FOOD PACKAGING

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PACKAGING

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INTRODUCTION

- **Packaging** is indispensable in the modern food industry
- It act as a barrier to gases(oxygen), moisture, light or odours
- It helps to retain the sensory characteristics of food products

FOOD PACKAGING

- Conventional
- **Emerging Packaging technologies (EPTs):**

✓ Control release food and beverage packaging (Active packaging)

✓Active antibacterial food and beverage packaging

✓Edible chitosan coatings

✓Flavors-release food and beverage packaging

✓EPTs: Antimicrobial, Edible coatings, MAP, combining different technologies

Functions for packaging and Reasons for Growing Packaging Technologies

- Packaging makes foods **easy to store**, handle and identify.
- It also helps **protect** them from spilling and from being damaged.
- Packaging materials and methods **protect food** from air, bacteria, chemicals, insects, light, moisture and odours - all of which might spoil the food.

- **3C + 1P= Functions of Food Packaging**
- **Containment, Convince, Communication**

FUNCTION

- Packaging materials have the four basic functions of providing protection, communication, convenience and containment (Paine, 1981; Robertson, 1993).

- Traceability and tamper indication are said to be the secondary functions of increasing importance.

Functions of Packaging

- *To protect product from damage during transport & storage – allows stacking*
- *To protect from deterioration – Food*
- *To describe and identify the contents*
- *To stop tampering and contamination*
- *Sells the product by being eye-catching*

1. Protection:

- One of the main objectives of the packaging of food is to protect it against spoilage or deterioration due to physical damage, chemical changes or biological damage.

2. Communication:

- Any special instructions or information.

11. Deteriorative Reactions in Foods

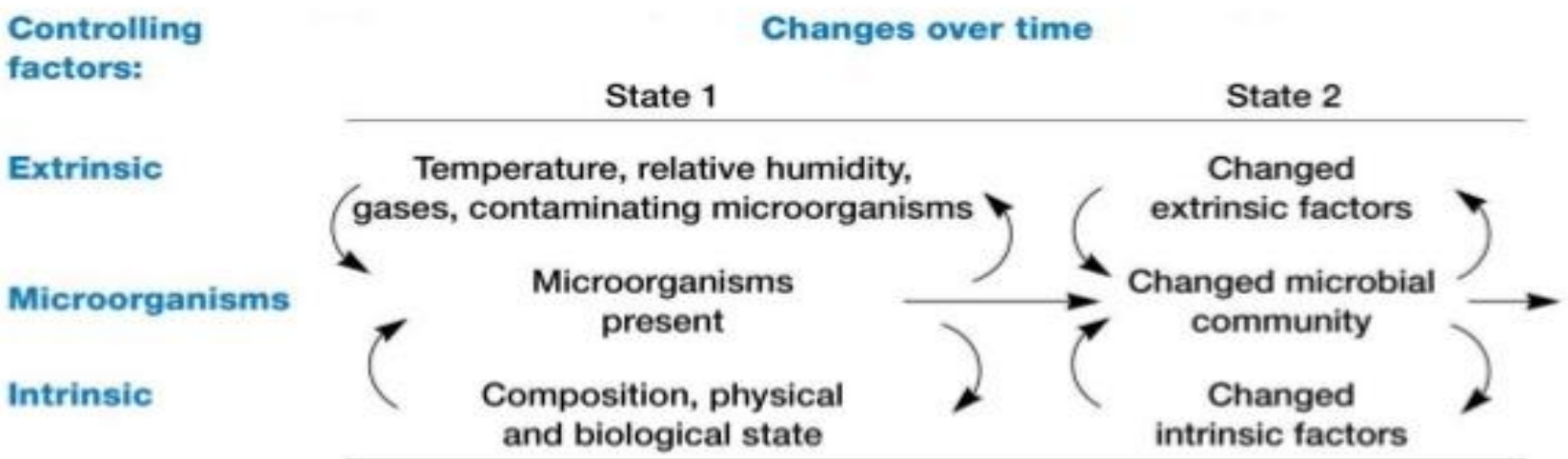
Deteriorative reactions in food

- Enzymic reactions
- Chemical reactions
  - — Sensory quality
  - — Nutritional quality
- Physical changes
  - — Caking
- Biological changes
  - Microbiological
  - Macrobiological

Factors controlling the rates of deteriorative reactions in foods

- Intrinsic factors
  - Water activity
  - Oxidation-reduction potential
- Extrinsic factors
  - Temperature
  - Gas atmosphere
  - Light

Microorganism Growth in Foods



3. Convenience:

- Ease of access, handling, and disposal; product visibility; resealability.

