

Packaging Food

Looking for Durable & Efficient Options

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Conventionally, food items were packaged with an intention to delay the process of environmental effects on the food. But today, innovative methods of food packaging are durable, environment-friendly and also incorporate the use of intelligent technologies.

PACKAGING, since ages, has been one of the most important components in several industries, more importantly in the pharmaceutical, food and beverage industries. It plays a crucial role in preserving and maintaining the quality of products by protecting them from any chemical, physical or environmental changes around them. The protection acts as a deterrent to moisture, oxygen, carbon dioxide and several other gases, apart from simply protecting the breakage and spillage of food items. Packaging also preserves the nutritional value by blocking light thereby, preventing the deterioration of food.

Traces of food packaging can be observed from the pre-historic times. Natural substances such as leaves, twigs, wood, animal skin, etc. were used as packaging materials to store food items. As humans evolved and their living and eating habits changed, so did their packaging techniques. With the development of cities and rise in trade, the storage material was required to be sturdy. This led to the use of wooden boxes, crates, clay pots, and barrels for the transportation of goods from one city to another.

It was the industrial revolution in Europe that prompted a massive change in the methods of packaging. Machines overtook the process of manufacturing packaging materials like metal cans and cardboard boxes, which were previously hand-made. But it was the invention of polythene that changed the world altogether. Its durability, lightness and flexibility made plastic bags a sudden hit in the packaging and storage industry. A major concern though was its decomposition and recycling.

With rising environmental concerns, food safety norms and consumer demands, manufacturers started looking at other materials that could be easily recycled and disposed of after usage. Many manufacturing giants made a conscious effort to ensure their packaging was made of recyclable materials which could be easily disposed.

Nowadays, paper and cardboards obtained from wood, cotton, and hemp are extensively used for manufacture of biodegradable food containers. In order to assist these

materials in providing resistance against moisture, the paper and cardboard packages are laminated. Glasses have also been used to store milk, juices, soda, and soft drinks. Many eco-friendly materials such as wood, bamboo and cork have been used in lieu of plastic containers and plastic caps for packaging materials.

Some of the modern methods of packaging such as, modified atmospheric packaging, active packaging, and intelligent packaging are the outcomes of the massive evolution in technology in the food industry which today provides the finest quality products with increased shelf life.

Modern Packaging

As the general public grew aware of what the packaging items were made up of, the food corporations had to change the composition of their packaging materials to make them free of chemicals harmful for our health. Today many brands while advertising for their products label their plastic bottles as BPA (Bisphenol A) free and/or PFAS (per- and polyfluoroalkyl substances) free. We often ignore these labels but they are of extreme importance from the perspective of our health.

Apart from packaging, the foods that we consume come in contact with several materials before reaching us. These materials are referred to as the Food Contact Materials (FCMs). Other than packaging materials, FCMs can include any substance that the food item comes in contact with during its production, harvesting, transportation or storage. Other than these, the conveyer belts and cleaning agents can also act as FCMs and transport unwanted substances and chemicals on to the food items.

Approximately 6,000 different types of chemicals found in the FCM inventory list have been identified by the USA and the European Union (EU). Out of these, BPA is one chemical that has been highly regulated due to hundreds of studies proving its toxic impacts on human health.

In the mid-twentieth century, scientists discovered that BPA can be polymerized to form polycarbonate plastics which are lightweight, durable, and flexible and exhibit exceptional transparency, colourability, and an extraordinary

resistance to heat and chemicals. These properties made BPA a common ingredient in the production of plastics and became popularly useful to produce a variety of substances. But BPA had extreme health hazards associated with it.

When used for food and beverage packaging, it was found that BPA leaches very easily into the food items thereby, causing breast cancer, diabetes, cardiovascular diseases, obesity, kidney diseases, reproductive disorders in men and women, among many others. Due to these toxicological properties of BPA, the food safety organisations put a ban on the use of BPA for packaging.

Further, more than 600 chemicals found on the FCMs have been identified as carcinogenic, mutagenic, bioaccumulative or environmentally harmful. Some of these chemicals are phthalates, parabens, styrene, phenol, p-Cresol, trichloroethene, benzophenone, and 1, 3-dihydroxybenzene. Exposure to these chemicals can impact human health causing several diseases with irreparable damage to the human body.

Therefore, today we see many food container labels that read 'BPA and parabens free'. Shampoos, soaps, and cosmetics are now produced sulphates- and parabens-free with an aim to reduce their side effects on the consumers as much as possible.



A shampoo bottle mentioning the list of items not used in its preparation (Credit:<https://www.vivawoman.net/2013/04/5-reasons-why-you-may-need-a-sulfate-free-shampoo/>)

Conventionally, food items were packaged with an intention to delay the process of environmental effects on the food. But today, innovative methods of food packaging incorporate the use of technologies, such as active packaging, intelligent packaging, and modified atmospheric packaging. These technologically advanced methods of packaging not only preserve the food but are environmentally friendly as well.

