Advance Aquaculture Technology
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Lecture-53
Fish by-products

Hello everyone, welcome to the third lecture of module 11 aquaculture industries. My name is Professor Gourav Dhar Bhowmick, I am from the Agriculture and Food engineering department of IIT Kharagpur.

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The concepts that I will be covering in this particular lecture the waste that is generated from the fish processing industries, the fish byproducts what are the important byproducts that we can use of it like as I discussed in the last lecture also to remember that there is nothing called waste is just that it is in a misplaced resource.

So, if we can use the waste, if we can use those misplaced resource for the purpose for which we can be utilized, then it can be of a very good use for human human utilization human purpose or like for our utilisation or even for you can be it can be give it back to the environment for the replenishment of the environment as well. So, what are the different fish byproducts that is there and how we can use it.

In this particular lecture material, we will be covering the protein fish protein concentrate, fish meal and fish oil of which you already have some basic idea. Chitin and chitosan, fermented fishery products and the fish glue, there will be some more that is left about the

about when we discuss about the important byproducts that I will be covering in the coming lecture video.

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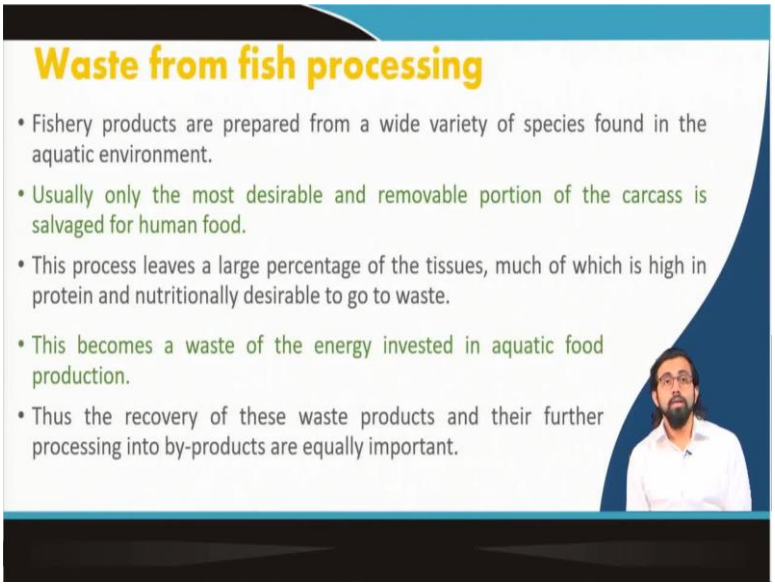

The waste from fish processing. So, as I already discussed, like the fishery product that is prepared from a wide variety of fishes that is or the species that is found in aquatic environment, usually the most important like the most desirable part or the part which is like the removal portion from the carcass that is used for human food for human consumption. However, this process leaves a large percentage of tissues which is of high in protein and nutritionally desirable to go in waste.

This is like a waste of energy that we invest in the aquatic food production and all, so why not to use that waste also, why not to use that waste so called waste and utilize it for different other purposes and we can get some additional economic recovery and also, we can sustain we can be more sustainable kind of you can say it is a more sustainable aquaculture production. So, this recovery of this waste products and they are further processing into byproducts or that is why it is very important. And nowadays people are really worried there are experts in aquaculture enthusiasts, aquaculture researchers all over the world, they are working on it.

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Fish byproducts, the products which is prepared from the left-out portion of the fish process or the fish processing operations or as well as the raw material itself that has not mean for the human consumption are called the fish byproduct. The principle fish products are those which are prepared for human consumptions everything else can be classified as fish byproducts. It is very important both economic and the neutrality point of view and converting this unwanted fish and the fish wasted to some byproducts and this nutrient by which we can utilize meaningfully the nutrient and the economic return out of it.

So, by this way, we can help in reducing the waste product which is generated from which can cause nuisance to the environment because you can just throw this waste into the environment and it will pollute the surrounding vicinity rather than so that when you can utilize it for the byproduct recovery you can reduce the environmental impact as well, is not it? There are various types of byproducts made from fishery and the aquatic product wastage and these byproducts are the one that we will be discussing in details.

