Food Packaging Technology

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Rigid, semi-rigid, flexible packaging forms P2

Welcome back to another session. In today's session we will be discussing about Rigid, Semi-rigid and Flexible packaging system and also, we will discuss about different packaging systems for different food products. In the previous classes, we had discussed about packaging systems. We had also discussed about product characteristics and how to choose a packaging material based on the product characteristics and the requirements of the product. So, till it reaches to the consumer from the place of production what all requirements are there everything need to be taken care of. Accordingly, only the packaging material need to be selected. Now rigid, semi-rigid and flexible packaging system. Flexible packaging system it consists of foils, cellophanes and papers and these are mainly used for packing chips, candies and this is because they are easy to mold.

Whereas rigid packaging materials, they are rigid in their structure and these include glass metal plastics. Also, they give protection to the content, inside from temperatures and packs during transportation. Therefore, they have very good mechanical resistance to scratches in low temperature storages also. Semi-rigid packaging material; these are hybrids. Their properties lie in between flexible and rigid packaging material. These mainly include foams and cardboards which we use for giving protection to products like eggs and wine bottles. Now, rigid packaging system was defined as being unable to bend or being forced out of shape or simply not flexible. So, this was the definition which was put forth by EPAC in 2020 and this is a structural component. It contributes to structure and it is highly stable and supports the product and the main property of the rigid packaging system it comes from its strength.

So, the global rigid packaging market it was projected that by 2026, there will be a 5.6% growth from 2019. So, there is a very great demand for rigid packaging material and it is also involving utilization of plastic materials for packaging purposes. This is not only for the food and beverages. This also finds application in personal care, household items and health care items. So, this can be a part of primary packaging, secondary packaging or tertiary packaging. We had already, discussed the different types of materials that are used as rigid packaging material or flexible packaging material in the earlier classes. This slides it shows the comparison between different materials.

So, here also you can see that plastic materials as a packaging they are very much in demand and only after plastic the paper and paper board items come. Their applications are in food and beverage industries, chemical industries, consumer goods, health care, pharmaceuticals and they usually go as a rigid packaging material. It goes as boxes, trays, containers, bottles. When we go to the segments in the world market this is North America which is utilizing these packaging materials in large amount compared to the other parts of the world. Now, this is a comparison table which shows the difference between flexible packaging and rigid packaging. So, in flexible packaging, we have polyethylene, polypropylene. They are basically called plastics, also include flexible forms, papers, aluminium foils whereas in rigid packaging, we have papers, glass and metals and this will be hard in shape and rupture than flexible packaging materials. Since, they are flexible in nature, they take only less space. So, they occupy much lesser space than rigid packaging whereas rigid packaging it is bulky in shape and it occupies larger space. Flexible packages are easier and cost effective to transport and we can customize the shape of the packaging material. Rigid packaging, the cost is very high because of its bulky size. Weight is lesser for flexible packaging materials whereas it is heavier for rigid packaging materials.

The rigid packaging materials, they are prone to deformation though they are rigid. They are durable. The flexible packaging material can be punctured or crushed, if it is not handled properly. Now, coming to the next topic, we have different packaging systems for dehydrated foods, frozen foods, dairy foods, fresh fruits and vegetables, meat and that is animal-based products, beverages. So, one thing we have to understand is we cannot have single type of packaging material for all kinds of food. It differs from product to product and when we choose a packaging material, it depends upon many criteria. First, main criteria will be the content what is going inside the packaging system. What we are going to pack and what is expected like? What is a shelf life? What we are expecting from the product? In what form, it should reach a consumer and what is the cost of the product? What will be the environmental condition? How it will be transported. So, likewise we have to consider everything from the beginning till it reaches to the consumer and also even after reaching to the consumer it should be able to build up their confidence. Every food product, they need their own packaging material and it should be unique and also the producer and consumer their viewpoints need to be taken into considerations. So, now this is a table it shows the control atmospheric conditions for certain commodities when they are transported or storage. For example, asparagus if it is stored at 1 to 5 degrees centigrade and with an optimum oxygen content of 21% and carbon dioxide content of 5 to 10%, we can get an approximate storage life of 21 days.