Modified Atmospheric Packaging (MAP)

The nutritional and sensory qualities of a produce starts deteriorating right after it is harvested. This occurs due to

transpiration and ripening of the produce post its harvest. MAP, a method of intelligent packaging, is used for fresh produces in which the environment inside the package is modified or adjusted with an aim to increase the shelf life of these produces. This alteration in the environment can be done by displacing the air and flushing a desired gaseous mixture which increases the produces' shelf life.

Active Packaging (AP)

This method of packaging integrates the use of active additives with a desire to meet the criteria of the client and convince them. In AP, the active additives react with the environment and the food components to increase the shelf life, improve the condition and safety of the product. The conventional way of packaging, also called passive packaging, was done with an aim to preserve the food from external environment and delay its process of decay.

AP is done by using materials that absorb moisture and odour, reduce the quantity of oxygen and ethylene gas, and emit antioxidants and antimicrobials in the internal atmosphere. These active additives can be mixed with the ingredients or enclosed in the packaging. For example, the



Picking of fruit made easier with the help of ripeness sensor (Credit:<https://www.jenkinsfps.co.nz/labels-tags/labels/ripesense-smart-labels>)

packaging of fruits is done using films that absorb ethylene gas, resulting in slow ripening of these fruits and a longer shelf life.

Intelligent Packaging (IP)

Intelligent packaging focuses on conveying data to the consumers. It is a packaging method which effectively carries out intelligent functions like detecting, sensing, recording, tracing, communicating and applying scientific logic to facilitate decision-making to extend shelf life, enhance safety, improve quality, provide information and warn about possible

problems. It gives credible and authentic data to the client about safety, quality and integrity of the package. It includes tightness, temperature and gas leakage indicators, biosensors, barcodes, and so on. IP devices are labels or tags which are attached on the packaging (such as pouches, trays, containers, tetra-packs etc.) to convey the information throughout the supply network to make it possible to take suitable actions in order to maintain optimum quality and safety.



A sensor that monitors carbon dioxide as indication for the freshness of the food item (Credit: <https://edepot.wur.nl/298571>)

Smart Packaging

It is a combination of active and intelligent packaging in one system. Such packaging is able to detect and control the essential variables influencing the quality description of the product. The latest systems being explored in the group of smart packaging are self-cleaning, self-heating or cooling and self-healing packages. Many self-heating polymers are efficient in the recovery of the authentic properties of the packaged substances, if and when there is damage. Self-cleaning, heating and cooling properties also make smart packaging a very popular concept.



A self-heating food packaging (Credit: <https://thespoon.tech/self-heating-can-company-heatgenie-raises-6m/>)

Biodegradable Packaging

A wide variety of synthetic polymers are used in the manufacture of packaging substances such as Poly Ethylene Terephthalate (PET), polypropene, polystyrene, High Density Polyethylene (HDP) and Low Density Polyethylene (LDP). These synthetic polymers are non-biodegradable and therefore pose a threat to the environment and living beings as they emit enormous amount of pollution.

To overcome the drawbacks of non-biodegradable packaging materials, bioplastics are now being used in the packaging of many items. These bioplastics are composed of polymeric material obtained from nature such as, polysaccharides, proteins and lipids. Their wide availability, non-toxic nature and biodegradability make these bioplastics extremely suitable for packaging materials.

A major drawback in using biodegradable packaging is that the natural polymers have poor mechanical strength, low thermal stability and do not act as good barriers for the substance stored in them. Due to these reasons, biopolymers are modified to enhance their properties, making them suitable to be used as packaging materials. These modifications are done by mixing them with synthetic polymers, by blending different kinds of biopolymers or by increasing their hydrophobic properties.

Promise of the Future

The packaging industry has made great strides right from its inception centuries ago, with the majority of innovations being made in the past hundred years. The industry has made intelligent innovations ensuring an improvement in safety standards and quality of the materials stored in them. Where initially plastics, papers and metals were used for packaging, today newer, smarter, and environment friendly trends in packaging are being seen.

For instance, nanoscience is emerging as a fertile ground for developing much durable food packaging. However, research on the use of nanomaterials in food packaging is still at a nascent stage because consumers prefer to use naturally obtained substances for packaging of food. But in the times to come, nanotechnology could change the food industry once and for all by producing high-barrier packaging materials with more potent antimicrobial agents and UV protection. This packaging can also be incorporated with nanosensors to detect any trace of contaminants, gases or microbes in the packaged food items.



Benefits of nanotechnology in food packaging

With plenty of innovative work being carried out in finding smart ways of packaging, we can only wait to see what the future has in store for us.

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