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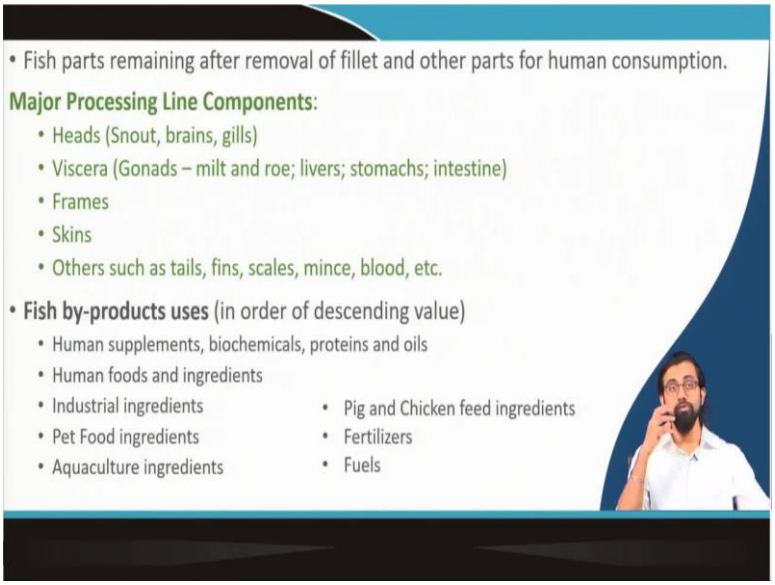

The most mostly the fish parts which remained after the removal of the fillet portion and other parts of the fish consumption are the byproducts. What are the major processing line components in these byproducts? First is the head, like snouts, brains or the gills, part of the head? Part of the visceral part like Gonads, milt and roe or the egg, liver, stomach and stomach and intestines.

Other than that, the bone frames, the skins, the tails, fines, scales mince, blood, etc. etc. All these things can reutilized for different other purposes that is what that is what the like beautiness of this kind of lecture matter and all that. We got to know some very important facts which really goes unknown to us and we do not utilize them at all and at the end, if we gone through this information, so if we have this information or knowledge with us we can easily identify those waste product and we can completely reconvert it for an important byproduct recovery which will give you environmental sustainability and also a high economic return.

What are the byproducts fish byproducts that can be vital in terms of uses? The human supplements, biochemicals, proteins and oils, human food or ingredients can be used for industrial ingredients, it can be used for fish, pet food ingredients, it can be used for aquaculture ingredients, or pig or chicken feed ingredients, fertilizers, fuels, etc. etc. A lot of applications that it has, like I will discuss within in this lecture material and then in the later slides and also in the coming lecture like what all are the uses of this fish byproducts.

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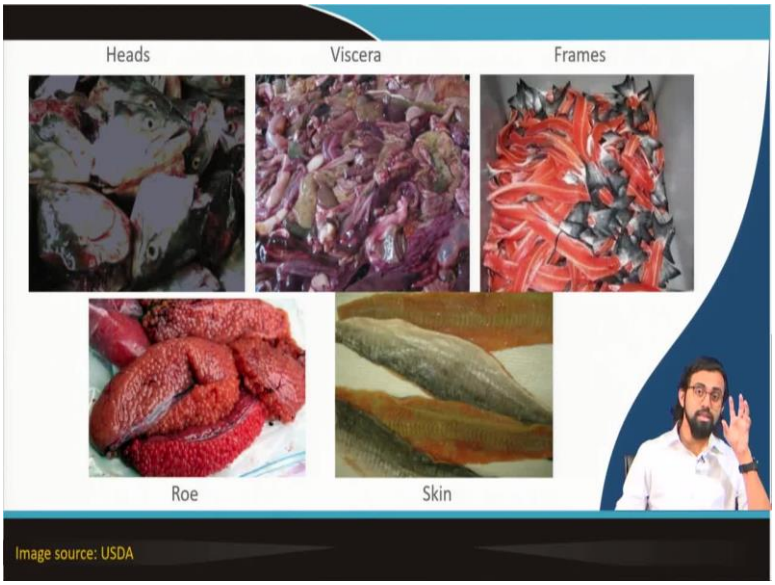

See, these are the different parts the heads, viscera, these frames, this roe or the egg part, the skin part, which we normally what we do we after we felting is done after we use the actual meat portion and we just throw it away, it constitutes a huge amount of the actual the work or the energy that we use for producing this aquatic animal, is not it?

