Food Packaging Technology

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Week – 05
Lecture – 25
Safety aspects of food packaging

Hello everyone. Welcome to another session of the food packaging technology course. We are now moving on to week 5 of module 3. We have completed looking at the different principles in developing a safe and protective packaging. We also went through all the transport worthiness tests which test the different hazards that the package goes through and if it withstands these. Today we will look at the safety aspects and assessment of food packaging materials.

Health-conscious consumers all over they do check all kinds of things on the labels. They look in for organic certification of milk products. They might even look for nutritional labels and see if there are artificial colours or flavours or even acceptable levels of salts. Some even take the pain to looking for eggs regot from a pasture raised hen.

But actually do they even check that these eggs that come in cardboard boxes or do they come in moulded plastic containers? What about the milk cartons or the plastic milk pouches? Ironically though people spend their time and the money to eat healthiest and most sustainably produced foods they can find and afford. The package in which the food is actually packed that is usually overlooked. Shouldn't the package be as healthy, good for health and for the planet as the food? That is the aspect that we are going to look into in this session. It is very important thing that we look at how does the package contribute to the health of people around the world. Now what are the problems of food packaging? Now the food package actually is the one that comes in direct contact with the food, the primary package actually.

And they are usually underestimated as a source of contamination. They can actually release and transfer harmful components to the food to the extent that there is a migration depends on the physicochemical properties of the migrants of the packaging material and the food composition. That is if there is a fat content is high you get more migration of components from the package to the food. Moreover, you know there are additives like phthalates which are added to these plastics to give them their pliability or their flexibility. You have components like perfluorinated chemicals added to cardboard.

Why? To allow them to hold the liquids. Usually, cardboard boxes cannot hold your liquids. It will easily seep through you know it will soak up the package. So, in order to make it more water resistant they have this layer of perfluorinated compounds that are added. We even have bisphenol linings that coat the aluminium cans that you can see and these are all dangerous to our health.

Now single-use packaging is taking a huge toll on our environment. Plastic bags, styrofoam food containers, disposable coffee mugs, everything that we use for convenience of packing food that is filling our landfills and our oceans. So, the convenience of the food packaging is actually outweighed by the waste and the pollution that it is actually causing and leaving behind. It is not a mistake to say that the industry has evolved with little concern for the environment and for human health. And there is a need to make human health and the environment a priority over convenience.

Every single-use fork or plastic spoon that you have it's thrown again into the waste. So, these have to be carefully thought over and see what are the alternatives that you have. Are they causing any problems to the environment? Are they causing a problem to our health? Very serious and great questions that we need to ask. So, most food packaging they can be broadly broken down into four categories. You have packaging made of plastics.

This is the plastic packaging. They include all types of plastics from styrofoam to clear plastic packages, even the lids of your take away coffee cups. The raw material that you use to make these plastic materials are usually harmful to health. Or harmful chemicals may be added to them to make them more functional, make it more flexible or make it more-firm. All these kind of things chemicals added these are harmful to our health.

A second category is your metal packaging. So, this includes your aluminium and other metal cans that both food and beverages can be packaged in. Now these metal cans are usually lined with anti-corrosive substances and these may leach into our food and affect our health. A third category is your paper and fiberboard packaging. This includes the tetra packs that is commonly used and other types of cartons like take away food containers.

Other type of packaging paper or fiber packaging often lined with coatings that make it more function. So, in all these cases there are chances that these finally end up in the human system and can be harmful to us too. Glass package this includes all the glass bottles and containers. Glass is usually one of the most inert packages that is available but it has its own disadvantage and is so is less consumed or utilized in the industry nowadays. Now how is the food packaging affecting food safety? Very important

question.

One most important is there's a migration of residual chemicals from the package to the food. There might be insufficient barrier properties that will affect the quality of the food. Packaging failure is another problem that can happen. Unknowingly it might affect the product and the consumer health. Last loss of seal integrity.