4.Containment:

Hold the contents and keep them secure until they are used.

5.Traceability:

- Ability to track any food through all stages of production, processing and distribution.

6.Tamper indication:

- Food tampering is the intentional contamination of a food product, with intent to cause harm to the consumer or to a private company (Canadian Food Inspection Agency, 2010).
- There are several measures to detect tampering, including banding, special membranes, breakaway closures, special printing on bottle liners or composite cans such as graphics or text that irreversibly changes upon opening and special printing that cannot be easily duplicated (Marsh and Bugusu, 2007).

7.Packaging as a Marketing Tool:

- Packaging is an important tool for advertisement.
- Packaging protects the interests of consumers.
- The information on the packaging includes quantity, price, additives, ingredients, inventory levels, lot number, size and weight is very important for merchandising.

8.Socioeconomic Factors in Food Packaging:

- The use of food packaging is a socioeconomic indicator of increased spending ability of the population, an increase in the gross domestic product or an increase in food availability (Brody et al., 2008).
- Packaging technology must balance food protection with other social and environment issues, including energy and material costs, heightened social and environmental consciousness, and strict regulations on pollutants and disposal of municipal solid waste.

MASS TRANSFER & FOOD-PACKAGE INTERACTION

- The quality of packaged food is directly related to the attributes of the food and packaging material (Cooksey, 2007; Lee et al.,2008).
- The quality of most packaged food deteriorates owing to mass transfer phenomena (e.g., moisture absorption, oxygen permeation, flavor loss, absorption of undesirable odors, and the migration of packaging components) (Kester and Fennema, 1986).
- Migration may also result in mass transfer of an additive from the packaging material to the food.

- Several possibilities have been reported for the interaction between foods and packaging materials when they come into contact with each other (Gnanasekharan and Floros, 1997).

- These are the following:

(i) Migration of volatile and nonvolatile compounds from packaging materials to the packaged **food**, including unreacted monomers or additives present in the polymerized packaging material. [Diffusion]

(ii) Sorption of components from the food or from the environment into the **packaging material**. The kind of molecules sorbed is dependent upon the type of interface between the food and the packaging. Some common examples are the sorption of fatty matter, pigments and vitamins into the packaging. [Absorption]

(iii) Permeation of volatile compounds (flavors and water vapor) from the food through the packaging. [Permeation]

A SIMPLIFIED MASS TRANSFER OPERATION IS ILLUSTRATED IN FIGURE:

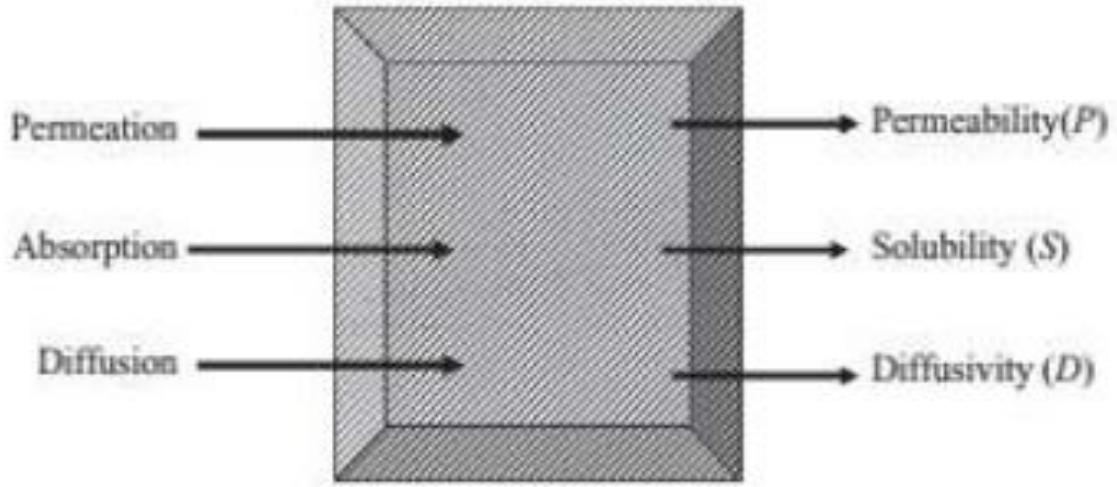


Figure 41.1 Mass transfer in food packaging.

Diffusivity:

- Diffusion is quantified by a kinetic parameter called the diffusion coefficient or diffusivity.
- The driving force behind the transport process is the difference in chemical potential between the two phases on either side of the membrane.
- The transport process slowly tries to equalize the concentrations, partial pressures or chemical potentials of the penetrant in the phases separated by the membrane.

