUBBER HYDROCHLORIDE(PIOFILM)

- Produced by action of HCl on natural rubber.

Merits:

- Non toxic
- Stretchable
- Grease resistant
- Heat sealable

K.VINYL FILMS

Vinylidene chloride copolymer(saran,cyovac):

Produced with 13-20% VC.

Contains very little plasticizers, stabilisers and slip agents.

Merits:

- Clear
- Non toxic
- Very low permeability to gases and water vapours.
- Almost impervious to odour transmission.

L.IONOMER

- Unique thermoplastic with ionic bonds.
- In Surylin –A (ionomer of LDPE),
  - ionic bonds serve to increase:
    - Overall bond strength
    - Melt strength
    - Superior oil, grease and solvent resistance.

Smartness in packaging is a broad term that covers a number of functions. Examples of current and future 'smartness' would be in packages that

- Retain integrity and actively prevent food spoilage (shelf-life)
- Enhance product attributes (e.g. look, taste, flavour, aroma etc)
- Respond actively to changes in product or package environment
- Communicate product information, product history or condition to user
- Assist with opening and indicate seal Integrity
- Confirm product authenticity, and act to counter theft.

ACTIVE PACKAGING

i.e. The packaging plays an active role in reducing food spoilage.

Oxygen scavenging

- Most moulds require oxygen to grow and in standard packages it is frequently mould growth which limits the shelf life of packaged baked goods. Trials have shown that mould growth on some baked products can be stopped for at least 30 days.
- Removal of oxygen can also delay oxidation of and therefore rancidity development in vegetable oils.

Existing O_2 scavenging technologies are based on oxidation of one or more of the following substances:

- iron powder
- ascorbic acid,
- photo-sensitive dyes
- enzymes (such as glucose oxidase and ethanol oxidase)
- unsaturated fatty acids (such as oleic, linoleic and linolenic acids)
- rice extract
- immobilized yeast on a solid substrate

- These materials are normally contained in a sachet although recent developments have seen some incorporated into the plastic film used to wrap the product

ETHENE REMOVAL IN HORTICULTURAL PRODUCE

- The gas ethene is released by fruit after harvesting and accelerates ripening.
- The use of an ethene absorber can significantly extend shelf and storage life of fresh fruit and vegetables.

ADDITION OF CARBON DIOXIDE

- Carbon dioxide is known to suppress the growth of microbes.
- Some packaging has the addition of a CO_2 generating system, often in the form of a sachet.
- High CO_2 levels can cause changes in taste of products and promote the development of undesirable anaerobic glycosis in fruits.
- As a result such packaging only has a use in certain applications such as fresh meat, poultry, fish and cheese packaging.

Antimicrobial Food Materials

- AM materials can extend the lag phase and reduce the growth rate of microorganisms in order to extend shelf life and to maintain product quality and safety.

- Food packages can be made AM active by incorporation and immobilization of AM agents or by surface modification and surface coating.

CONTD

- Ethanol is often used in medical/pharmaceutical packaging applications and has been shown to prevent microbial spoilage and extend the shelf life of cheeses, bread, cake and pizza. It also reduces the rate of staling and oxidative changes.

- The use of ethanol is prohibited in many countries.

WATER REMOVAL

- Moisture problems may arise in a variety of circumstances, including respiration in horticultural produce, melting of ice, temperature fluctuations in food packs, or drip of tissue fluid from cut meats and produce.

There are two main ways that moisture is dealt with in food packaging

- use of plastics with an antifog additive that lowers the chance of condensation formation.

- superabsorbent polymer located between 2 layers of a micro-porous or nonwoven polymer.