That is why we need to find out the way by which you can utilize this product. So, what are the important fish byproducts that we will be discussing in this lecture in the coming lecture video? Fish protein concentrate, fish meal and fish oil, chitin and chitosan, fermented fishery products, fish glue, fish gelatin, roe or the caviar, fish maws and isinglass, pearl and essence.

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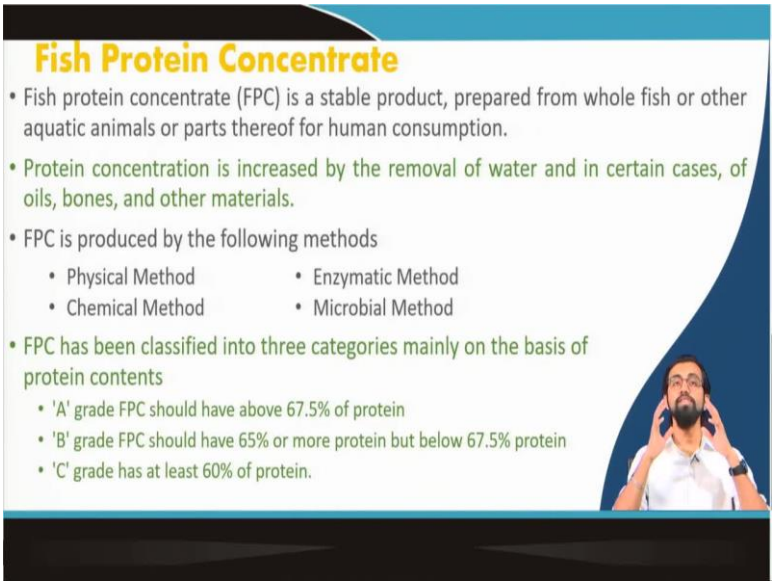

First is the fish protein concentrate. Fish Protein Concentrate in short, we call them FPC is a stable product or prepared from the whole fish or other aquatic animals or the parts thereof for the human consumption, how? Protein Concentration is increased by removal of the water and in certain cases of bone, oil, and other important other material from the fish body. What are the methods? There are different methods physical, chemical, enzymatic, and the microbial method by which you can readily utilize this fish protein concentrate.

It is classified into 3 major categories, A grade FPC means it should have at least 76.5 percent as a protein or above, B grade FPC which should have at least 65 like at least 65 to more than 65 and in between 67.5 percent as a protein, as C grade which is having at least 60 percent of protein. So, these three are the protein constituent that it should be had when we can utilize it for like for as a stable product for different different production different tools different reasons.

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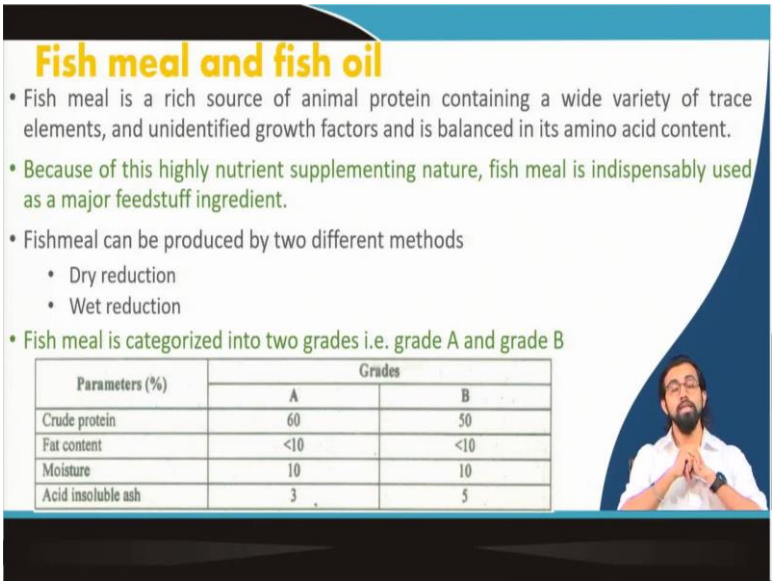

Second is the fish meal and fish oil. Fish meal it is a rich source of animal protein, it can be used for again the bigger fish production like all the other fish production, some carnivorous fish production specifically or you can use it utilize it for as a fish meal for different omnivorous fishes and all you can use it for the your cattle feed, your livestock, and like it can be utilized for different purposes.