Permeability:

- At thermodynamic equilibrium, the gas permeability, or permeability coefficient P is the product of the diffusivity and the solubility coefficient, i.e., $P = DS$.

Aluminium

- Aluminium **cans** with ring pulls are often used for fizzy drinks.
- Aluminium is strong but expensive, though it can be recycled.
- Aluminium cans do not need coating to stop them **reacting** to food like tin cans do.

Aluminium **foil** is also used as a wrapping and to make containers for food.

Plastic bags and film

- Plastic bags are used to package bread, cakes and other products for **short-term** storage.
- They are also used to store **frozen** foods for longer periods of time.
- The bags can be **printed** with designs and information.
- Some bags have **zip closures** that let you reseal them.

Cling film is useful for wrapping foods.

Jars and bottles

- **Glass** bottles and jars preserve food in a similar way to cans.
- Glass jars and bottles can be **reused** and recycled, but they are quite easy to **break/Expensive**.

Bottles can also be made of plastic, but these are more difficult to recycle.

Boxes

- Cardboard is used for folded **boxes** to hold products.
- Cardboard is not **airtight**, so another layer is often needed inside.
- Large cardboard **cartons** are often used to hold individual food packages.

These Jaffa cakes have been packaged in sealed plastic, and then inside a branded cardboard box.

Vacuum formed packaging

Shapes produced by **vacuum forming** can be used to **support** and **protect** food, sometimes inside other packaging, such as boxes.

Film **lids** can be added to protect against bacteria.

Plastic boxes can be used for transporting salads and sandwiches, or for storing food.

Tamper-evident packaging

We all need to be sure that our food packaging has not been opened before we are ready to use it.

It might also be possible for someone to open a food packet, eat some of it and then put it back on the shelf.

Tamper-evident packaging cannot be opened without it being obvious.

Recycling

Recycling is a real issue for food packaging, as huge amounts of packaging is thrown away and buried in landfill sites every day. Government legislation is trying to make sure that more packaging gets recycled.

We need to make sure that we:

- Don't use any more packaging than we really need to
- Use packaging that can be **reused**, like glass milk bottles
- Recycle packaging wherever possible to be made into new material
- use **biodegradable** packaging, like paper, that rots naturally, rather than plastic that doesn't.

CRITICAL ISSUES

- LEGAL
- REGULATION (safety and regulatory aspects of plastics as food packaging materials)
- RISK ASSEMNT and Compliance
- Environmentally compatible food packaging

✓ Eco-design of food and beverage packaging

✓ life cycle assessment (LCA) of food and beverage packaging (Thesis title: Potential)

Active and Intelligent Packaging for Food Industry Applications

KEY ASPECTS

- Shelf-stability
- Product safety and quality
- Consumer demand satisfaction
- Global market share
- Environmental Friendly

PACKAGING REQUIREMENT OF FOOD PRODUCT

Packaging

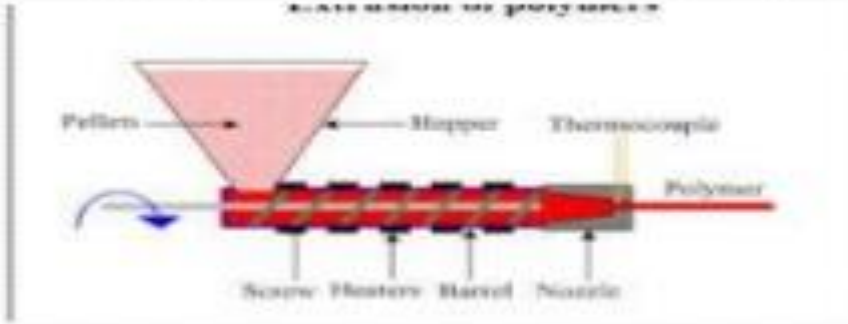
- For the logistics, a package system requires 3 types of information to design viz.:
  - Severity of the distribution environment
  - Fragility of the product
  - Performance characteristics of various cushion materials

- For an uniform and smooth logistics, labeling of the packaging is important. It consists of:
  - Retroflective labels
  - Batch numbers
  - Weight
  - Specific contents
  - Instructions for use
  - Information to allow passage through customs
  - Compliance labeling
  - One- or two-dimensional bar codes
  - Smart labels or RFID labels

