**Modern Food Packaging Technologies: Regulatory Aspects and Global Trends**

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**Week – 10**
**Lecture – 48**

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 seen the packaging of cereals and flours. In the present lecture we shall be packaging of food products with special reference to the bakery and ready to eat products. And in this the topics we will be covering is packaging of bakery products which will include which will include product characteristics, packaging materials, techniques for packaging of bakery products and then packaging of ready to eat products which will include the packaging requirements of ready to eat and ready to serve foods and packaging requirements for ready to cook foods. Now, the packaging of bakery products, bakery products are becoming a major part of the international food market. The baking industry is undergoing a period of rapid change.

Baking industry must try to satisfy the healthy eating trends and the consumer demands for fresh products. Food technologies have to select a suitable type of packaging that will ensure the necessary shelf life for the bakery products. The success of the product in the market must be based on the design and the production both with the very best raw materials and advanced technology. The principle function of food packaging is to minimize reactions that affect the stability of the product.

Mold spoilage is common in bakery industry and in many cases mold growth determines the product shelf life of both high moisture and intermediate moisture baked foods. Baking destroys molds however, during cooling and packaging, recontamination can occur and cause growth to take place. The product characteristics dry bakery products, these products are fragile and characterized by low moisture content that is less than 6 percent and lower water activity that is around 0.3 and are highly hygroscopic. The moisture is the decisive criteria for the organoleptic properties and acceptability by the consumers.

The basic characteristics of dry bakery products are given in table which is presented in the next slide. Like a physical and mechanical that will govern the fragile, light, low resistance to moisture and variable sizes. Whereas, the organoleptic properties are crisp or crunchy texture, distinctive flavors, flavors that may change that is loss of initial flavor or ingress of foreign flavor. The flavor that may deteriorate that is go stale, soapy

or bitter etc. The physical physical chemical properties are governed by low moisture content, hygroscopic containing fatty matters, greasy surface and sensitive to oxidation, enzyme reactions, non enzymatic browning and light.

Whereas, the techno economical features are related with industrial and low sales price. The moist bakery products bread and cakes are another category of baking products with comparatively less shelf life. These products have high moisture content that is more than 12 percent, supple texture and high water activity between 0.6 to 0.85 with low resistance and tendency to crumble and go stale.

Their basic characteristics are given in the next table. Like the physical mechanical that is fragile, light, low resistance, varied sizes and shapes, the organoleptic properties are related, the supple and creamy texture, distinctive flavors, flavors that may change that is loss due of flavor or fixation of foreign odors, flavors that may deteriorate that is go stale or soapy and appearance that may change that is the drying out. And the physicochemical properties are high moisture content, high water activity and sensitivity to oxidation, enzymatic reactions and microbiological alterations. Now, the packaging materials for bakery products, the first biscuits. A wide range of packaging materials is used to pack biscuits.

Since paper cartons, tins have lost out to flexible packaging materials as the packaging medium, the focus is now on the latter. A variety of flexible packaging materials are used for packaging biscuits due to advantages such as functionality, lower cost, printability, light weight, savings in freight and other such factors. The flexible packaging materials, these are used as wrappers, pre-formed pouches or form fill pouches. The oldest flexible film to be used was cellophane because of its excellent gas barrier properties and heat sealability. Cellophane becomes less popular when it became too expensive.

Another material which is widely used is biaxially oriented polypropylene film. For less demanding applications oriented polypropylene monofilm is used while for higher quality products duplex oriented polypropylene or OPP combinations with that is pearlized or metallized such as OPPPE or OPP PET etc are used. Today, most of the biscuits are packed in flexible laminates of composite structures where every component fulfills a specific function. These laminates have desirable properties such as moisture barrier, gas barrier, heat sealability, printability characteristics, high production and overall economy. The thermoformed plastic trays, thermoformed plastic trays of polystyrene or PVC with multiple cavities are used to pack assorted biscuits, pastries, cookies etc.

They are closed with a snap on lid or over wrapped or shrink wrapped or sealed with a

leading material. The products rest nicely in the compartment and make a good presentation. Use of active packaging with oxygen absorbent and anti microbial properties for bakery products helps to significantly increase the shelf life and maintain the original quality of the product. Polyvinylidene chloride coated nylon, polyester, LDPE, PP, ethylene vinyl alcohol, polystyrene are examples of flexible packaging materials used with active sachets. The breads traditionally bread in India was packed in waxed paper wrappers.

