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Food Packaging: A Primer

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Abstract Packaging has become an indispensable component of food manufacturing. Food packaging allows consumers to enjoy a variety of foods year-round. The main objective of food packaging is to protect food products from damage. Food packaging technology must balance food protection with other issues such environmental consciousness, regulations, and disposal of waste. This paper provides a brief introduction to food packaging.

Keywords food packaging, food preservation, food protection

Introduction

Food is any substance which has nutritional value. Packaging is the process of protecting and preparing products for transport, distribution, storage, sale, and end use. Food packaging or packing for food is integral the modern food industry. Packaging is basically providing enclosure of products in a rapped pouch, bag, box, cup, tray, can, tube, bottle or other container form for protection and preservation. The package protects the food against the harmful effects of bacteria, oxygen, light, and insects. It also provides tampering resistance, and special physical, chemical, or biological needs.

The package often includes package labeling with the information on ingredient and nutrition facts of the food product. Labeling of food packing is mandatory. It must identify the product, name/address of business/manufacturer, and nutritional information. The packaging and labels are designed to encourage or entice potential buyers to purchase the product. An example of food packaging is shown in Figure 1 [1].

Figure 1: An example of food packaging [1]

Figure 2: Food tracking example [11]

In our modern society, packaging is pervasive and essential. The field of food packaging has undergone tremendous development over the last 30 years. Food packaging draws on several disciplines including chemistry, microbiology, food science, and engineering [2].

Importance of Food Packaging

Key factors such as increasing globalization of food trade, changing lifestyles, and the rising consumption of packed products have led to an increased demand for food products with increased shelf life, which in turn increases the demand for food packaging technologies. The present consumer demand for convenient and high-quality food products has increased the importance of food packaging. Food packaging serves an important source of competitive advantage for retailers and product manufacturers.

Food packaging plays a more important role in consumer decisions. It can be a helpful marketing tool through in-store advertising. It makes the first impression on consumers. Packaging is one way your product can stand out from the crowd. The design and materials used in a packaging can make a huge difference. It can be the difference between a disappointed customer and a loyal advocate.

Food packaging provides protection from three major classes of external influences: chemical, biological, and physical [3]:

- *Chemical protection* provides a chemical barrier and minimizes compositional changes caused by environmental influences such as exposure to gases, moisture, or light.
- *Biological protection* provides a barrier to microorganisms (pathogens and spoiling agents), insects, rodents, and other animals, thereby preventing disease and spoilage.
- *Physical protection* shields food from mechanical or physical damage and includes cushioning against the shock and vibration encountered during distribution. Packaging must be designed to effectively withstand various conditions in the supply chain: rough handling during loading and unloading. Appropriate physical packaging also protects consumers from various hazards.

Types of Packaging

Food packaging is done through the use of a wide variety of materials such as plastics, metals, papers, and glass. There are different kinds of packaging depending on the type of product being packaged: medical device packaging, bulk chemical packaging, retail food packaging, military materiel packaging, pharmaceutical packaging, transport packaging, etc.

For example, a retail package is the best chance to make a sale. Food packaging can also be categorized by layer [4]:

- *Primary packaging* is the material that is in direct contact with the product and holds it. Common examples of primary packages include metal cans, paper board cartons, glass bottles, and plastic pouches.
- *Secondary packaging* is outside the primary packaging such as carton, and may be used to prevent pilferage, e.g. a corrugated case or box.
- *Tertiary packaging* is used for warehouse storage or transportation shipping.

These classifications can blur. Packaging may also be classified as consumer and industrial packaging. Consumer packaging means a packaged product is ultimately for consumers in the retail store. Primary and secondary packages can be used in this case. Industrial packaging means a package is for warehousing and distribution and tertiary package is used in this case [5]. Commercial/industrial food packaging is promoted on the global market. The type of packaging selected depends on the product type.

Materials for Food Packaging

To keep it safe, food needs to be packaged with a strong material. Our society often advocates the use of the poisonless and harmless materials in food packaging. Currently, most food packaging materials are regulated by the US Food and Drug Administration (FDA). There are various materials used for food packaging. Each material is used in increasing the shelf life and maintain the freshness of the product. (The shelf life of a food is the amount of time it can be stored before its quality becomes unacceptable.) Some common food packaging materials are discussed here [6,7].

