PACKAGING

Module- 37

Lec- 37

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Learning objectives

- Definition of packaging
- General Requirements
- Functions
- Marketing considerations
- Factors influence success of package in advertisement
- Factors contribute to deterioration of food during storage
- Types of packaging
- Manufacture of packaging material
- Labeling

Definition

- Defined in terms of its protective role as in
  - “packaging is a means of achieving safe delivery of products in sound conditions to the final user at a minimum cost”
  - “a techno-economic function for optimising costs of delivering goods whilst maximizing sales and profits”.

General requirements

- Nontoxic
- Prevent contamination from microorganisms & environmental toxicants
- Barrier to moisture, oxygen, UV light & odors
- Provide resistance to physical damage
- Be transparent
- Be tamper-resistant or tamper-evident
- Easy to open
- Have dispensing & resealing features
- Be disposed of easily
- Meet size, shape & weight requirements
– Have appearance, printability features
– Have low cost
– Be compatible with food

WHAT IS PACKAGING
• Integral part of Production
  – Means a system of preparing goods for transport, distribution, storage, retailing and end-use.
• Part of Physical Distribution
  – A means of ensuring safe delivery to the ultimate consumer in sound condition at minimum overall cost.
  – A techno-economic function aimed at minimizing cost of delivery while maximizing sales.
  – A tool for Marketing

FUNCTIONS OF A PACKAGE
• Containment
  – Keep its contents secure between end of packaging
• Protection and Preservation
  – It is required from both mechanical damage during handling and deterioration by climate(s) during distribution and storage
• Communication
  - Identify contents and assist in selling product. Shipping containers should also inform carrier about destination and any special handling or storage instructions. Some packages inform user about method of opening or using contents

FUNCTIONS OF A PACKAGE
• Machinability
– Smooth movement of packages, material economics and ability of packaging material during packaging operation are important

• Convenience and Use
– Easy to Open, close, dispensing, disposal, recycle, information, eye appeal, warnings, distribution etc.

• Other Packaging Needs
– Age group, Impulsive or irrational buying practices, follow of competitors general line or different, distributors and retailers needs, possibility of pilferage, tampering or stealing, possibility of after use of packaging, development of brand identity

Marketing considerations for packaging

• Brand image and style of presentation required for food
• Flexibility to change size and design of containers
• Compatibility with methods of handling and distribution, and with requirements of retailers

• Package should
  – Be aesthetically pleasing
  – Have a functional size and shape
  – Retain food in a convenient form for customers without leakage
  – Possibly act a dispenser which opens easily and re-closes securely
  – Be suitable for easy disposal, re-cycling or re-use
• Package design should meet any legislative requirements concerning labeling of foods

Factors influence success of package in advertisement

• Standout
  – Ability of a pack to compete with up to 6000 similar products, each vying for attention of consumers
• Content identification
• Imagery
• Distinctiveness
• Adaptability
• Suitability
• Legality

Shelf life of packaged foods

• Controlled by
  – Properties of food including
    • Water activity
    • pH
    • Susceptibility to enzymic or microbiological deterioration
    • Requirement for sensitivity to
      – Oxygen
      – Light
      – Carbon dioxide
      – Moisture
    • Barrier properties of package

Packaging materials

• 1) Shipping containers
  – Contain and protect contents during transport and distribution, but no marketing function.
    • Corrugated fiberboard are common
    • Others are made of metal, plastic, etc
      – They are expensive and therefore made returnable e.g. plastic crates for milk, etc
      – Requirements for shipping container are to
» Contain products efficiently throughout journey
» Protect against climate and contamination
» Be compatible with product
» Easily and efficiently filled and sealed
» Easily handled
» Remain securely closed in transit, open easily when required and re-close securely
» Carry information for carriers, wholesalers, and manufacturers about contents, destination, and how to handle and open the pack
» Have minimum cost
» Readily disposable, re-usable or have another use

• 2) Retail containers or consumer units
  – Which protect and advertise food in convenient quantities for retail sale and home storage
  – Eg., metal cans, glass bottles, jars, rigid and semi-rigid plastic tubs, flexible plastic bags.