5. Processing and Converting of Thermoplastic Polymers

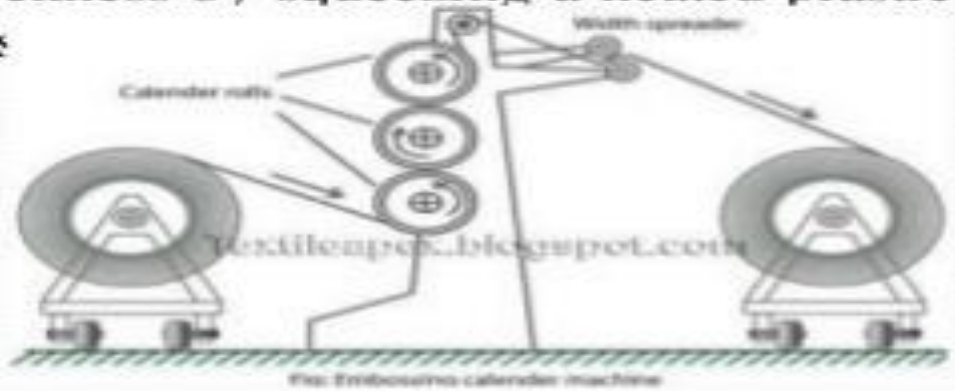
(A) Extrusion:-

- It is the most important plastics processing methods in use today.
- It can be defined as continuously forcing a molten material through a shaping device.
- It includes monolayer extrusion and coextrusion
- The screw is the heart of extruder



(B) Calendaring:-

- It is a complementary process to film and sheet extrusion and involves the formation of continuous sheets of evolved thickness by squeezing a heated plastic material between two or more horizontal rollers



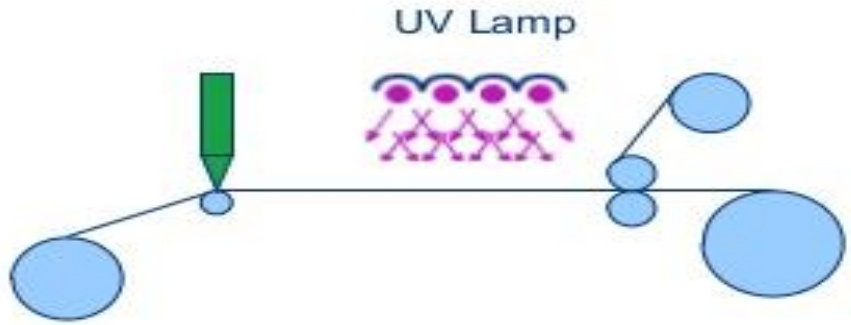
PACKAGING MATERIALS:

- The major categories of materials used for food packaging are glass, metals, paper and paperboard, and plastics.
- There are many multilayered packaging materials containing either layers of different plastics or combinations of plastics with paper/board, metal or glass.
- In many cases, a packaging material with two layers is chosen.

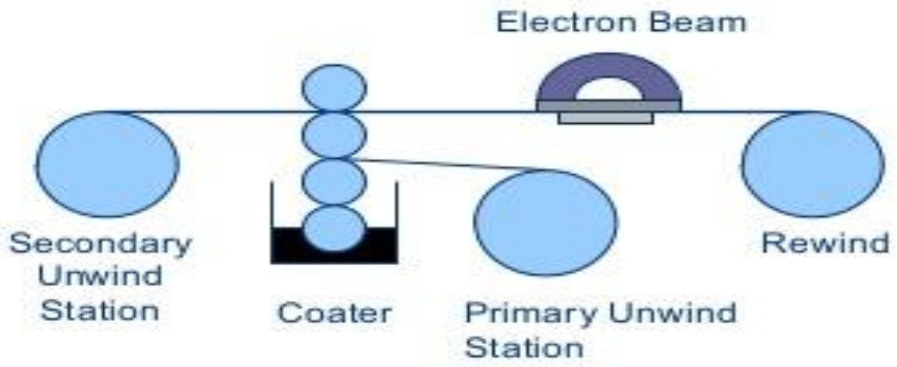
LAMINATION PROCESS

UV/EB Adhesive Laminating Process

UV Adhesive Lamination:
- High line speed
- Low VOC



EB Adhesive Lamination:
- No heat generation
- Will cure through opaque films



SARTOMER ARKEMA

SOME NOVEL PACKAGING METHODS:

1.BIODEGRADABLE PACKAGING:

- The present global concern about petrochemical - based plastic materials has generated much interest in biodegradable, or " green" packaging materials.

- According to the ASTM,2003 guidelines, a "biodegradable plastic" is defined as a degradable plastic in which the degradation results from the action of naturally occurring microorganisms such as bacteria, fungi and algae.