It normally contains it is a rich source of animals protein plus that different kind of trace elements and also some unidentified growth factors and which and also in balance of the ammonia acid content and all, the essential amino acids contain all. You know there is there are 10 essential amino acids which are very much important for fish to have in their feed, is not it?

Because of its highly nutrient supplementing nature fish meal is indispensably used as a major feed stuff ingredient. It can be produced by two methods, dry reduction and wet reduction method. It can be also classified in 2 grade, grade A and grade B. Then depending upon your the economic return that you are expecting the growth or the growth in a high amount of growth that you are expecting from your farm, so based on that from your farm animal based on that, you produce a product or you supply it with a grade A fish meal or the grade B fish meal.

Grade A fish meal, it should have at least 60 percent of crude protein, less than 10 percent of fat content, around 10 percent of moisture and the acid insoluble ash walk around not more than 3 percent. Whereas, in case of Grade B the main difference is the crude protein it is

much lesser around 50 percent of its should be the crude protein level for this great B type of fish meal.

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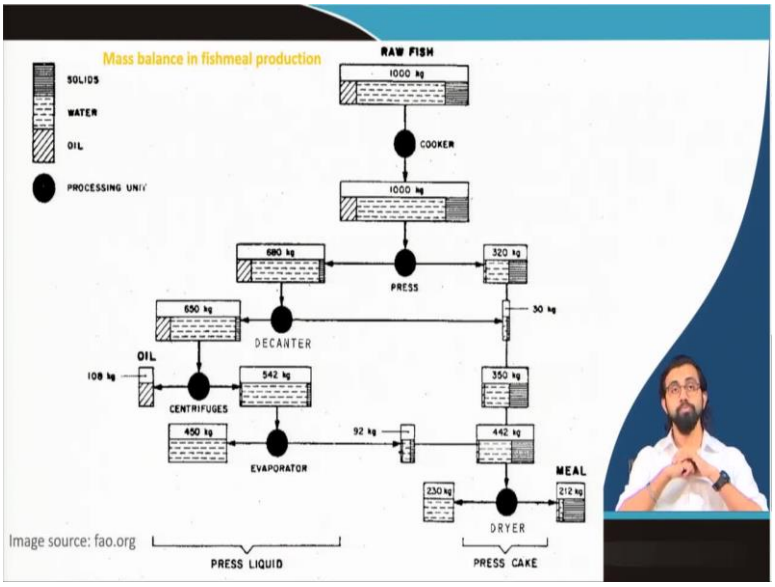

If you just as this is just one example of how it looks like if you go do the mass balance of this fish meal production. Suppose you have a raw fish like of 1000 kg see, the different texture means that different states of matter like solute, contain water or oil. I mean like here this water and all is the same state of matter, but I am just saying like one is water, the water line one is oil, and another is solid that is it showcase the amount of or you can see the amount of water presented the raw fish is very high, and almost the same amount of solid and oil is present, oil is it a little bit higher to fat content.

So, now when you cook it, after the cooking is done, then if you press it will you can have in almost 600 kg of like put which you can put it in a decanter, another around 320 kg of the rest of the material that you can go through in the further procedure. In case of decanter, after the decanting is done almost you see 650 kg of the material that you can get out which you can put it in the centrifuge, you can easily take out the oil part almost 108 kg and 542 kg of rest of the portion. If you put it in the evaporator all the watery portion will evaporate and that you can condensed and you can collect it separately, which is say like around 450 kg.

So, now 92 Kg is separated out and it is connected to the other side of the portion, like you see 320 kg plus 30 kg, which is coming from the decanter all total 350 kg plus 92 kg which is coming from the evaporator all total 442 kg, which is like in us kind of slurry form. So, now, then when you do it in the dryer when you put it in the dryer, what will happen you can easily

get out of the watery portion and you will get the final meal which is around 212 kg. So, you can easily identify it after the press hacking procedure is done.

