Course Name: Canning Technology and Value Addition in Seafood
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Preservation methods.

Hello everyone, welcome once again. In today's session, we are going to discuss preservation technology. Just to sum up what we have seen in the previous classes, we have discussed the composition and nutritional quality of seafood, different major components and micro-components. We have also seen the muscle structure in seafood. After that, we saw the spoilages and how spoilage can be assessed in seafood.

In today's class, we are discussing preservation methods and why preservation is important. Fish is a perishable commodity and because it has high moisture content, it has to be preserved to prevent spoilage. Fish is more susceptible to spoilage than any other organism or any other animal protein food. Animals are generally rich in proteins, and compared to terrestrial animals or higher animals, fish is more susceptible to spoilage due to its distribution of components and muscular texture.

And to prevent spoilage, preservation is the most important methodology. We have to adopt suitable preservative methods to increase the shelf life, which is unavoidable in the case of fish or any animal products where proteins are rich. Without employing preservation techniques, it's very difficult to extend the shelf life or maintain the nutritional quality. When we do preservation, we have to be careful about these two parameters. We are not only extending the shelf life of the product, but also ensuring the nutritional quality is maintained. When we preserve the product, the nutritional quality should not be affected much.

So, whatever the nutritional components are in the original material, they should be retained without much change in the end product. That is what preservation does. Preservation, by definition, means keeping the fish in a wholesome condition and fit for human consumption. Preservation will extend the shelf life of the product by a few days, months, or even years, and during this period, there won't be much change in the nutritional quality. Whatever is there in the beginning will be retained in the end, and at the same time, it will be safe for human consumption.

Now, why do we adopt preservation? You might have seen cases where fish are captured in bulk amounts, which is a glut in certain seasons. Similarly, fruits and vegetables also experience glut in certain seasons. When we get a large number of products in one particular season, there's a necessity to store and preserve them so that they are available

in the off-seasons. That is one reason why we opt for preservation. The second reason is the distance of farms from the market. Whether it's terrestrial produce like fruits or vegetables or fish, they are often produced in one place and need to be transported to the market, which may be a longer distance. Sometimes, there aren't enough transportation facilities or storage options available along the way. Therefore, processing becomes necessary. When a large quantity of produce is harvested, by the time it reaches the market, it may undergo spoilage. By preserving it—by lowering the temperature, cooking it, or employing other preservation techniques like curing or pickling—we can ensure that it doesn't spoil before reaching the market, at least maintaining its nutritional quality. So, keeping fish fresh is very important. At the same time, there should not be any losses to the flavor, texture, or nutritive value of the product. The weight and digestibility of the flesh should also be maintained. Preservation from the point of capture, that is, from farm to fork, until it reaches the consumer, is crucial.

Before we delve into preservation, what are the things that we have to consider? First, we have to understand the composition of fish. What are the different components present in fish, and why are we going to adopt or do preservation? We need to comprehend the details about the components—whether the fish is rich in lipids or proteins, and what changes might have occurred in the components depending on the season it was captured. So, understanding the composition is very important. Only then we can adopt a particular technique. Next, they have to understand why fish undergo spoilage. What is the reason? For example, we understood that the gut or the intestine contains a lot of microbes, and similarly, the gills and scales contain microbes. So, these are the places from where the microbes enter or start the deterioration. If there is no idea, the person doesn't know that these are the places where microorganisms are present; they will delay the de-gutting process. So, they have to understand where the microorganisms are and only then can they take measures to preserve the fish. If a person knows that the intestine contains a lot of bacteria, they will immediately go for de-gutting, meaning removing the gut to prevent contamination from the gut to the muscle.

The next criterion we have to know is methods and principles of preservation. So, when we go for preservation, we cannot randomly adopt any preservation method. We have to understand which preservation method has to be adopted for what kind of product. There are products that can be cured, frozen, canned, or converted to value-added products. We cannot adopt the same technique for all kinds of food products. Depending upon the nature, the technique has to be selected, and when we select the technique, we have to know in great detail the thorough idea about the processing or the preservation technique needs to be there.

To begin with, composition is important. This we had already seen in the previous classes. To brief up, moisture is the major component. It contributes to about 60 to 80 percent, followed by protein. So, again, fish is very rich in protein. It's a chief source of

protein. The other micro components are glycogen, sugar, sugar phosphates, nucleotides, and the most three important parameters here are moisture, protein, and lipids. So, these three things are important. They are nutritionally important, and they again can easily be deteriorated by microorganisms. So, we have to preserve these three things if we are going to eat fish. It is mainly because it is rich in PUFA or protein. If the protein is deteriorated or eaten up by microorganisms or PUFA or polyunsaturated fatty acids, it has been converted to lower fatty acids, then it is of no use.We have to preserve these components.

