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Technical notes

Recent technologies for dairy products packaging

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ABSTRACT

In modern times packaging has been identified as an integral part of processing in the dairy industry. Package is the gateway to know a product and is brand ambassador of a product. It serves as a vital link in the long line of production, storage, transport, distribution and marketing. The investments made in the manufacture of an excellent dairy product can be a complete failure if the packaging is not appropriate. From the technical point of view, the major advances in dairy products making of recent years have been in packaging.

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1. Requirements of appropriate packaging material

Any material used for packaging of a particular dairy product should afford general protection, prevent moisture loss, improve appearance, protect against microorganisms, and prevent oxygen transmission. Broadly speaking, there are two main types of packaging requirement, viz., the long term wrap for factory packaging and the short term wrap for retail sale. The selected packaging material should have good gas barrier properties, mechanical strength, integrity of sealing, fogging, biodegradability, recyclability, thermal properties, and above all capability to attract the consumers when packaged products are displayed in the shelves of malls.

2. Dairy products packaging

Fluid Milk / UHT Milk: Milk has been packaged in different types of containers throughout the world. Of the total milk packed, flexible pouches dominate with 92%, glass bottles 7% and aseptic packaging 1%. Flexible pouches have proved to be safe, quick and cost effective with a wide distribution network, providing ease of packaging and handling. Butane LLDPE or C – 4 and Octane LLDPE or C – 8 are widely used because of their excellent cold storage properties and also to reduce leakage losses. In order to save the nutritional qualities of milk, the inner layer of the pouch should be black so that effect of light could be avoided. A paper milk carton that features easy open, easy pour with resealable cap offers convenience and locks in freshness of milk. The popular commercial systems available for aseptic packaging of milk are Tetra Pak, Brickpak, Combi block, Purepak. Doypack system provides a shelf life of almost 90 days.

Table Butter: Butter is generally packaged in vegetable parchment. Some dairies also use attractively printed, low grammage folding cartons as secondary package. Butter in such cartons remains in good condition for over two months under refrigerated conditions. The use of aluminium foil coated with nitrocellulose for retail packaging of butter increases the shelf life many fold.

Ghee: Ghee is clarified butterfat. The most common and serious deterioration in ghee is the development of rancid flavour, which give unpleasant odours even in micro quantities. The modern packaging plays a vital role in delaying the onset of this defect. The packaging material should possess good water vapour barrier properties. High-density polyethylene and polypropylene are known to have low water vapour transmission rates, which are less expensive. The packaging of ghee can also be done in polymer coated cellophane, polyester, nylon – 6, or food grade PVC and their laminates.

Milk Sweets: In Indian subcontinent, it is common practice to keep the milk-based sweets in open metal trays. On demand, the items are weighed and placed in ordinary paper bags or kept on *dhak* leaves and given to the consumers. At the most, some sweet makers or shopkeepers wrap sweets in glassine or grease – proof paper and sell them in duplex board boxes. Canning of rasogolla (chhana based sweet dipped in sugar syrup) is expensive and the other methods of packaging are unhygienic, inconvenient and unsuitable for outstation retail sales. It is therefore essential to meet the requirements of quality, convenience and economy. The efforts should be made to study the utility of various types of available flexible packaging films like polyethylene, polyvinyl chloride, PVDC, cellophane, food grade paperboards and various laminates for packaging of milk sweets for extending the shelf life. Though lacquered tin can is the most suitable packaging material for rasogolla and gulabjamun (khoa based sweet soaked in sugar syrup), but it is expensive. Hence, these products should be packed in composite cans made of plastic and laminated with a PP – Al foil material.

Paneer: It is a variety of Indian soft cheese, commonly packaged in polyethylene bags. Some organizations have started its vacuum packaging for enhancing the keeping quality. In order to increase its shelf life significantly, the product should be packed under modified atmosphere (100% CO₂), which increases the shelf life by 300%.

Hard cheese: Hard cheese packed in new biopolymers which will give it an extended shelf-life may be on the shelves in the near future. Substituting fossil plastic materials by renewable biopolymers may benefit the environment and at the same time improve the utilisation of agricultural by-products. According to the Centre for Advanced Food Studies in Denmark, the new biopolymers may be based on proteins like casein, on carbohydrates like starch, cellulose, on lipids, and also on polymers from surplus monomers produced in agriculture such as polylactate (PLA); and finally, on bacterial produced polymers from microorganisms grown on waste, like poly 3-hydroxy-butyrate (PHB). Scientists are dealing with these perspectives for the packaging of hard cheeses: they are developing a new proactive packaging material based on PLA, and are incorporating oxygen scavengers and preservatives encapsulated in cyclodextrins to reduce cheese oxidation (development of rancid taste) and surface growth of moulds.

Yoghurt: Generally packaged in PP (polypropylene) or PS (polystyrene) cups. Also two compartment packages – crunchy nuts and fresh dried fruit housed in one, and yoghurt in the other are used. After removing the foil lid, the contents are mixed before consuming. Keeping in view the pollution problem, it is recommended that the earthen pots should be used for the packaging of yoghurt.