PACKAGING MATERIALS FOR MAJOR FOOD PRODUCTS

<table>
<thead>
<tr>
<th>FOOD PRODUCTS</th>
<th>PACKAGING MATERIAL/ PACKAGES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bakery Products</td>
<td>Tinplate containers, wax papers, paperboard cartons, polyethylene bags, cellophane pouches or aluminium laminates.</td>
</tr>
<tr>
<td>Beverages</td>
<td>Glass bottles, PET bottles.</td>
</tr>
<tr>
<td>Breakfast Cereals</td>
<td>Plastic bags, cellophane, wraps, tinplate containers, glass bottles.</td>
</tr>
<tr>
<td>FOOD PRODUCTS</td>
<td>PACKAGING MATERIAL/PACKAGES</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fruits &amp; Vegetables (Processed)</td>
<td>Gunny bags, bamboo and other baskets corrugated boxes, plastic films and bags</td>
</tr>
<tr>
<td>Fish</td>
<td>• Bamboo basket or plywood baskets.</td>
</tr>
<tr>
<td>• Fresh</td>
<td>• Gunny bags, baskets, plastic film bags.</td>
</tr>
<tr>
<td>• Dried</td>
<td>• Tinplate containers.</td>
</tr>
<tr>
<td>• Canned</td>
<td></td>
</tr>
<tr>
<td>Meat and Meat Products</td>
<td>• Plastic film and paper bags</td>
</tr>
<tr>
<td>• Fresh</td>
<td>• Tinplate containers</td>
</tr>
<tr>
<td>• Canned</td>
<td>• Plastic film bags</td>
</tr>
<tr>
<td>• Frozen or smoked</td>
<td>• Tinplate containers</td>
</tr>
<tr>
<td>• Canned</td>
<td></td>
</tr>
</tbody>
</table>
### Milk and Milk products
- Aluminium cans, glass bottles, plastic pouches, tin cans, lined gunny bags.

### Ice creams
- Waxed paper board cartons and cups

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**Factors that cause deterioration of foods during storage**

- **Climatic influences that cause physical or chemical changes**
  - UV light, moisture vapor, $O_2$, tempt changes

- **Contamination**
  - By micro, insects or soils

- **Mechanical forces**
  - Damage caused by impact, vibration, compression or abrasion

- **Pilferage, tampering or adulteration**

- **Packaging provides a barrier between food and environment.**

- **It controls**
  - light transmission
  - Rate of transfer of heat
  - Moisture and gases
  - Movement of micro or insect

- **Packaging should be**
  - Smooth
  - Efficient
  - Economical operation on production line
  - Resistance to damage such as fractures, tears or dents caused by filling and closing equipment, loading/unloading or transportation, and minimum total cost
TECHNICAL DEVELOPMENT

• Availability of newer material and improved construction. Improved flexible barrier through metallizing and co-extrusion and changes in thermoforming techniques etc.
• Development in food processing and/or packaging machinery. Aseptic processing an modified atmosphere packaging.
• Changes in methods or storage and distribution.
• Improvement in methods of management an control, bar codes and just-in-time deliveries

MARKET DEVELOPMENT

• Marketing is defined as ‘the identification, anticipation and satisfaction of customer needs profitability’
• Effect of customer lifestyle is also important. In many times, improved packaging can also change life-style.
• Malicious tampering
• Green issues such as organic farming
• Eco friendly i.e. reuse and recycling of packaging before disposal.
• Health awareness such as low fat, low calories
• Reduction in preservation, artificial colouring, sugar diets etc.
• Desire to reduce meal preparation time to a minimum.

DESIGNING SUCCESSFUL PACKAGING

• FOUR STEPS
  – Product assessment
  – Hazards of Distribution
  – Marketing Requirements
  – Packaging Machinery selection and
Machinery consideration

PRODUCT ASSESSMENT

• Nature of Product
  – Material from which it is made and the manner by which these can deteriorate.

• Physical State
  – Gas, Mobile liquid, Viscous liquid, Paste, Liquid+solid, Powder (free flowing), Granules, Tablets, Capsules, Solid block

• General Nature
  – Corrosive, toxic, Volatile, Odourous, Perishable, Sticky, Fragile, Abrasive, Easily scratched.

REASONS FOR DAMAGE

• Mechanical shock - Fragility factor

• Abrasion - Surface finish

• Vibration - Frequency range

• Crushing - Safe load

• Temperature change - safe range

• Moisture and Relative humidity - Critical values

REASONS FOR DAMAGE

• Oxygen - how much

• Odours - which odour

• Light - fading

• Spoilage - Chemical change
• Non compatibility with material

• Rodents or insects

UNSATISFACTORY PACKAGE

• Admits dirt

• Leaks

• Not sift proof

• Not compatible

  – Transfer of odour, flavour to product, corrosion of product, chemical reaction, loose strength in
    contact with product)

• Easily pilfered

• Stains easily

HAZARDS OF DISTRIBUTION

• Type of transport i.e. rail-road-sea or air.

• Private or Public transport

• Form of transport - break bulk, roll-on/roll off, freight container, unitized load, postal,
  passenger train etc.