Seal integrity or the seal might be broken and this might also cause problems or decrease the quality of the food. So, what is the issues and the usage of plastics in beverages? Now you know all the beverages that you have soft drinks, water bottles that you have it's made of plastics. Leaching of unreacted monomers and monomers that are produced when the polymers break down. There are two ways either the polymers can break down or unreacted monomers might be there in the polymers itself. Now under adverse conditions these might migrate into the food and these monomers have been proven to be carcinogenic and toxic to humans.

This is very important to remember. What is migration? The mass transfer from an external source into the food and that impacts both the food safety and the quality. Now stages of migration of the monomers are of three. Number one is the diffusion. Diffusion of monomers within the polymer because of the brownie movement.

These are the unreacted monomers or the monomers that are broken from the polymers. Next, solvation. These monomers might get dissolved at the polymer food interface. The first is the diffusion. They start moving around by the brownie movement then they move into solvation and at last they disperse or they disperse into the food matrix itself.

Now one of the main factors that affect this chemical leaching is called ore migration. Temperature very important. Higher the temperatures leaching is more. Prolonged storage. If you keep it for a longer time in a particular package more chances for it to migrate or leach out.

Frequency of reuse. You know do not use it just like your oils you know supposed to reuse it many times. Though reuse recycle is the buzzword. Reusing it, reusing it indiscriminately is also another way in which your monomers can enter into your food system. Polymer age is important. UV exposure again increases your leaching.

Bottle volume. The higher the volume, greater the leaching bottle material. So, depending on the material, certain materials they will migrate, have more monomers that will migrate into the food. You should be careful. We'll now look into an interesting picture on the potential migrants. And this is from this particular source.

The base of it is shows the major portion of the components which actually cause the migration. These are added to retain the properties of the polymer. For example, your plasticizers, phenolic antioxidants and organophosphites. These are added to retain the properties and these are the major components that might eventually end up in the food. The second portion is components that are added to improve or extend the properties of the polymers.

For example, these might be UV absorbers, anti-fogging additives, those that are added for optical brightness or the gloss, for light stabilizer or a slippage. These are all added to polymers to improve their properties. These again can finally end up in the food matrix. The minor components are those which improve the product properties like your anti-microbial agents, antioxidant agents, your colorants. These again can help be leached into the product.

This is again another beautiful illustration from the report on by Footprint. I have divided this in the next few slides so that it is more visible. You have these chemicals in both in metals, plastics and in paper. If you look at metals, look at the list of components that can leach out from metals. Aluminium, manganese, sodium chromate, your bisphenol B, A, S, innumerable.

If you look at the list from your paper itself, you will have all these components again that can be leached into your food matrix. Coming to plastic, the list is even more. Your vinyl chloride, sodium perchlorate, tributyltin oxide. These lists are innumerable but these might enter into the food and cause many problems, especially cancer. This is a gist of some of the components that have monomers and the sources.

Some of them are added intentionally and some may be non-intentional. In the classes that is intentional, you can divide them as plastic monomers, metals, dyes, antioxidants, plasticizers, photo initiators and water or fat repellents. These are actually added to the packaging material to improve their properties. Now in your plastic monomers like we saw, you have all these monomers including vinyl chloride and they may come from your PVCs, your polyacrylamides, polyamides and from metals you have aluminium, especially from the source aluminium foil. Aluminium foil that is used to cover food, this aluminium can leach into the food.

Another component is in paper, you might dye it, let us use colors like azamines, these might again migrate into the food. Antioxidants are added like your synthetic ones, natural ones like your vitamin C and E are natural but your synthetic ones, BHA and BHT, they all have their own limits but this might go beyond the limits and they might

come from the plastics. Similarly, plasticizers can be added, Bisphenol A, again coming from the plastics, photo initiators and water repellents again can come from your paper and cardboard. Because to make your paper and cardboard more able to contain the liquids, you need to add these repellents but these repellents might finally be a migrant. At the same time, there are components or substances that are added unintentionally.