Dried Milk Products: Consumer packages for milk powder and infant food include: metal can, plastic bottles, sachets and flexibles kept in cartons. The metal can is nearest to complete container for milk powder but the major drawback is its high cost and tendency to rust. The severity of this problem has been solved by using Al ends and lacquering of the cans. A typical composition of sachet for whole milk powder (WMP) is polyester 12mm / Al foil 9mm / PE 50mm, which should be satisfactory in relation to oxygen transmission. For skim milk powder (SMP), polyester / PE and metallized films are widely used.

3. Innovative dairy packaging

Innovative packaging technologies become necessity for the development of extended shelf life and value added dairy products. The newer packaging technologies such as Modified atmosphere packaging (MAP), controlled atmosphere packaging (CAP), vacuum packaging (VP), and active packaging (AP), antimicrobial packaging, retort packaging, do more than just provide protection from outside influences. These innovative packaging reduces physiological change, oxidative deterioration and microbial growth by changing the levels of gas that surround the product.

4. Modified atmosphere packaging

Modified atmosphere packaging is defined as "the packaging of a perishable product in an atmosphere which has been modified so that its composition is other than that of air. English territorial cheeses, *e.g.*, Cheddar have traditionally been vacuum packed. Increasingly MAP is being used now with high CO₂ concentration CO₂/N₂ gas mixes. This has the advantage of obtaining a low residual O₂ content and a tight pack due to the CO₂ going into solution. Use of N₂ / CO₂ atmospheres has significant potential for extending the shelf life of cottage cheese. This is high moisture, low fat product that is susceptible to a number of spoilage organisms including *Pseudomonas* spp.

5. Aseptic packaging system

Aseptic packaging can be defined as the filling of a commercially sterile product into a sterile container under aseptic conditions and hermetically sealing the containers so that reinfection is prevented. This results in extension of shelf-life of products at normal temperatures, which is shelf-stable at ambient conditions. Aseptic packaging technology is fundamentally different from that of conventional food processing by canning.

5.1. Intelligent packaging system

The intelligent packaging monitors the condition of packaged foods to give information about the quality of the packaged food during transport and storage. Intelligent packaging can monitor the product quality and trace the critical points in the food supply chain. Thus, an intelligent product quality control system enables more efficient production, higher product quality and reduced number of complaints from retailers and consumers. To food industry, intelligent packaging also gives technological support to carry out in-house control required by food regulations. Active and intelligent packaging systems have been regarded as potential new breakthrough technologies for the future.

6. Active packaging

A variety of packaging technologies are being developed to provide consumers with high quality dairy products that have a long shelf life. Technologies such as CAP or MAP, use of edible coating are the recent developments in the area of packaging. These developments have led to the concept of interactive packaging.

7. Anti-microbial packaging

Anti-microbial packaging is one of the most researched areas of active packaging. The research activities have been directed at determining how the surfaces of plastic can be made not only sterile, but also capable of exerting anti-microbial effect on packaged food or beverage. Two approaches can be applied to achieve anti-microbial effect. The first consists of binding an agent to the surface of packages and this would require a molecular structure large enough to retain activity on the microbial cell wall even though bounds to the plastic. Such substances are usually enzymes or anti-microbial proteins. The second approach involves the release of anti-microbial agents into food or beverage or localized removal of food ingredient essential for microbial growth. This application could be used for foods effectively not only in the form of films but also as containers.

8. Antimicrobial edible packaging

A considerable quantum of used packaging material is non-biodegradable and becomes a source of visible nuisance and toxic substances that are accidental byproduct of improper disposal of non-biodegradable packaging materials mostly plastics. Increasing environmental issues, awareness among the consumers and growing market of convenience foods have augmented the need for development of biodegradable and edible packaging materials. Edible films and coatings are thin continuous layers of edible materials formed on or placed between food components to provide a barrier to mass transfer, to carry food ingredients and additives, and/or to act as a food integrity enhancer. Edible film could significantly reduce the plastic package and reduce municipal waste.

9. Bio-packs

Use of oxygen scavengers, and other preservatives, as active, protective agents in a new bio-based packaging material. They improve the shelf life after opening the package at home, reducing the growth of moulds and development of rancid taste in fat rich dairy products. The shelf-life of cheese becomes triple from the 2-3 months up to 9 months.

10. Smart indicators

- O₂ / CO₂ indicators – Redox or pH indicators;
- Microbial growth indicators – pH indicators or certain metabolites indicators

11. Metal detector

According to Lock Inspection Systems, occasional metal contamination is a concern throughout the dairy industry, whether metal swarf (fine metallic filings or shavings removed by a cutting tool) from machinery, fractions of broken cutters and blades or fragments of the clips used to seal packages. The units are fully waterproof and modular construction ensures simplified servicing. The detection units are placed towards the end of each packing line, between the filling and the sealing machines, to detect any metal contamination before the packaging is sealed.

12. Conclusion

A product is often identified by the package in part of food production, marketing and distribution. The changing lifestyles, urbanization and increased consumerism have flooded the market with value-added, branded, and attractively packaged food products. Today, an array of packaging materials and systems such as aseptic and retort packaging gas/vacuum packaging, thermoforming, bag-in-box and lined carton systems, shrink wrapping and stretch wrapping is available. Development of high barrier materials, MAP systems, aseptic packaging systems and the like has changed the food marketing system, providing more “fresh food” in retail stores for a longer duration. Development of suitable packaging system is essential for modernization of the dairy products industry and the organized sector’s greater participation in it.