• Mechanical conditions and duration of storage

• Nature and intensity of the mechanical and climatic hazards in transport, storage, retailing and
  use.

HAZARDS OF DISTRIBUTION

• Handling aids for loading and offloading

• Minimum volume in relation to transport cost
• Vertical drops and horizontal hazards

• Strainer package impact i.e. vibration, compression, deformation, puncture, tear etc.

• High temperature, low temperature, low pressure, light, liquid water i.e. fresh polluted, dust, water vapour

OTHER HAZARDS

• Biological hazards

  – Micro-organism, fungi, moulds, bacteria beetles, moths, flies, ants, termites, rodents
  contamination by other goods, leaking content of adjacent packs, radio activity.

PACKAGING MATERIAL SELECTION

• Production Methods

• Display Requirements

• Economic Consideration

• Marketing Needs

• Product Characteristics

• Properties of Packaging Material

Manufacture of packaging material

• Enable consumers to receive foods in good condition at lowest reasonable price
• Code of packing include
  – must comply with all legal requirements
  – must be designed to use materials as economically as possible while having regard to protection, preservation and presentation of product
must adequately protect food under normal conditions of distribution, retailing and home storage
material should have no adverse effects on contents
must not contain any unnecessary void volume, nor mislead as to amount, character or nature of product it contains
should be convenient for consumer to handle and use for opening and re-closing when required and be appropriate to product and its use
all relevant information about product should be presented concisely and clearly on pack
should be designed with regard to its possible effect on environment, its ultimate disposal and to possible recycling and re-use

PROPERTIES & FORMS OF PACKAGING MATERIALS

• WOOD
  – Withstands tremendous pressure and keeps its shape
  – Offers a cheap way of shipping oddly shaped heavy equipment
  – Enhances food and beverages in gift boxes
  – Offers good impact strength
• Used for solids
• More expensive than other raw materials
• Inappropriate for high speed packaging

• METAL
  – Offers the best barrier properties after glass
  – Can be micro-waved when coated or sandwiched between vinyl
  – Provides the tensile strength needed to operate aerosol sprays
– Can be reused as a container and offers ‘collectible’ image

• Limits reusability (sardines, nuts, cat food)
• Can affect taste of food or beverages

• GLASS
– Offers tremendous barrier properties
– Reinforces consumer security
– Conveys the ‘feel’ of crystal and creates a good impression
– Provides the impermeability necessary for certain medical uses
• Weighs more than any other packaging material
• Can break in filling, shipping, palletizing, storage or use

• PAPER
– Billboards the product
– Makes aseptic paperboard packaging possible when laminated with plastic
– Microwaveable
– Contain a variety of geometric shapes
• Degrades quickly
• Offers few barrier properties

• PLASTIC
– INJECTION MOULDING
• Gives the widest possible variety of crisp shapes
• Allows for greater detail
• Conveys a quality impression and is reusable
• Can hold spring and check valves, making pump dispensers possible
  – Needs high tolerances to function correctly
  – Requires larger expenditures in tooling

• PLASTIC
  – THERMOFORMING
• Offers cost benefits over glass and injection moulding
• Requires less development time than other methods
• Allows many packages to be immediately filled at any temperature
  – Can make a given item seem inexpensive
  – Generates waste in the production process
  – Generally less attractive than injection moulding

• PLASTIC
  – BLOW MOULDING
• Can often be manufactured quickly with a small amount of material
• Offers greater versatility in shapes than glass or paperboard
• Can hold a wide variety of liquids
• Does not allow corners to be crisp

• PLASTIC
– FLEXIBLE PACKAGING

• Offers the advantages of plastic, metal and paper

• Maximizes barrier properties

• Increases shelf life over certain other plastics

• Can be shipped in light weight sheet form

– Involves high start-up manufacturing costs

Labeling

• An item used to identify something, as a small piece of paper attached to food to designate its origin, manufacturer, contents, use, etc.

• A distinctive name or trademark identifying a product or manufacturer, especially a recording company.