- *Glass:* Glass is a popular packaging material because it is non-toxic, non-leaching, easy to clean, non-reactive to food/chemicals, non-porous, relatively cheap, and environment friendly. It has many advantages because it is odorless and chemically inert with virtually all food products. It is impermeable to gases and vapors, so it maintains product freshness for a long period of time. Glass is used for carbonated beverages, beer, and sauces.
- *Aluminum:* Metal is the most versatile of all packaging forms because it offers a combination of excellent physical protection and barrier properties. Aluminum is the most abundant metal on earth. It is light weight, lustrous, long lasting, and re-cyclable. It has good barrier properties. It is commonly used for making cans, foil, metallic trays, and forms for ready-to-cook food that are resistant for high and low temperatures. Aluminum foil is used in laminates and has wide application in food packaging.
- *Plastic:* Food packaging is one of the largest growing sectors within the plastic packaging market domain. Plastic is a generic term for many related synthetic materials that are commonly used for food packaging. It is strong, long-lasting, light weight, air-tight and recyclable. It can be used to make many types of packaging materials like bags, wraps, bottles, tubs, buckets, containers, re-sealable pouches, etc. Plastic packaging offers a large range of barrier properties but is generally more permeable than glass or metal. Plastics such as polypropylene, polyethylene, polyamides, polyethylene terephthalate, polyvinylidene chloride copolymers, etc., have been used as food-packaging materials. With time, plastic bottles had successfully replaced glass and metals in most household containers. The main disadvantage of plastics is being non-biodegradable. Several governments have regulations regarding the use of plastic and other non-decomposable packaging materials.
- *Paper:* Paper is an age-old packaging item, prepared from cellulose based materials (e.g. wood). It accounts for the largest volume packaging materials in the United States. It is permeable to air, water vapor, and gases (oxygen). It is used for carrying dry food stuff. It can also be used to make lightweight cartons. Paperboard is also used in food packaging; it is thicker than paper with a higher weight per unit area. It is commonly used to make containers for shipping—such as boxes, cartons, and trays.

Emerging Trends

There are many emerging food packaging technologies in the industry today.

- *Active or Intelligent Packaging:* Enormous technological advances will make the food packaging almost as intelligent as the consumer. Active packaging is an intelligent or smart system that involves interactions between package or package components and food and complies with consumer demands

for high quality and safe products. Active packaging is essentially the combination of food-packaging materials with antimicrobial substances. It can extend the shelf life of many food products [8].

- *Radio Frequency Identification* (RFID) is applied to food packages for supply chain control. It allows food producers and retailers to create real-time visibility of their supply chain.
- *Nanotechnology:* Nanotechnology involves the manipulation of matter at the molecular scale. It has revolutionized almost all the fields of science and technology, especially the food packaging industry. One of the main applications of nanotechnology is the use of nanocomposites in active packaging. Nanocomposites are with barrier properties to oxygen, water, and limonene. Nanotechnology innovation could produce remarkably new packaging concepts for barrier and mechanical properties, pathogen detection, and active and intelligent packaging [9,10].
- *Tracking:* The mobile application that will allow smartphone users to easily track packaged food product content using bar code information on food labels and bar code reading capabilities with smartphones. This will provide a clear understanding of the food contents and nutritional values. Figure 2 shows an example of food tracking [11].
- *Computer Aided Design* (CAD): This involves using computer software and systems to design and create 2D and 3D virtual models. CAD system can be used to design food packaging according to the standards. CAD is a software environment that enables the cooperation of a variety of design tools.

Benefits

Being a large industry, packaging has its own science, technology, processes, advantages, and disadvantages. Packaging protects against breakages, vibrations, temperature, heat and humidity. Optimal packaging make products easier to use or provide more convenience for the consumer. Food packaging has the following benefits [12].

- *Waste prevention:* Food packaging can help prevent or minimizes waste. Packaging plays an important part in preventing damage to the packaged product.
- *Security:* Packaging can reduce the security risks of shipment and improve tamper resistance.
- *Convenience*: Packaging can have features which add convenience in distribution, handling, display, and sale. Packaging plays a vital role in minimizing the effort necessary to prepare and serve foods.
- *Marketing:* Since packaging is often the only product exposure consumers experience prior to purchase, marketers use packaging to encourage potential buyers to purchase a product. Packaging is an integral marketing strategy to glamorize a product in order to lure buyers.

Challenges

Critics of food packaging have the following concerns [13].

- *Environmental Concerns:* In the past, most packages were not designed with environmental issues in mind. To ensure that food packages are designed with minimal environmental impacts. Government agencies and the food industry are under pressure to greatly reduce or eliminate packaging or recycle packaging materials. Packaging has become a major source of solid waste: filling up landfills, littering streets, and clogging waterways worldwide. Some food packaging substances (such as fluorinated substances) can be harmful to both humans and the environment.
- *Overpackaging:* Another criticism is overpackaging, whereby food companies use more of it than necessary which raises the product price and contributes to waste disposal. As a result, reduced packaging is becoming common.
- *Migration:* This usually describes a diffusion process, which may be strongly influenced by an interaction of components of the food with the packaging material. The packaging material (paper, plastics, glass, and metal) used for food packaging can be a source of chemical leaching into foods. Some packaging materials such as plastic, polythenes, and styrofoam can release toxins when they are heated and can be dangerous to consumers. Migration is an important health issue and is a legal problem in most countries [14].

Conclusion

The main purpose of food packaging is protection and preservation from external contamination. Food packaging seeks to contain food in a cost-effective way that satisfies consumer desires, maintains food safety, and minimizes environmental impact. Effective food packaging is critical to protecting food quality during transportation, distribution and storage. It is a vital component of the food industry because it prolongs food storage, enables long distance transportation, appeals to customers, and prevents waste. More information on food standards can be found in books [15-31].

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