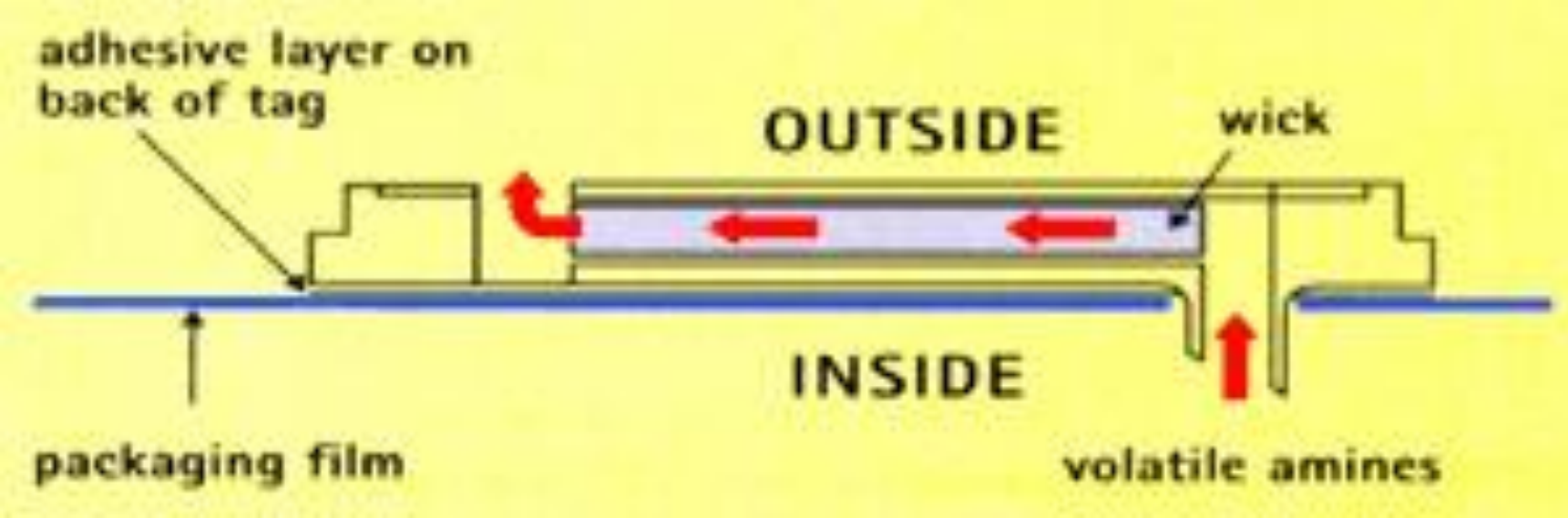
INTELLIGENT PACKAGING

- In ‘intelligent’ packaging, the package function switches on and off in response to changing external/internal conditions, and can include a communication to the customer or end user as to the status of the product.
- A simple definition of intelligent packaging is ‘packaging which senses and informs’
- It is expected that this will be a major part of the smart home of the future.

- Intelligent packaging” has become the accepted term for anything used in the packaging chain which informs the consumer that something has happened to the pack during the stages of its journey from the production line to the point of purchase or use. Examples are
  - child-resistant packaging
  - taper-evident packaging
  - TTIs - Time/Temperature Indicators

- For some products it is very important to have a precise record of the temperatures they have experienced throughout their lifetime inside a package.
- TTIs are devices used in packaging to achieve this.
- Modern TTIs use liquid chemicals contained in blisters formed between two flexible plastic layers. The indicator is activated by applying pressure which breaks the seal between adjacent blisters and allows the solutions to mix, starting a chemical enzyme reaction which when exposed to temperature over time undergoes a colour change from the starting green colour to a final "end point" yellow.

- COX Technologies has developed a colour indicating tag that is attached as a small adhesive label to the outside of packaging film, which monitors the freshness of seafood products. A barb on the backside of the tag penetrates the packaging film and allows the passage of volatile amines, generated by spoilage of the seafood. These are wicked past a chemical sensor that turns FreshTag ™ progressively bright pink as the seafood ages.



INTELLIGENT TAMPER-PROOF PACKAGING

- Tamper evidence technologies that cannot easily be replicated are being developed.

- Optically variable films or gas sensing dyes, involving irreversible colour changes.

- Piezoelectric polymeric materials might be incorporated into package construction so that the package changes colour at a certain stress threshold.

ASEPTIC PACKAGING

- Packaging of presterilised and cooled product in presterilised packages under sterilised environment.

Methods:

- UHT
- HTST
- Direct heat treatment
- Indirect heat treatment

Now sterilants are used e.g.:

- Hydrogen peroxide with heat or UV radiation.
- Ethylene oxide with heat or gamma radiation.