For example, mineral oils, in recycled paper and cardboards, these might be up there and this might again leach out into the food. These are some of the international migration alerts that have been got from the source. In 2005, there was an incurring agent, ITX was detected in cardboard packaged milk. Again in 2005, Swiss, they surveyed the jarred foods and identified concentrations exceeding allowed level of epoxidized soy or bean oil. In 2011, the clouding agent's diethyl hexyl thalate that was found in probiotics substituted by probable carcinogenic compounds that was done to add cause, which is a pathetic reason to be done.

Just to add or reduce the cause, they have added these kinds of compounds which are actually carcinogenic. In 2007, they found poorly manufactured polyamide utensils that leach these carcinogenic amines. Bisphenol A is recently a concern in all the infant feeding bottles. There have been many reports in the past on such dangerous migration alerts. Now these are the additives that you have in plastic bottles, plasticizers, coloring agents and heat stabilizers.

All of these are added to make your bottles. Why? They offer a broad functionality to the polymers. They are not chemically bound to the polymer change and they can migrate within the material and leach into the water which makes it very dangerous and they are prone to dissolve in aqueous environment that finally ends up in the oceans also. Let's look at some of these additives that are added. One is Bisphenol A. These are found from plastic bottles and some cans that are lined with polycarbonates in tiny amounts of course.

They are also formed when polycarbonate bottles are washed with harsh detergents and bleaches like sodium hypochlorite. So, these are formed also, they might be present naturally also. And at high levels of exposure, Bisphenol A is potentially a hazardous because it mimics the female hormone estrogen. So finally, it will have effect on the reproductive function.

Diethyl hexyl adipate is another compound. They are found in commercially clean films and in PVC pipes and bottles. These food compatible phthalate plasticizers and tiny amounts, in tiny amounts they may migrate into the fatty foods like cheese and meat especially when they are heated. These are also very dangerous compounds. Then there

are certain other chemicals that are endocrine disrupting. So, these substances they interfere with the synthesis, secretion, transport, binding and elimination of natural hormones in the body.

So, they can actually deter or affect the development, behavior and fertility and hemostasis. So, among them comes your BPA, phthalates and the alkali filons. So now you get a picture of how dangerous some of these monomers, some of these additives in the packaging can be on human health. Now there are international regulations for these. In European Union you've got the framework, 1935-2004 EC.

United States also they have their own framework. So, the same in Japan, China, South America and Australia. So, each of these countries they have their regulations regarding this migration limit. Now there are regulations to limit the contamination of food by monomers. A commission of European communities, they have laid a limit of overall migration limit to 60 mg per kg and some pre-monomers have specific limits. Not all, overall monomer limit is 60 mg per kg but for specific ones they have their own limits.

Now in the United States, the Food and Drug Administration, they have included both basic resins that are used in packaging as well as the adjuants used in the final food packaging. In India, the Food Safety and Standards Authority of India, they have defined that the overall migration limit will be 60 mg per kg or 60 mg per decimeter square. And the specific migration limit for certain contaminants in the plastic containers have also been defined. Now let's look at the basic guidelines for minimizing chemical leaching. Like we all realize, we cannot completely eliminate the plastics as of now.

The research is going in a big way to replace them with biodegradable and non-harmful components. But as long as we're dealing with them now, what are the ways in which you can minimize this leaching? Number one, source is your bottled water. So, it's very important to take care of how you store and transport the bottles. See that you keep them at room temperature of 20 to 22 degrees centigrade without sunlight exposures. You keep your bottled water in the car in the sun, there’s a high chance that many of the monomers will migrate easily into the water.

Another very important thing to remember, we have to minimize prolonged storage of bottle water from reusing the plastic bottles and filling hot or tap water into the plastic bottle. All these simple techniques can actually help to reduce the chemical leaching into your food or water. Now what are the steps in this risk assessment? First question you have to ask is what? What is the polymer analysis that you can do and the characterization things that you can do? Number two, you have to identify the additives used, identify any unknown substances or chemicals. So, these are the what question,

what are the additives, what are the unknown substances and what are the analysis to be done? Another question that we need to ask is how much? How much of these trace impurities are there? What is the level? Is it a ppb level or ppm level? In fact, such components, even at ppb level, they can be carcinogenic. That is the difference between other toxic and these kind of monomers or plasticizers that can leach into the food.

