

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

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**Week – 10**

**Lecture – 47**

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 packaging of fruits and vegetables and now we shall see the packaging of cereals and floors. In this lecture we will be covering the packaging of cereals which will include the whole and split grain packaging and packaging of floors which will include the regions for flour infestation, precautions to be taken and the materials to be used on the packaging of cereals. India produces a variety of food grains like paddy, wheat, maize, barley, millets and millets like jwar, bhajra, ragi etcetera. The country is self sufficient in grain production and is the second largest rice producer in the world with a 20 percent share.

Grain processing is the biggest component of the food sector sharing over 40 percent of the total value. Primary processing sector shares 96 percent of the total value while the secondary and tertiary sector shares only 4 percent of the total value addition. The grains and pulses are low moisture commodities due to which they are less susceptible to spoilage and have greater shelf life. The spoilage mainly occurs due to moisture absorption during storage leading to fungal growth at high temperature and humidity.

Before bulk packaging and storage the whole grains are fumigated to reduce microbial load and increase storage period. The following factors are to be taken into consideration while developing packaging materials for cereal and cereal products. The protection against environmental condition like humidity, temperature etc. Packaging material should be able to withstand mechanical hazards during transportation and facilitate stacking. Several tires high so as to optimize the use of available space.

To protect from external odor, easy to handle and at the economical and easily available. Now, the whole and split grain packaging. The packaging materials used for bulk packaging of cereals and pulses are as follows. The first of its kind is jute bags. The woven sacks made up of high density polyethylene or polypropylene or multi wallpaper sacks.

The multi wallpaper sacks are not commonly used in India owing to its high cost and lack of proper availability. Now, the jute bags. Traditionally jute has been packaging

material used for bulk packaging of food grains and pulses. With the increasing growth of these commodities there has been a quest to look at alternate packaging materials due to the stagnant jute production. The jute bags of the basic woven sacks have the potential to fulfill this need in a cost effective manner.

These are made either from HDPE or PP. The disadvantages associated with jute bags are availability. The food grade jute bags are not easily available. Mineral oil contamination. Mineral oil is used as a lubricant in the processing of jute fibers.

Insect breeding. The structure of jute fabric being porous the insects like stored grains and pests find it easier to lay their eggs on these fibers. The cost jute sacks are 5 to 6 times heavier than the sack made out of plastic material like HDPE or PP for a similar weight pack. The nature of jute packaging is such that lot of food packages there in gets exposed to deteriorating factors and jumps. Airborne jumps and the once present in the storage go downs may seek way to the pores of the fabric and may contaminate the food.

Such food when consumed may cause illness like food poisoning. Now, the high density polyethylene polypropylene woven sacks. HDPE and PP woven sacks have replaced jute bags in number of applications. Several plants manufacturing these sacks have come up in different parts of the country making the availability of these products possible at low price. Advantages of HDPE and PP woven sacks include elongation at break of HDPE types is about 15 to 20 percent in comparison to jute bags which is about 30 percent.

Owing to this property HDPE woven sacks have better resistance to dropping. Plants of HDPE PP woven sacks do not impart any odour to the food product packed in them and are not attacked by insects. HDPE and PP woven sacks of strength equivalent to that of jute bags can be made using almost 70 times lower weight of the resin and hence are almost 60 to 65 percent cheaper than the jute bags. HDPE and PP woven sacks are the most hygienic material for packaging of cereals, pulses and one need not reuse the same owing to their low cost. Fabric allows diffusion of air and gases easily through the gaps between the filament thus facilitates ventilation of grains during earlier stages of harvest and penetration of fumigants.

Although, HDPE PP undergo degradation under UV light it is possible to arrest the same by using appropriate UV stabilizers. It is possible to laminate HDPE woven sacks with LDPE. The laminated bag protects the product packed in the bag from moisture and also prevent the loss of products like floors due to spillage which usually occur through plain jute bags which are commonly used for packaging floor. Consumer packs for whole food grains although cereals and pulses are primarily packed in bulk packed

owing to development of supermarkets and due to increase in consumer awareness on the quality of food products branded commodities are now being sold in the market on a large scale. The packaging material used for consumer packs of whole cereals and pulses are as follows packs made up of printed LDPE and LLDPE film laminate.

Packs made up polypropylene or biaxially oriented polypropylene films. High molecular high density polypropylene film packs. Laminates made from BOPP and LDPE are cast propylene and LDPE are polyester and LDPE are used in few branded commodities. Although laminates are essential for expensive products like basmati rice where the flavor retention of the product is very important it may prove to be very expensive for low value products. The three types of films mentioned above in A B C offer adequate protection to the consumer packs and they are most cost effective packaging materials for consumer packs of cereals and pulses.

Laminate mentioned in D helps in protecting the product from insect attacks as polyester is tough material due to which insects find it difficult to puncture the laminate or the packaging of flours. The flour is the ground or milled form of wheat grain in which the bran and jam are partly removed and the remainder is comminuted to a suitable degree of fineness. It has been suggested that for long periods of conservation flour should be stored in a closed atmosphere. Under these conditions flour acidity increases due to the accumulation of linoleic and linolenic acids. Flour is stored commercially in bags or bulk bins.

The threats to flour in storage are similar to those of wheat in storage. For example, mold and bacterial attack, insect infestation, oxidative rancidity and eventual deterioration of baking quality. The rate of increase in acidity increases with the storage temperature and decreasing flour grain by increasing ash residue in the flour. Thus, the shelf life of brown and whole meal flour is shorter than that of white flour. Freedom from insect infestation during storage can be guaranteed only if the flour is free from insects at the time of packaging and even the storage area is free from insect infestation.