2. ACTIVE PACKAGING

- Active packaging is an innovative concept that can be defined as a mode of packaging in which the package, the product and the environment interact to prolong shelf-life or enhance safety or sensory properties, while maintaining the quality of the product (Suppakul et al., 2003).
- It allows the active preservation of foods, according to their needs, by modification of the environment inside the package by removing undesired gases or by regulating the composition of the gas in the package headspace.
- Active systems can be classified according to their functionality as scavengers, regulators and emitters, and their action can be specific for several substances (O_2 , CO_2 , ethylene etc.).
- The internal atmosphere may be regulated by substances that absorb (scavenge) or release (emit) gases or vapors.

3. Edible Packaging

- Edible packaging is defined as a thin layer of edible material formed on a food as a coating or placed (preformed) on or between food components (Pagella et al., 2002).
- Natural polymers have been studied extensively for the development of edible packaging.
- A variety of polysaccharides (starch and hydrocolloids), proteins (whey proteins, soybean proteins and fish proteins) and lipids have been used, either individually or in mixtures, to produce edible films.

- Edible films and coatings have some advantages such as edibility, biocompatibility, barrier properties, absence of toxicity, the fact that they are nonpolluting, and low cost (Han, 2000).

- Moreover, biofilms and coatings, by themselves or acting as carriers of food additives (i.e., antioxidants and antimicrobials), have been considered particularly for food preservation because of their ability to extend the shelf - life (Franssen and Krochta, 2003).

PACKAGING TECHNOLOGIES

4. Intelligent or Smart Packaging

- Intelligent, or smart packaging is basically designed to monitor and communicate information about food quality (Kerry et al., 2006).
- It is essentially an integrating method that deals with mechanical, chemical, electrical and/or electronically driven functions that enhance the usability or effectiveness of the food product in a proven way (Mahalik and Nambiar, 2010).
- Some common examples of intelligent packaging are Time–Temperature Indicators (TTIs), ripeness indicators, biosensors and radio frequency identification (RFID).

- In addition, self-heating and self-cooling containers with electronic displays indicating use-by dates and information regarding the nutritional qualities and origin of the product in numerous languages are available in smart packaging (Mahalik and Nambiar, 2010).

- These smart devices may be incorporated into packaging materials or attached to the inside or outside of a package.

- The FDA recognizes TTIs for fish products, so their importance may increase in the seafood industry.

EMERGING PACKAGING TECHNOLOGY

5. NANO PACKAGING:

- Nanoscale innovation could potentially introduce many amazing improvements to food packaging in the form of barrier and mechanical properties, detection of pathogens, and smart and active packaging with food safety and quality benefits (Brody et al ., 2008).
- Nanotechnology enables designers to alter the structure of packaging materials on the molecular scale, in order to give the material the desired properties.
- With different nanostructures, plastics can be given various gas and water vapor permeabilities to fit the requirements of various foods.
- By adding nanoparticles, one can achieve packages with more resistance to light and fire, better mechanical and thermal performance, and less gas absorption.
- These properties can significantly increase the shelf - life and sensory characteristics of food products, and facilitate transportation and usage.
- The addition of nanosensors to food packages could be used to detect chemicals, pathogens and toxins in foods .

PACKAGING METHODS:

1. ASCEPTIC PACKAGING:

- Process in which a food product, such as ultra high temperature (UHT) milk and its package is sterilized separately and then combined and sealed under sterilized atmosphere.
- It increases the shelf-life.

2. VACCUM PACKAGING

- It is a procedure in which air is drawn out of the package prior to sealing but no other gases are introduced.
- This technique has been used for many years for products such as cured meats and cheese.

3. MODIFIED ATMOSPHERE PACKAGING (MAP)

- Modified atmosphere packaging (MAP) is a procedure which involves replacing air inside a package with a predetermined mixture of gases prior to sealing it.
- The gases involved in modified atmosphere packaging, as applied commercially today, are carbon dioxide, nitrogen and oxygen.

i. Carbon dioxide reacts with water in the product to form carbonic acid which lowers the pH of the food. It also inhibits the growth of certain microorganisms,mainly moulds and some aerobic bacteria.

ii. Nitrogen has no direct effect on microorganisms or foods, other than to replace oxygen, which can inhibit the oxidation of fats.

iii. Oxygen is included in MAP packages of red meat to maintain the red colour, which is due to the oxygenation of the myoglobin pigments.

CONCLUSION: CURRENT RESEARCH ON FOOD PACKAGING

- Nanocomposites for food and beverage packaging
- Emerging coating technologies
- Light protective packaging materials for foods and beverages
- Tamper-evident food and beverage packaging
- Advances in freshness and safety indicators in food and beverage packaging
- Radio Frequency Identification (RFID) for food and beverage packaging application): Potential for traceability research

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CONCLUSION