The search for lower cost over wrapping materials led to the use of polyethylene film and nearly 80 percent of all bread is now packed in plastic films such as LDPE, LLDPE, LDPE laminate and PP. Also auto bagging machines require high slip PE resin that is pouches with good open ability. LDPE, LLDPE laminate bags of 1 to 1.5 millimeter thickness secured by plastic clip or twisted wire ties are normally used. Now, the cakes pastries and doughnuts these products are available in various sizes shapes and forms.

Since these products contain high moisture content they are prone to mold growth and hence the packaging material selected should not encourage mold growth. The packaging material used is polypropylene, cast polypropylene, polyvinyl chloride etc. While the choice of the film depends upon the machinability and economics required. The techniques for packaging of bakery products wrapping style there are several popular wrapping styles which are applied widely to a variety of biscuits of all shapes and sizes and other bakery products. Biscuits packed using following two wrapping styles must be of common size and shape with a certain consistency and rather narrow tolerances in their dimensions.

The first is End fold wrapping, this wrapping style is the classic traditional biscuit wrapper. A portion of biscuits is standing on edge is roll wrapped or fold wrapped into a heat sealable film. The longitudinal packet seal is sealed tightly in a fin sealed style, the packet ends are folded neatly and heat sealed. Due to the neat and tight surrounding of the film this packet gives utmost mechanical protection and acceptable barrier properties for hard and semi hard biscuits and many other cracker types. End fold wrapping is considered the most effective in terms of presentation by many marketing is specialists not only due to neat and impeccable shape, but also due to its ability to clearly distinguish the product amongst the host of pillow pack items on the retail shelves.

The pillow pack wrapping, this is the standard wrapping style for a smaller biscuit packs that is snack packs or single shop packs containing one or more piles of biscuits. In addition pillow pack wrapping is used for bigger packets with products standing on edge that is slug wrapping as well. In this configuration it often serves as a primary wrapper to be over wrapped by a carton to improve presentation and acceptance. The main

advantage of pillow packs, on edge is its flexibility with regard to slug length. For instance it allows the machine to automatically adjust the length during wrapping by means of tendency control check wares.

This feature ensures the highest weight accuracy. Additionally the pillow packs typical fin sealed sealed style sealing is somewhat tighter than the N fold wrap. This disadvantage of pillow packs slug wrapping is its laminated is its limited mechanical product protection due to its rather loose packing. Further the presentation of products packed using the pillow pack style is considered by most to be less attractive than Nendfold packets. The packing for odd size biscuits besides end fold wrapping and pillow pack wrapping which by the way cover about 85 to 90 percent of all biscuit products.

There are some specialty biscuits with their own unique wrapping needs. These include assortment of small cocktail crackers filled in bags by vertical FFS that is the form filled sealed style machines and cookies of uneven sizes whose tolerance do not allow a standard wrapping. The latter are automatically are manually loaded into decorated trays and subsequently over wrapped on pillow pack machines. The packaging of ready to eat products convenience food is a concept that is prevalent in the developed world since long while its inception into the Indian market has been recent. With the changing socio economic pattern of life and the increasing number of working couples the concept is first becoming popular in Indian market.

This type of food is becoming popular because it saves time and labor this food has extended self life and is available of the market selves. The convenience food could be basically classified into two categories the shelf are the shelf convenient food and the frozen convenient food. Shelf stable convenience food are further classified as ready to eat and ready to serve foods for example, idlis, dosas, pav bhaji, meat products like pre cooked sauces, ham, chicken products, curries, chapatis, rice, vegetables like aloo chole, noratan korma, chana masala etc. Ready to cook food for example, instant mixes like cake mixes, gulab jamun mix, falooda mix, ice cream mix, jelly mix, pudding mix etc. Pasta products like noodles, macaroni, vermicelli etc.

The packaging requirements of ready to eat and ready to serve foods. A ready to eat food product may be defined as food product which does not require any elaborate processing procedures on the part of consumer before it is good enough for consumption. It is ready to eat as soon as pack is opened in a form which is tasty and appetizing. The advancements in food technology and packaging technology have made it possible to extend the shelf life of these products. Before deciding which packaging material is to be used it is necessary to know the packaging requirements of the product that is what

hazards will cause product deterioration and the conditions to which package product will be subjected throughout its shelf life.

Some important packaging considerations which influence the selection criteria for choosing packaging materials are highlighted that is product characteristics. The type of food and its composition which include the moisture, fat, protein, flavor etc. The form and shape of the product like smooth, regular, irregular with sharp edges etc. The nature of the product that is the crisp, brittle, sticky etc. Ready to snacks like idlis, tosas, pav bhaji etc are sold across the counter and have a very short shelf life.