Now, again, this figure shows that moisture is the highest percentage, and by removing the moisture by adopting the suitable preservation method, if we can control the moisture content or the water can be trapped, then we can control the microorganisms. Now, what makes fish different and what are the reasons for spoilage? Fish has high amounts of trimethylamine oxide. This is one reason why it is different, but this is the same reason why fish undergo spoilage. TMAO can be easily acted upon by microorganisms, and again, it will be converted to trimethylamine. So, that becomes a reason for spoilage.

Now, fish has high amounts of lipid, that is polyunsaturated fatty acids, which are nutritionally very important. But then, since it has high amounts of unsaturation, it will undergo rancidity. So again, that is the same reason why it is important, the same reason why it undergoes spoilage. Then again, it has low amounts of carbohydrate; again, that can be another reason for spoilage. Again, because of the high amounts of non-nitrogenous protein, the non-protein nitrogenous compounds, then reduction of pH, then autolysis, and bacterial degradation, these all details we had seen in the previous classes also, but these are the reasons why the spoilage starts. So, why fish is important, the same reasons are also important in the case of spoilage also.

Now, coming to the definition of food preservation or fish preservation, it is a method to extend the shelf life. That is the main important idea behind preservation. Whenever you get a product or whenever a catch is there or something has been harvested, the shelf life has to be extended. It is not necessary that in the same day everything will be consumed. Today, you might have harvested 10 kilos of fish, and it's not necessary that the entire 10 kilos will be utilized today itself. It may be balanced; nobody will purchase it, so it can be taken or it can be sold the next day. So, if you are going to sell it the next day, then you need to extend the shelf life; you cannot sell a spoiled product to the consumer. So, there it comes the importance of preservation. So, to extend the shelf life, you need preservation. Then it's not only extending the shelf life; you also improve the quality of the product. Quality, whatever is there in the initial raw material in the fresh condition, what is present, what are the micro components or what are the micro components, these components, they need to be retained in the final end product. So, that is also another aspect. So, these two aspects are important in preservation. And preservation is not

biology, or you cannot say that I know biology, I can do preservation. You need to know all the other aspects of science. That is, it includes physics, it includes chemistry, it includes microbiology, it includes engineering. So, all branches of science are important in preservation.

Preservation methods are of different types. You have seen conventional preservation methods. The conventional preservation methods include canning, salting (also called curing), and drying methods. Then, there was a slight evolution, and new techniques came into existence. We had freezing and thermal techniques. Again, there were evolutions in the preservation techniques, which include high-pressure processing (HPP), microwave processing, ultraviolet (UV) processing, and irradiation. Several methods have been developed to preserve the fish. Now, we have to understand which method has to be adopted for which kind of fish.

Now, let's see each one by one, with a brief description. Chilling, by chilling we mean that the temperature has to be brought down. It is not below zero degrees; it is near zero degrees. So, just by reducing the temperature, that is, the optimum temperature is 37, you bring it down. You chill it using ice or ice-cold water, and when the temperature comes below or near to zero, enzymatic action can be stopped. So, enzymes will not act, thereby you can prevent autolytic degradation. Also, microbes will not be able to grow or multiply because it is not the optimum condition for them. So, by chilling, that is the first method of preservation and a very common method. You would have seen that many times in households and in the local markets; it is the common method of preservation. They immediately chill the product.

Now, the next method is freezing. So, this is just a play of temperature. You reduce the temperature; the optimum temperature is 37 °C, which is room temperature. From room temperature, we are bringing it down to 0°C or below 0°C. In freezing, we go below 0°C, and it is a lowering of temperature. There are different techniques for freezing.

In curing, the water activity is controlled by drying. It is subjected to solar drying; you can just put it in direct sunlight, and it will undergo solar drying. Alternatively, you can use dryers to reduce the water activity. We can also use salts and sugars for osmotic dehydration. Osmotic dehydration is a method of controlling the water activity. In this method, the food, vegetables, or the test sample is soaked in high concentrations of salt or sugar. Since it is a high concentration, we can observe osmosis. The principle behind osmosis is that movement happens from higher concentration to lower concentration through a semi-permeable membrane, and here, this membrane is the fish tissue or the fruit tissue. So, this is one method of reducing the water activity. Alternatively, we can apply some mild heat or use additives to control the water activity.Smoking is yet another method. It is a conventional method whereby you can reduce the water activity. At the

same time, we can also get deposits of bioactive components on the surface of the muscle tissue, which will prevent microbial growth.

