Modern Food Packaging Technologies: Regulatory Aspects and Global Trends

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Welcome to the NPTEL online certification course on Modern Food Packaging Technologies Regulatory Aspects and Global Trends. Dear friends, in the last lecture we have covered the packaging of meat and poultry products. Now, we will see the packaging of dairy and dairy based products. We will cover in this lecture introduction, important requirement for dairy products packaging and then specialized packaging like packaging of fluid milk and packaging of cream. The appropriate packaging of milk is of utmost importance not only to preserve its nutritive value and saving of wastage, but also to improve the marketability to achieve better returns. The challenge to the packaging industry is to deliver the nutritious milk to the consumer in most economical, hygienic, safe and environmentally friendly package.

Because of the shelf life requirements of UST milks multiple laminates for example, the triple layer of high density polyethylene are used. An intermediate light barrier may be incorporated according to the manufacturers preference. Oxygen penetration during storage is not usually a problem. Whatever the source of bottles aseptic techniques are used in filling and sealing to prevent contamination and milk can be expected to have a shelf life of at least 6 months at ambient temperatures.

The cream contains a high percentage of fat. So, it is very susceptible to spoilage. So, packaging material used should be selected in such a way that it possesses good grease resistance and barrier properties against oxygen and moisture. Cultured milk products have various textures and viscosities that is when liquid they are considered as beverage for example, buttermilk and when they are semi solid they are spoonable products like yogurt. The material used for packaging must be compatible with the special physical, chemical and bacteriological properties of the fermented milk.

Traditionally Indian dairy products have been manufactured by individual sweet makers which is in India known as halwais and small entrepreneurs. Very little attention is paid to sanitary handling and packaging of these products. Indigenous products have been packed in leaves, paper, cartons and paper board boxes. These materials do not provide sufficient protection to the product from atmospheric contamination and manual handling. Consequently the sweets soon lose their typical body and texture, absorb

foreign odors, lose their aroma characteristics and show mold growth.

Moreover the products are stored in open metal trays. Global dairy products packaging market. This slide shows the global dairy products packaging market was worth around 29.7 billion US dollars and in the 2021 which is expected to rise in 2028 to 38.23 billion dollars with a cumulative annual growth rate of 4.

3 percent from 2022 to 2028 and these are the various key players those who are handling in the dairy products. The dairy products packaging market in 2022 it was estimated to be 23.15 billion dollars which is expected to rise in 2023 to 34.75 billion US dollars with a cumulative growth rate of 5.3 percent per annum.

And the applications are the product which are marketed are mainly the milk, cheese, yogurt and other products and the raw materials which are used for packaging these products are metals, glass, paper and other materials. Now packaging of fluid milk. Milk being extremely perishable product requires suitable packaging to preserve its initial quality for a predetermined length of time. Milk has been packaged in different types of containers throughout the world. Milk is sold in flexible packages like curtains, bags, pouches, plastic bottles, jars etc.

The unique advantage offered by the plastic packages are that they have good barrier properties, permit visibility of the content or light in weight, can be used for single service or easy to carry home or more economical and can be made more attractive. The use of plastic containers eliminates noise normally encountered in the milk bottling plants and during delivery and also reduces water pollution caused by milk residues and detergents used in the bottle washing process. At present only 15 percent of all milk produced is packaged by the commercial dairy industry and the flexible pouch accounts for approximately 92 percent of total marketing. Marketing of liquid milk in India is quite difficult keeping in view the agro climatic conditions that is high ambient temperature and poor infrastructure for transportation. Concerted effort are needed to improve the overall quality of the packaged fluid milk in India which will prevent colossal wastage of milk due to inferior packaging.

In the light of technological advances in India and abroad in the dairy sector the success of dairy business is deeply anchored in the packaging system. Inadequate packaging leads to rapid degradation of products quality. There are two main types of packaging systems of fluid milk one is traditional bottling system in which container is to be returned and another is one way delivery in which container is disposable and does not travel back to the dairy. In the non-returnable distribution system there are several alternative systems where different packaging materials shapes, sizes, forms and

machines are employed for packs. For selection of a suitable packaged material the knowledge of important characteristics of milk and milk products is essential.

The packaging serves the following purposes to contain and protect the product during handling and storage thereby increasing the shelf life to inform consumers about product quality and facilitate transportation. Third one is to attract the attention of consumers and increase sale. The last one is to prevent scope of adulteration that is temper proof system. Why milk packaging? Milk has a tendency to absorb the flavors from its environment. Risk of contamination is more in liquid milk.

Adulteration can be done easily when not packed properly. It is difficult to handle milk in bulk quantities. Milk is prone for oxidation when exposed to sunlight. Characteristics of package for pasteurized milk, it should be free from off flavors, it should not impart any taste or flavor to the product, it should act as barrier to bacterial contamination, it should be resistant to UV light that is maximum transmission of 8 percent at 500 nanometer and 2 percent at 40 nanometer. It should have no physiological effects on the products, it should possess good mechanical properties that is sealing, tensile, structural strength etc.