To get this optimum condition of 21 days, the packaging material for the asparagus it should meet the requirements. That is, it should be able to withstand lower temperatures

and also it should have good barrier properties for the gases. So that the conditions inside the package can remain as such. The oxygen level has to be 21 and the carbon dioxide it should not go above 10%. In case of wheat, we don't require the oxygen and carbon dioxide is not controlled and it's only the temperature that is very important. So, the packaging material should be able to withstand lower temperatures and this will help in attaining the storage life of 8 months. Likewise for different products this is just one example. So, what we are expecting? How long you are going to keep the product that is also very important. Accordingly, when we make changes inside the package, the package should be able to withstand all the conditions. These are different criteria's that need to be taken into consideration, when we choose a material for packaging. Now these are the beneficial aspects of controlled atmosphere.

Asparagus storage life is extended and also, these will help in retaining the sugars, organic acids and proteins. It will retard the toughening of the asparagus and discasing. Similarly, we have the pigments that can be retained in green beans. In broccoli, we can retard yellowing and in Brussels, the storage life can be extended. Cabbage, it will be retaining its green color and fresh flavor. All these things will happen or we'll get the benefits only when we are maintaining the conditions which has been discussed in the previous slide.

So, for that, when we maintaining the controlled atmosphere, but same time the packaging also plays an important role there. Now, these are different types of food products. On the right column, you can see the normal packaging materials that are used to pack the products. For example, in case of milk we can go for LDPE and LLDPE, linear low-density polyethylene. Then we have milk powder. They can be packed in tin cans with aluminum foil or aluminum foil and polythene laminates. So, we can have laminates. Ghee can be packed in LDPE HDPE laminate or nylon. Chocolate bars, we commonly see, it is packed in aluminum foil and polyethylene laminate. We can also pack it in PET and polyethylene laminate. Then confectioneries like candies, they can be packed in paper wax, PET, polyethylene. Then ready to eat products like a lays and other things, it can be packed in PET or BOPP that is biaxially oriented polypropylene and can be co-extruded with polyethylene. Edible oils they are packed in three to five layers of nylon films. Products like gems, they are packed in BOPP or polyethylene then one is pithy packed in LDPE, HDPE and nylon-based films and biscuits they can be packed either in wax coated papers. They can also be packed in glassine or polyethylene then aluminum foil paper. So, the choice of the packaging material, it depends upon the commodity that is going to be packed inside. For bread we are going to use wax paper, biscuits also we can use wax paper. But tea cannot be packed in wax paper. So, depending upon the requirement and necessity, we have to choose the packaging material. This again it shows compiled table apart from the previous materials. We can