Hence the packaging requirement of these products are different from those of ready to eat products like curry rice, upma, vegetable biryani etc which are retard processed for longer shelf life. Products like idlis, dosas, pizzas are packed in packaging materials having low water vapor and oxygen permeability, odor and grease resistance and good physical strength. The packaging materials generally used are injection molded plastic containers, plastic film or bag pouches or paper board curtains. Even food like palak paneer, dal fry, curry rice, upma, vegetable biryani etc are retard processed. Hence their packaging requirements are different.

These products are retard processed because they are low acid food with moderate to large sized particles. Hence it is easy to remove oxygen from the head space by gas flushing. The selection of a polymer or its combination is based on the requirement of barrier properties. Retard pouch is a special package in which the very perishable food items are preserved by physical and or chemical means. It is a flexible laminate which can withstand thermal processing and combines the advantage of the metal can and the boil in bag.

Ready to use retard pouches are flexible packages made from multilayer plastic films with or without aluminum foil as one of the layers. Unlike the usual flexible packages they are made of heat resistant plastics thus making them suitable for processing in retard at a temperature of around 121 degree Celsius. These retard pouches possess toughness and puncture resistance normally required for any flexible packaging. It can also withstand the rigors of handling and distribution. The material is heat sealable and has good barrier properties.

In India 3 ply laminate consisting of pet aluminum foil polypropylene is commonly used for packaging of ready to eat retard packed food. The product packed in such laminates has a shelf life of 1 year. Now, packaging requirements of ready to cook food based on their initial moisture content ready to cook food can be broadly classified as low moisture food, medium moisture food and high moisture food. Low moisture food up to

1 to 5 percent weight basis and equilibrium relative humidity of 18 to 20 percent. These food have very low moisture and ERH hence they have the tendency to absorb moisture from the surroundings and turn soggy thereby losing their crisp brittle nature and taste.

The most important factor to be considered is moisture vapor transmission rate of the packaging materials used. The MVTR values of less than 1 gram per meter square per 24 hours are required. The medium moisture food moisture up to 6 to 20 percent weight basis with ERH up to 65 percent. The typical examples are Indian savory snacks, sweet meats. The barrier properties that is moisture vapor transmission rate requirement for these food is less stringent.

However, for longer shelf life microbiological spoilage has to be given due importance. Use of preservatives is often used in these things. Now high moisture food are categorized by moisture content up to 20 to 60 percent weight basis and ERH up to 85 percent. The typical example are freshly baked products for example, bread, cake, chapati, pickles, chutneys, sausage etc. Medium and high moisture food are very susceptible to microbial spoilage and need adequate processing and preservation methods prior to their packaging.

Based on their major ingredients the ready to cook mixes can be divided into 4 groups that is cereal based, legume based, fat rich and spice enriched mixes. The first category consisting of mixes for idli, dosa, chakli are mainly sensitive to the moisture pick up only and require protection against this. These generally have moisture content in the range of 8 to 10 percent and become soft and unacceptable at about 12 to 13 percent moisture content. The polyolefin plastic pouches of 37 to 75 micron thickness are generally used for packaging which provides 3 to 4 months shelf life. Legume or pulse based mixes comprise of vada, thara sev, bonda, urad bhat etc have packaging requirements similar to those of cereal based mixes, but have lower permissible moisture pick up.

Hence this requires packaging materials having a good water vapor impermeability, LDPE and PP pouches have been found to offer 1 and half to 3 months storage life under high temperature and relative humidity conditions which would correspond to 5 to 6 months under normal conditions. A ready mixes of gulab jamun, cake, donuts etc which have high fat content and milk solids are susceptible to density and interactions with oxygen and water vapor. The cast polypropylene pouches of 200 grams capacity have been found to give short shelf life of 2 to 3 months which is adequate for local marketing. However, for longer shelf life and exports purposes plain printed polyester LDPE and HD-LDPE co excluded films would be better suited from the point of protection and attractive appearance.

A spice ednrich mixes such as those of rasam, sambhar, soup, bisi bele bhat are highly susceptible to aroma loss, oxidative deterioration changes and seepage of oil. Unsupported PE or PP pouches are inadequate to pack these items. More functional ones based on laminate of cellophane and PE, plain or metallized PET and PE and co extruded films with polyamide core layer provide longer shelf life. Food mixes such as orange peel gravy, tamarind sauce etc have very low moisture peel pickup tolerance and necessitates the use of highly fat resistant and flavor resistant packages. The innermost layer of HDPE and LDPE co extruded film, ethylene acrylic acid copolymer provide the required properties and good heat sealability. Thank you very much.