It should be temper proof, it should possess good oxygen barrier properties, it should be economical and it should fit into processing in line. The packaging material and forms the packaging system is composed of two things that is the materials and the forms. The materials may be in form of paper and paper board or plastics or aluminum foil or glass or it can be tin plate or it can be laminates and the forms which may include the different types of bottles, curtains, cans and collapsible tube. Now, the packaging materials, paper and paper board. The paper used commonly in the form of wrappers, curtains, boxes, bags etc.

The merits of paper are its relative weightlessness, low cost and easy disposable. Its availability in various types etc while disadvantages are it is of low tier and weight strength unless treated or coated with some splice material. Now, the plastics a wide variety of rigid plastics can be used as thermo formed such as bottles, curtains etcetera. Flexible plastic package flexible plastic packaging films are used as wrappers, bags and pouches. These are of two types low polymers which include cellophane coated with polyethylene and high polymers which includes polypropylene, polystyrene, polyester etc.

The merits of rigid plastic containers are its low cost and ease of fabrication and demerits are lack of product compatibility, plastic deterioration, lack of resistance to high heat and fragility at low temperatures. The another important material is aluminum

foils. Aluminum foil has good barrier properties, grease proof, non-sorptive, shrink proof, odorless and tasteless, hygienic, non-toxic, bright in appearance etc. The common thickness of this medium for use in products is 1.

012 to 0.015 millimeter. The glass packages are it has low tear strength is attacked by certain strong alkalis and acids and it does not heat seal by itself. The glass packaging of milk in glass is the oldest system. The glass bottles offer certain advantages like transparency, rigidity, hygienic and non-toxic nature and compatibility. This system involves collection and transportation of empty bottles to processing plant washing and sterilization of dairy bottles. The tin plate this consist of thin sheet about 0.

025 millimeter thick of mild steel coated on both sides with layer of pure tin. Tin plates have the merits of good strength, excellent barrier properties while the demerits are of high cost, heavy weight, difficult recloser and disposal it is used in the form of cans. The laminates, laminates are made of following reasons. To further strengthen the film material, to improve barrier properties, to improve grease resistance, to provide a surface that will heat seal etc. Some typical laminates are paper polyethylene, cellophane polyethylene and polyester polyethylene.

The packaging forms the bottles, the glass bottle is still continues to be the most frequently used package for milk in the world. It has got advantages like light in weight, easy to handle and no danger to breakage. Lower distribution cost effective sales message can be printed on the bottles, no exposure to sunlight, it is temper proof and at the same time filling machinery compact and occupies less space. But at the same time there are disadvantages also associated with the glass bottles that is the difficult to remove cream, regular supply of special paper or like film necessary, difficult to open. Some of the cases leakage may occur, cost higher per unit milk distributed.

This packaging system requires large storage space for both empty as well as filled bottles. These factors increase the fixed and the variable costs. Heavy weight, fragility and returnability of bottles has inconvenience both to the distributor as well as to the consumer which made this packaging system undesirable and is not in use as present. The cartoons, this kind of packaging materials are commonly used in specific filling systems for milk, cream, fruit juices, soups etc. The filling systems could be either of the following two types.

Those in which the carton is formed within the filler from a continuous reel of material and in those in which the cartons are supplied as preformed blanks folded flat which are assembled into cartons in the filler. The packaging material is mainly composed of printed paper coated with aluminium foil and several plastic layers like polyethylene,

paper board polyethylene, aluminium foil polyethylene. The inner material side of the finished product is coated with special layer facilitating the sealing process. Each layer has a specific function. The outer polyethylene layer protects the ink and enables the sealing process of the package flaps.

The paper board serves as a carrier of the decor and printing gives the package required mechanical strength. The laminated polyethylene binds the aluminium to the paper. The aluminium foil acts as a gas and light barrier. The inner polyethylene layer provides liquid barrier and sealing. Now, the cans this is commonly used for all types of solid, semi solid and powdered products.

Recently aluminium cans have been introduced. Cans are the most convenient for gas packaging. Collapsible tubes It is made up of aluminium and lacquered on the inner side. Its merits include low cost, light weighted, ease of handling, product protection etc. It is generally used for semi fluid products such as sweetened condensed milk, processed cheese spread etc.

Now, the packaging of cream. Cream is the concentrated form of milk fat and contains high percentage of milk fat. Cream is a high moisture product and hence is very perishable. It is prone to oxidative as well as lipolytic rancidity. It needs care to preserve and improve the shelf life.