also go for different types of packaging materials. For example, in dry fruits, we have to give emphasis to seal strength and moisture barrier. So, for these reasons, we can select OPA/PE and OPA/OPA/PE. So, this can be three layered and biscuits we can have BOPP and BOPP/CPP then PET polythene. Here, we give an emphasis to seal strength and moisture barrier, in case of candies, it is seal strength how quickly it can be packed and then moisture barrier. So, considering this, we are taking PET and BOPP. Tea is packed in metalized PET metal layer. It gives an odour barrier. So, whatever contents are inside, the order of the contents, it will not go out and at the same time will get a good seal strength. Then coffee, instant coffee, again, it should have good barrier properties if moisture enters into the pack. Then, coffee will form lumps. So, that should not happen so considering that we select the packaging materials which are lined with aluminium foils. Then, we have potato chips. Again, we can go for metalized PET and the tension is given to high seal strength, integrity, gas retention and moisture barrier. Again, for rice and pasta, seal strength and integrity are more important for frozen foods. Seal strength is important. Integrity is there and again it should be able to retain the gas. That is, it should have good barrier properties for moisture as well as gas. Ice creams, they should again, have good barrier to moisture properties and water vapour transmission and gas transmission. It should be able to seal it and it should have high seal strength and integrity. Desserts, similarly, good seal, strength and integrity. This is again, what is the application; accordingly, we chose the material. This slide, it shows the use of laminated films in food packaging. Generally, the foods which have low moisture content, that is water activity is very low, such kind of foods, they are packed in laminated films. So, we have snack foods, dry fruits, confectionaries, biscuits even ice creams and frozen vegetables, they can be packed in laminated films. The laminated film, it not only gives a good barrier property but also it helps in preventing the loss of odour. It reduces the transmission of movement of odour from inside or do not let the odour to come inside into the product. Because these are very sensitive products and it may take order from outside. So, these need to be well protected and in this case, we use polyvinyl chloride coated with polypropylene. These are two layers actually and these are used for snack foods, confectionaries, biscuits crisps and chocolates. Even PVDC, it can be coated with polypropylene and polyethylene. It's a combined film, this laminate can be used for bakery goods, cheeses and dried fruits, confectionaries. Cellulose is a plant-based material, it's a natural material, so we can have combination with polyethylene and cellulose. So, the laminated film, it can be used for crusty bread, bacon, coffee, cooked meats, cheeses and cellulose acetate, paper foil and polyethylene. This is again four layers. So, these are used for dried soups, metallized polyester, polyethylene it is used for coffee. Again, it prevents escape of odour. So, polyethylene aluminium paper, it is used for dried soup, dried vegetables and chocolates and then we can also use co-extruded films. Co-extruded films are generally of high impact using polystyrene and PET. The polystyrene is again used for making foams or thermos foamed containers. So, this is co-

extruded with PET and it is used as a packaging material for butter and margarine. It is used as a tub in these cases and polystyrene it can also be conjugated with PVDC to pack juices and milk bottles. Polystyrene it can be extruded with PVDC and polyethylene to be used as tubs for other dairy products, coffee and mayonnaise. Polystyrene has a basic property of strength and we are using this property to develop tubs and other things because it helps in that particular application where we need to give bulky storage or bulky transportation. It is it may be a retail pack but will be a slightly higher site so such kind of packs can be developed using silane based extruded films.

Now improved packaging. When we improve the packaging materials or when we use good packaging materials, it is not only helping in marketing but it is also help enhancing the international trade. So, improving packaging materials is also important for a country every country. They are also giving equal importance to packaging materials also packaging need to be standardized based on the size and grading. This will help not only help in reducing the labor but will also protect the quality of the food product and it will be helping good relationship between the sellers and buyers. Also, packaging material it should be able to reduce the waste consumers nowadays. They don't want to have bulky packaging and waste. Most of them they go for environment friendly packaging system even if they have to rely on the other kinds of packaging materials. They always see that if it can reduce the waste so that is again important criteria. Also packaging, when you select the packaging material it should address all these aspects which we had discussed from the beginning. The material characteristics, the product characteristics from the logistics aspect, from the marketing aspect, sales aspect, from the consumer point of view, from all these aspects, need to be addressed. The most important one is the content because food is very perishable and that is a very important thing and each component we have to know. We are not just attracting the consumer. We are also intending to keep the food safe and extended shelf life and also keep its nutritional quality safe without any losses. So, we need to know everything and packaging, we cannot say that, it is an independent area. It is a combination of all the sciences. So, everything has to be studied in detail before we go for a packaging material. Now let's wind up for today and in this class, we had discussed about different types of foods and respective packaging materials. It is not necessary that we have to select whatever packaging material has been mentioned here. We have to go for that only it is not necessary like that but if you can come up with new ideas that is also good. Again, researches are being done to develop biodegradable and edible packaging systems so that is again encouraged. We can assign new packaging systems also. It depends upon the requirement of the consumer and the producer. So, let’s wind up and thank you!