Then we have another method, MAP, that is modified atmospheric packaging. We are modifying the environment inside the package. It can be an active method or it can be a passive method. If it is an active method, the atmosphere inside the packaging material will be controlled throughout the cold chain or throughout the food chain, from the point of production till it reaches the consumer. If there's a break in the chain, it will be immediately noticed or it will be tagged on the food product. So, when it reaches the consumer, the consumer can identify if the chain has broken or not. That is one method. Irradiation is another method where we damage the DNA and cell tissue with the help of gamma radiation. Then we have canning and retort pouch packaging, which you have seen in detail. So that is yet another method of packaging. Marination is another method where we add acid and salt, and this method is based on fermentation because you reduce the pH. Boiling is another method where heat is used, and freeze-drying is a dehydration method where sublimation is the principle.

Now let's see one by one. The salting. Salting is a very common or conventional or traditional method of preserving. In this, we use salt, which can be dry salting or wet salting. If it is dry salting, the fish is degutted, meaning you remove the gut and other unwanted parts. Then it is cleaned, and the scales and other parts are removed. Afterward, it is salted. The fish is packed with dry salt, and there's a higher concentration of salt. The water from the body will come out, and this liquor will be transferred regularly so that it will not cause any spoilage. At the same time, we can also go for wet brining. In wet salting, the brine is prepared, and fish is kept soaked into it at regular intervals. The brine also has to be changed. This is one method, and this is a very common method. In the state, we can see that a lot of dry fishes are available. If it is a smaller fish, we can keep it as such for drying; you don't have to split it up. But if it is a large fish, then we have to split it into two halves and then do the salting.

The next method of processing is drying. Drying is also one of the conventional methods, a traditional method which we follow regularly. You can see grandparents using the drying method, even on the Bombay coast. It is very common to see harpadon, that is Bombay duck, being dried. The fish can be hung by gills and dried in the sun. In earlier times, it was a common practice to spread it on the shore and dry the product, but it was understood that it contaminates the product. The fish, the sand, and the birds or the other rodents pass over the product, so the product gets contaminated, and it is not hygienic. For that reason, some modifications have been brought now. Solar drying has also come, and a lot of dryers have come. There are tray dryers, drum dryers which can be used for drying the process, and these are mechanical dryers.

Then we have smoking. Smoking is another method and very common in Lakshadweep. It is usually the tuna fish which is used for doing the smoking process. Large amounts of tuna are captured in the Lakshadweep islands, and these are subjected to smoking. The product that is developed is called masmin. It is more like a cookie which you can have as a snack. Smoking can be of two types: hot smoking or cold smoking. If it is hot smoking, the temperatures are elevated, it is higher temperature, whereas in cold smoking, it is below 30 degrees centigrade. During smoking, the deposits of the wood or the smoke produced are deposited on the surface of the meat. This is the reason why it is rich in phenols and other volatile compounds, and this prevents microbial contamination.

The next process is chilling. In chilling, the fish is layered with alternate layers of ice and fish are placed, with the ratio being two to one for fish and one to one for shrimps. In this method, we can bring down the temperature to zero or near zero, which also extends the shelf life. You might have seen this method in local markets and other shopping malls. The next method is freezing. Generally, we can use block freezers or individually quick-frozen products. In block freezing, when we have bulk quantities received and there is no immediate demand, we can opt for block freezing. For block freezing, we use plate freezers, tunnel freezers, IQF (individually quick frozen) freezers, or other types of freezers. Canning, as we had already seen in the beginning, was covered in a previous session. This course mainly focuses on canning.

And the products we can convert, apart from employing these preservation techniques, we can also develop value-added products from the fish. We can use spices and other additives to make pickles and ferment them, which also helps in extending the shelf life of the product. These are some of the preservation methods.

We also have novel technologies like high-pressure processing, ohmic heating, and microwave preservation. However, these methods are still under trial and research and have not been adopted commercially due to limitations and expensive maintenance charges. Therefore, we are still continuing with the traditional or conventional methods of preservation.

To sum up this session, today we have seen the importance of preservation and the definition of preservation. It's not only to increase the shelf life but also to retain the nutritional qualities. We have also seen the different conventional preservation techniques that can be adopted for extending the shelf life and retaining the nutritional quality or to preserve the products. There are some novel techniques also to preserve the product, but they are not in practice due to limitations.

Why do we go for preservation? It is to prevent spoilage so that it can be made available to the consumers at the right time and in the right way. With this, let me conclude for today. Thank you.