Now, the reasons for flour infestation, the moisture content of the wheat flour that will affect the storage conditions, storage temperature and humidity, cross contamination, unhygienic conditions, cracks on floors and walls, standing water near stores, spillage and bird feces in the stores or stairs and floors, presence of grain jumps in the floor. Now, the precautions to be taken before milling use scorers to remove dirt in tempered grains, regularly clean the milling equipment and machinery, fumigate packaging material before every use, frequently fumigate bins and conveyors, always keep the parking area and the floor storage area clean and type of packaging materials used. Now, the packaging materials, the hanging bags, hanging bags in grocery stores and other

shopping outlets are commonly used. They are a type of plastic bag that is also sealed with a bagged middle seam on both ends as well. Hanging bags have a pre cut hole that makes it easier for them to hang from hooks, so that they can be seen in an attractive way.

Pillow bags, a pillow bag is another typical type of package. The bags are named for their shape which is like a cushion. They are found lying flat on grocery store shelves in the grocery store and we are known to carry the items. Now, the gusseted poly bags, gusseted poly bags are often called flat bottom bags because the feature tucked in pleat that has been pressed flat. It allows the bag to expand for greater carrying capacity and to keep the shape of a box if necessary.

These types of poly bags can be heat sealed, tied, stapled or taped shut. They are perfect poly bag for anyone looking to get more floor in a single bag. Now, the flexible bags, flexible pouches are a perfect way to carry most packaged items. They can be made with zipper seal closures which tend to keep the inside contents fresh for use. Flexible pouches offer amazing printing capabilities, so one can add attractive product branding to the pouch itself.

Many pouches stand up on their own which helps to improve self appearance. Now the polyethylene films. Low density polyethylene is the most commonly used packaging material for milk products owing to its low cost and easy availability. LDPE films has good balance property such as tensile strength, bursting strength, impact resistance and tear strength. It has good barrier properties to water and water vapour. It can be heat sealed very easily and gives good tough welds.

The film can also be printed very easily, however it has poor barrier to gases. Now, the linear low density polyethylene, LLDPE is a superior material than LDPE. Comparative properties of LLDPE and LDPE are given below to highlight the advantages of LLDPE. Improved tensile properties for products with similar melt flow index, the tensile strength of LLDPE is 50 to 60 percent higher. Improved stiffness strength of LLDPE is 50 percent higher than that of LDPE.

Now, the puncture resistance, puncture resistance of LLDPE film is twice as much as that of LDPE having similar thickness. Owing to better physical characteristics of LLDPE films, LDPE has now been replaced by LLDPE in number of cereal products applications. Thickness of LLDPE film used for different consumer packs is as follows. One kg pack 250 gauge, two kg pack 300 gauge, five kg pack 400 gauge, white opaque film give better aesthetics. Now, high molecular high density polyethylene, this material is characterized by its toughness and high mechanical strength.

The film prepared out of this material is translucent and it can be modified by addition of pigments. The films having very good strength and are thus used in very low thickness for packing of cereal products. The film being tougher in set penetration is difficult. Now, the co-extruded films, milled products like wheat flour containing a small amount of fat which tend to ooze out through the LDPE or LLDPE film giving a sticky fat to the surface of the pack and also affecting the print of the film. It is therefore, advantageous to use co-extruded film whereby a thin layer of HDPE and HM HDPE can be incorporated to prevent fat seepage.

Three layer co-extruded film having a structure of LDPE, HDPE and L LDPE is found useful in overcoming this difficulty. Use of metallocene resins in the above structure was found to produce a film of having good weldability and high hot type. As atta which is wheat flour is a powdery product fly off of the product is absorbed during filling the packs. The powder which flies off gets deposited in the seal area thereby affecting the strength of the seal. The metallocene resins helps in producing good seal along contaminated area.

The above structure of co-extruded film using metallocene resin is therefore, a very effective packaging material for milled products like atta or wheat flour. Now, the polypropylene, polypropylene finds wide application in packaging of food products like atta, suji owing to its following properties. Density polypropylene has very low density among the commonly used plastics due to which it gives higher yield that is the meters of film per kg of material as compared to LDPE or LLDPE. High stiffness and high tensile strength, high transparency, propylene, polypropylene has very high transparency as compared to LDPE and LLDPE. It is the most suitable material for products which require visibility.

Lower moisture vapour transmission rate, the cost one of the advantages of PP is its low cost as it can be used at lower thicknesses owing to its high tensile strength. This is a big advantage for low cost bulky products like atta. Biaxially oriented polypropylene films that is BOPP. Biaxially oriented polypropylene film has higher strength than polypropylene film and it is available in a heat syllable grade also. It has excellent barrier to moisture, high transparency and glass.

It can be reverse printed and can be laminated as a two layer film. Heat syllable BOPP film with thickness ranging from 2 micron to 40 micron is widely used for packaging of cereals. The laminates made of BOPP and LDPE or polyester and LDPE are used for packaging of milled cereal products. The advantages of laminates are as follows. Polyester and BOPP based laminates can be reverse printed thus giving good appearance

to

the

pack.

As the printed side of the film is sandwiched between two film layers, the odour due to ink solvent appearing into the pouch is prevented thereby protecting the product from tenting. Polyester being a tough material insects cannot puncture the pouch easily and hence the entry of insects can be controlled. The cereal products are mostly sold through grocery outlets. The grocer sells many other items like soaps and detergents, incense sticks, strong smelling deodorants, vegetable oils. It has been observed that the grocer displays the consumer packs by placing them next to the strong smelling items like soaps, incense sticks etc.

As a result the product packed inside the LDPE pack pick up the odour of the material stored in its vicinity. This problem can be overcome by using laminates with polyester and polystructures. As the laminates are expensive they are mostly used for packaging of high value products. Thank you very much.