So, you can easily identify from 100 kg of raw fish you will get only 212 kg of fish meal. So, it always like that it is a very small portion of the fish meal that you can utilize it for further purpose, which is like if something was on normally it ranges from normally it ranges from 15 percent to 30 percent of the raw fish constitute raw fish the weight. So, in general that can be utilized as fish meal for the procedures.

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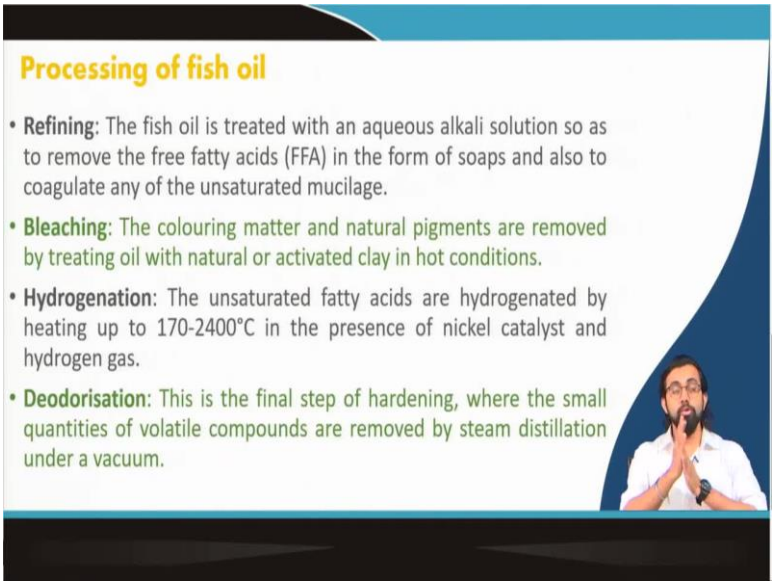

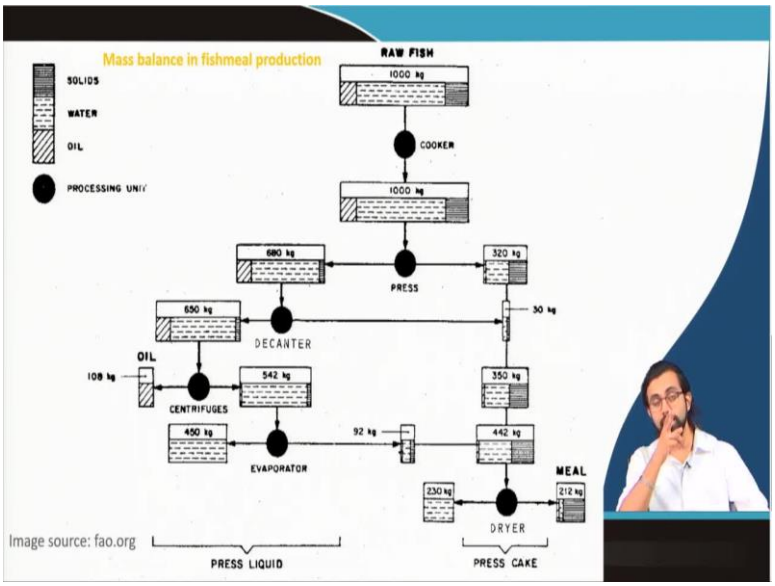

Processing of the fish oil. You see the fish oil that is that you can we can get out and we can easily find out without using the centrifuge centrifugation process you see almost 108 kg is separable and also it is still stays there as in a very small portion in your in the fishmeal also.

Anyway, the fish oil that you can get this fresh fish oil that you can separate it out almost 108 kg from 1000, just to give you one example.

So, in this fish oil can we use for different purposes. How will the fishery normally be treated with the aquatic alkalis solutions? So, to remove the any free fatty acids in the form of soap and also to coagulate any of the unsaturated mucilage and all, this is the process of very standard process of making soap.

You know the how earlier days people use the fish meal or the different animal oil, I mean like the fish oil or the animal oil, and we add it added with the aqueous alkali solution to produce the soap or the detergent material and especially the soap material soapy material and on how it is made earlier days. So, even now also this the same procedure is more like more sophisticated method has been used, but almost the procedures or chemical formula is almost the same.