Wrong food labels

• Falsely describing, advertising or presenting food is an offence,
  – there are a number of laws that help protect consumers against dishonest labeling and mis-description.
    • Refer to Food Safety 2003, page 102: item 13: Labeling requirements.
    • Fiji Food Safety Regulations 2009; Part V: Labeling rules and packaging
      – Includes general requirements in labeling, nutrient content labeling, mandatory labeling, prohibited claims, nutrient content claims, packaging

Types of Product Labeling
A. Packer/Manufacturer
B. Manufacturer’s Product Code
C. Sub Primal Identifier
D. Product Name
E. Product Size
F. Pack Size
G. Pack Size Metric
H. Storage Information
I. Bar Code for Warehouse and Inventory Identification

Product Nutrition labeling (2)
### Nutrition Facts

**Servings Per Container** (about 6)

- **Calories**: 180
- **Calories from Fat**: 160

**Amount Per Serving**

- **Total Carbohydrate**: 4g (1%)
- **Sugars**: 1g

**Ingredient List**:

- Wheat flour, egg white solids, nacin, iron, thiamin mononitrate (vitamin B1), riboflavin (vitamin B2) and folic acid
- Cream (derived from milk), chicken, contains less than 2% of:
  - Cheeses (granular, parmesan and roman paste [pasteurized cow's milk, cultures, salt, enzymes]), water, salt, lactic acid, citric acid and disodium phosphate
  - Butter (pasteurized sweet cream (derived from milk and salt)), modified corn starch, salt, whole egg solids, sugar, dextrose, rice starch, garlic, spices, xanthan gum, cheese flavor (partially hydrogenated soybean oil, flavorings and smoke flavoring), mustard flour, salt, pepper, and dehydrated egg yolk.

- Not a significant source of cholesterol, vitamin A and vitamin C.

*Percent Daily Values are based on a 2,000 calorie diet.*
Nutritional labeling requirement

![Nutrition Facts Diagram]

The Modern Packaging Industry

1. “Converters and users”—the broad industry divisions, converter and user subdivisions

   - “Converters”: to take various raw materials and convert them into useful packaging materials or physical packages (cans, bottles, wraps). To this point, packaging becomes a materials application science. The company forming the physical package will also print or decorate the package.

   - Package “users”, the firms that package products, are also regarded as part of the packaging industry, divided into a number of categories and each of these can be further subdivided.
- The “supplier”, manufacturers of machines for the user sector and the suppliers of ancillary services, such as marketing, consumer testing and graphic design, are also important sectors of the packaging industry.

2. Professional packaging associations

IoPP: Institute of Packaging Professionals

PAC: Packaging Association of Canada

PMMI: Packaging Machinery Manufacturers Institute

FPA: Flexible Packaging Association

WPO: World Packaging Organization

3. Other organizations having a major impact on packaging activities

ISO: International Organization for Standards

ASTM: American Society for Testing and Materials

TAPPI: Technical Association of the Pulp and Paper Industry

ISTA: International Safe Transit Association
The packaging industry can be divided into those that use packaging for their products and those that supply to these users

Conclusion

- Packaging is important as it serves to provide extended shelf life foods.
- Right information should be labeled clearly on the packet

Food Preservation

- *The Nature of Food*
- Food is derived from animal or vegetable sources. Its organic nature makes it an unstable commodity in its natural form.
- Various means can increase the natural shelf life of foods, thus reducing dependence on season and location.
- Food spoilage can occur by three means:
a) Internal biological deterioration

b) External biological deterioration

c) Abiotic deterioration

- “Taste” refers only to the sweet, sour, salty, and bitter sensations by the taste sensors located on our tongue
- Essential oils or “sensory active agents” and sense of smell by sensors located in our nasal passages
- What we perceive as a food product’s flavor is a combination of what we detect with our sense of taste combined with what we detect with our sense of smell.
- Essential oils are volatile. Volatiles can permeate packaging materials and making the problem of contamination or isolation even more difficult.
- Water vapor is similar to an essential oil in that it readily permeates many packaging materials.
- The creation of high-barrier packaging systems is partly in response to the need for packaging that will either hold desirable gases and volatiles in the package or prevent undesirable volatiles from entering the package.
- Temperature can promote undesirable changes that are abiotic in nature.
- Meat products
- Meats are an ideal medium for microorganisms because they contain all the necessary nutrients to sustain growth.
- Reduced temperature retards microorganism activity, slows evaporation and slows chemical reactions such as those associated with oxidation.
- Harvested fruits and vegetables continue to respire and mature.
- They contain large amounts of water and will wither if water loss is excessive.
- Peas, green beans, and leafy vegetables have high respiration rates compared with those of apples, oranges, and pears.
- Potatoes, turnips, and pumpkins respire slowly and are easy to store. Moisture loss is more rapid with lettuce than with a turnip because of the large available surface area.