Pasteurization of cream extends the shelf life to greater extent, but packaging of cream also play key role in extending the shelf life of the cream. The shape and characteristics of packaging material used for cream will vary depending on the manufacturing process of cream and also intended use of finished end product that is for retail or wholesale marketing. General requirements for packaging of cream. Various formats exist for the packaging of pasteurized or face cream. The following are the important factors to be considered in packaging of all creams whether pasteurized, UST treated or sterilized.

The exclusion of light is important. As light can initiate auto oxidation of the milk fat resulting in the production of rancid flavors. Homogenized cream is particularly susceptible to action of light. Cream may be tainted by the absorption of odors from various sources and packaging material must therefore, be impermeable to gases. The absorption of moisture or fat can cause the quality of cream to deteriorate. The packaging must therefore, be impermeable to both.

The packaging material themselves may contain compounds which can migrate into the cream causing a gradual deterioration in quality. For example, monomers from plastic packaging and printers ink and dyes used for labels and decoration. Packaging materials

should be carefully selected to avoid such problems. The design of the container can also influence product quality. With some creams serum separation may occur during storage and the ability to shake the contents to ensure mixing can be important to consumer acceptability.

Table cream. Table cream is packaged for retail sale in units similar to those for milk such as glass bottle, paper cartons, low density polyethylene satchets, plastic bottles etc. When table cream is produced for purpose of coffee whitening, UHT processing is combined with aseptic packaging employing multi cup tray package format. Each cup quantity serving as a single dose sufficient for one cup of coffee. The packaging for pasteurized cream.

Retail packaging. Pasteurized cream is packaged in cartons and bottles for retail sale with package size usually being in the range of approximately 100 ml to 1 liter. Pasteurized cream for retail sale was earlier packaged in glass bottles, wax cartons and polyethylene coated cartons. But now the most common form of packaging used is the injection molded polystyrene part or flat topped round containers. Polypropylene containers are used and alternative as these less likely to cause tent and when used as a coke of polymer with polyethylene it is more robust under chilled condition. However, due to technical difficulties these have limited use.

To improve the barrier properties of the plastic packaging for fresh cream multi layer materials may incorporate an ethylene vinyl alcohol layer. Once filled the containers are closed with a heat sealed polyethylene, aluminum foil laminate and often a clear plastic lid is provided for consumers to reseal the container once opened. Bulk packaging. It may be used for catering or institutional use. Normally plastic for example, polyethylene bags are contained in plastic crates or cardboard cartons are used for bulk packaging.

In this case package size range from 5 to 25 liters. Packaging of sterilized cream. In case of retort sterilized cream tin cans and glass bottles are commonly used packaging formats. The simplest method of sterilization is to package the material then heat the complete package and material to confirm sterility. The can and glass bottle have been traditionally containers for such operations, but other retortable plastic materials are now available for packaging.

It is normal to give the cream a preheat treatment before packaging to destroy bacterial spores. Sterilization takes place in a retort or hydrostatic sterilizer using temperature time regimes of 110 to 120 degree Celsius for 10 to 20 minutes. These severe heating induces gross changes in the cream with protein denaturation. Maillard browning and fat agglomeration may take place to modify texture and flavor. A calcium sequestering

agent such as sodium citrate or sodium phosphate may be added to make more casein available for stabilizing the emulsion.

The unit packaging volumes have to be relatively small about 400 ml because of the restriction on heat transfer with larger volumes. Normally cream of approximately 23 percent fat content is the base cream for in can sterilized cream manufacture. It enjoys a substantial market as a dessert agent or ingredient in a number of food items such as dressings and sauces. It is well known to be a good base for party dips.

Packaging of UHT. cream a number of different packaging options are available for packaging of UHT. cream to pack and the following are some of the packaging options. Aseptic canning was probably the first to be utilized with cream.

Aseptic polyethylene paper and foil laminate cartons were used. The plastics like polystyrene or polypropylene foam filled sealed packages are most widely used. Lacquered aluminum or tin plate cans are used for aerosol cream. Pre-formed parts are with laminates are also used. Laminates that is the polyethylene bag contained within a cardboard carton that is bag in box concept is used for bulk packaging of UHT. cream with unit volumes are in the range of 5 to 1000 liters. For aseptic packaging the packaging material is first treated with hydrogen peroxide solution. Later removed by squeezing or natural drainage. A residual solution is removed by heat while the evaporating and decomposing peroxide sterilizers and materials. The sterilized product must then be filled in a sterile environment.

In tetra pack system the laminate is in the form of a continuous tube and the evaporating peroxide above the filler forms a natural aseptic barrier. Individual packages are formed by heat sealers and cutters at the base of the filler. Most other systems incorporate laminar flow cabinets for filling operations.

Unit sizes range from 7.5 ml that is of coffee cream to 1 liter. Thank you very much for this.