Then how much of the additives are there in the plastic? How much of residual solvents or odor components are present? And how much of the leachable components are present in that? So, these are the how much questions that you need to ask. Another question we need to is why? You have to analyze why did the package fail? What is the reason why the package actually failed? Complaint investigation, why did the complaint come in the first place? Determine the role of each additive in the polymer formulation. So, each of these additives have got a function, see if it is really required and try to minimize that as far as possible. And most important, we have to make recommendation for alternative stabilizers for greater compatibility with the package. See these stabilizers and comb additives are added to improve the packaging.

But if in case it is carcinogenic and it poses any problems, there should be alternatives to these. Recycling plastic is another way in which you can minimize or reduce the problems, especially pollution problems. Though they do highlight recycling as one of the solutions, the problem is it is estimated that 91% of the plastics are not recycled. But still, let's look at the recycling symbols that you can see in most of your bottles and containers and see what they mean. You have noticed this code here, the triangular shape with the arrows, that is a symbol for recycling.

And number one means it is a PET, the plastic is a PET. You need to reduce your use of number one by drinking from reusable bottles. It is much better to minimize the use of PET bottles, number one. Number two is your HDP, High Density Polyethylene. This is what you see in your milk jugs, juice bottles, yogurt tubs, bleach detergents, shampoo bottles. These are safer and you need to reduce the number two plastics by using your cloth shopping bag.

Okay, number three that you see is your PVC, Polyvinyl chloride, which are used in some shampoo bottles, cooking oil bottle, blister packaging, sliding and PVC piping. These are rarely recycled, so best is to avoid number three. Number four is your LDP, most commonly used, relatively safe. It includes your squeezable bottles, plastic bags, dry cleaning bags, compost bins. You can use your glossary bags instead of that, but generally these are safer than the rest of your plastics.

Number five, PP, Polypropylene. Again, safer. Remember your polyolefins, that is your

HTP, LDP and your PP are relatively safe, but where possible try to use alternatives for these, which are more sustainable. This PP is found in yogurt containers, medicine bottles and caps and straws. Now it's better to skip plastic straws and choose reusable bottles. We do have a number of companies or researchers taking place where they have biodegradable straws and they're used. Now world over and in India too, we've got many startups that have come up with reusable or edible cutlery, plates and even straws.

So consumers should actually may take advantage of these and utilize them. Number six here is polystyrene. This includes including disposable plates and cups and coffee lids. Egg cartons may be made of this and even some takeout containers. Did you remember that PS or number six is the most dangerous of all the plastics? They have the most damaging effect to the environment and to human health.

Okay, so you need to try to use a reusable coffee cup instead of having the take away containers and cups. Number seven are all the other miscellaneous plastics and the polycarbonates. Okay, and avoid them as much as possible since it's not always clear what these plastics include and what the dangers might be. So, let's just sum that up. It's best to avoid all the plastics if you're able to, but at the very best, see that you avoid recycling symbols three, six and seven.

Okay, number one is usually considered as safe, which is your pet bottle, but it is best to avoid this plastic too. You need to look for symbols two, four, five, which is your polyolefin, LDP, HDP and your PP. Now these are the best among the rest, but as far as possible, avoid at all. Now these are the plastics that you need to remember and then the symbols that you need to give. So, in the end, plastics will still be used, but you can certainly limit the use of these products.

Instead of buying your plastic water bottles and other plastic containers, why not choose glass and your steel bottles, or you can even invest in high quality water filtration system. So, we all need to advocate for change. And this will make a lot of difference to this environment and the earth. And I hope you've got at least a conscious of what are the safety aspects or how do we assess these kinds of problems and how these can actually be a potential harm to our human health.

We need to all be careful. We need to all advocate for change. And I hope to see you all in the next class with another topic. Thank you so much.