Preservation Packaging Problems And Concerns
Condition          Quantification or Design Requirement
Oxygen              Determine required barrier level
Carbon dioxide      Determine required barrier level
Other volatiles     Determine nature and barrier level
Light               Design opaque package
Spoilage            Determine nature/chemistry
Incompatibility     Determine material incompatibilities
Loss of sterility   Determine mechanism
Biological deterioration   Determine nature
Deterioration over time   Determine required shelf life

CONTAINMENT

Goods need to be contained for transport & distribution. Food is the more likely to be transport and distributed in daily life and for betterment of the food; containment is required.

With the exception of large, discrete products, all other products must be contained before they can be moved from one place to another.

The "package", whether it be a milk bottle or a bulk cement rail wagon, must contain the product to function successfully.
The containment function of packaging makes a huge contribution to protecting the environment. Without containment, pollution could become widespread.

TRANSPORT FUNCTION

- The transport function entails the effective movement of goods from the point of production to the point of final consumption.
- This involves various transport modes, handling techniques and storage conditions.
- In addition to the general physical rigors of distribution, there are a number of carrier rules that will influence package design.
- Transportation and distribution is generally regarded as an activity that is hazardous to the product being moved.
- Packaging contributes to the safe, economical, and efficient storage of a product.
- Good package design take into account the implications of transport and warehousing, not just for the distribution package and unitized load, but for every level of packaging.

PRODUCT COMMUNICATION

There is an old saying that "a package must protect what it sells and sell what it protects". A package functions as a "silent salesman".

If there is no communication function (i.e. if there were only plain packs and standard package sizes), then weekly shopping expedition to the supermarket would become a lengthy, frustrating nightmare as consumers attempted to make purchasing decisions without the numerous clues provided by the graphics and the distinctive shapes of the packaging.

Packaging acts as a communication channel to inform users on product attributes.

Food packaging provides information on how to use store, its contents, its provenance, side-effects and warnings.

Package communication roles
• The communication role of packaging is perhaps the most complex of the packaging functions to understand, measure and implement because of the many levels at which this communication must work.

• Law or customs dictate certain messages without much leeway in their presentation. Examples of such message are:

  • Specific name of the product (what is this?)
  • Quantity contained
  • Address of the responsible body

**How a package communicates**

• Selected material

• Shape and size

• Color

• Predominant typography

• Recognizable symbols or icons

• Illustrations
• All of the communication channels must be balanced and supportive of one another to produce a persona with appeal and instant recognition.

• All supporting material, such as promotions and advertisements, must agree with the image projected by the package.

• Producing a well-balanced package persona requires an intimate familiarity with not just the structural qualities of packaging materials, but also the emotional qualities that they project.

• A thorough understanding of the various printing processes and the specialized decorating techniques used to create particular effects or decorate unusual surfaces is essential.

CONVENIENCE
The demand for a wide variety of food and drink at outdoor functions such as sports events, and increased leisure time, have created a demand for greater convenience in household products:
Foods which are pre-prepared and can be cooked or reheated in a very short time, preferably without removing them from their primary package.

**Two factors of convenience are important in package design:**

1. **Apportionment (relative proportions)**
   - The package functions by reducing the output from industrial production to a manageable, desirable "consumer" size.

2. **Shape**
   - Relation to convenience in use by consumers (e.g. easy to hold, open and pour as appropriate) and efficiency in building into secondary and tertiary packages.

**SYMBOLS ON PACKAGING**

![Symbols on packaging](image)

**INNOVATIONS IN FOOD PACKAGING**
Sustainable packaging

• Recyclability, reusability of packaging.

INNOVATION

The packaging sector’s major customers such as food and beverage companies are progressively collaborating with their suppliers to bring about sustainable packaging innovations.

Wal-Mart, for instance, implemented a supplier scorecard in 2006 enabling it to “evaluate its suppliers on the sustainability of their packaging and offer suggestions for improvement” – the company aims to become “packaging neutral” by 2025.

GlaxoSmithKline partnered with its suppliers to revamp its Aquafresh toothpastes’ packaging enabling it to have a smaller impact on the environment by being more recyclable and by simplifying the supply chain.

Amcor, an Australian packaging manufacturer, recently cooperated with Sainsbury’s to convert its fresh produce bags from non-recyclable polypropylene to recyclable polyethylene.

FLEXIBLE PACKAGING

Which can offer certain benefits compared to more rigid options. For example, a plastic flexible pack typically uses 50% less material than a rigid plastic container or bottle for the same application, and up to 75% less material by volume than a glass container or bottle

NANOTECHNOLOGY IN FOOD PACKAGING

Nanocapsules consists of a shell and space in which desired substance can be placed and delivered to the consumer in order to improve the food stability and by modifying the permeation behaviour of foils, block the UV light and antimicrobial activity.
References:

- http://www.oakpackaging.com/include/assets/Materials.pdf