Then the bleaching is done. The coloring matter and the natural pigments are removed by treating the oil with net activated clay or the natural clay in hot condition. After the refining and the bleaching procedure is done then we go for hydrogenation. The unsaturated fatty acids are hydrogenated by heating up to 170 to 2400 degrees Celsius in the presence of nickel catalyst and hydrogen gas.

As the final step which is called deodorizing as a final step of hardening where the small quantity of volatile compounds are removed by steam distillation and under in under a vacuum condition, using rotor waiters and different other procedures and all. So, by this way at the end you will get a very thick solid, like thick amount of fish oil which you can utilize it for different purposes.

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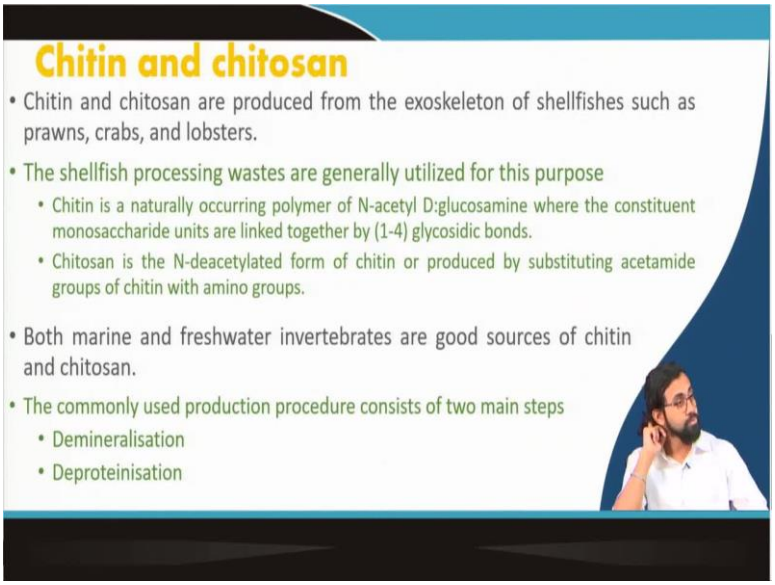

Second, like another important byproduct fish byproduct is chitin and chitosan. Chitin and chitosan like are produce from the exoskeleton of the shellfishes such as prawns, crabs, lobsters, etc. How we are collected there is a we can we can collect it we can simply we can produce it we can see we can they normally naturally they get rid of these processes they because of the molting process they are anyway they get rid of their exoskeletons.

This exoskeleton this we can we can chitin and we can use it for this production of different byproducts. How chitin is used? They are the what is this chitin? It is naturally occurring polymer of N-acetyl D-glucosamine, where the constituents mono-saccharides units in this are linked together with the one 1-4 glycosidic bonds.

Same way is Chitosan actually, it is a N-deacetylated form of chitin or produced by substituting the acetamide group of chitin with the different amino groups, majorly the quaternary amino groups or the tertiary amino groups. That is how the chitin and like chitosan are formed. And then this can be utilize it for further purpose like both marine and the freshwater invertebrates are good sources of this chitin and the chitosan.

So, this commonly used product or the production procedure mainly consist of two steps, demineralization and second deproteinisation, out of these two procedures we can get this chitin and the chitosan from the fish shell, I mean like the exoskeleton of this different kind of shell fishes.

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How it is done, you see the prawn shells are collected, washing, grinding and sieving and you will get this fine powder of less than five 500 microns in size. You go for this acid treatment like 7 percent HCL add to 24 hour you will get demineralization procedures and at the end you will get the mineralized powder.

Then this demineralized procedure powder is again go for this alkali treatment, 10 percent NaOH at 60 degrees Celsius for 24 hour you will get the chitin. And then if you add it with the sodium hydroxide nitrogen gas the condition when you burn it at 60 degrees Celsius for 8 hour you will get the chitosan or the chitosan it depends like place to place it the pronunciation vary. So, you understand the procedure how we can get the chitin or the chitosan from the fish the exoskeleton of the shell fishes and all.

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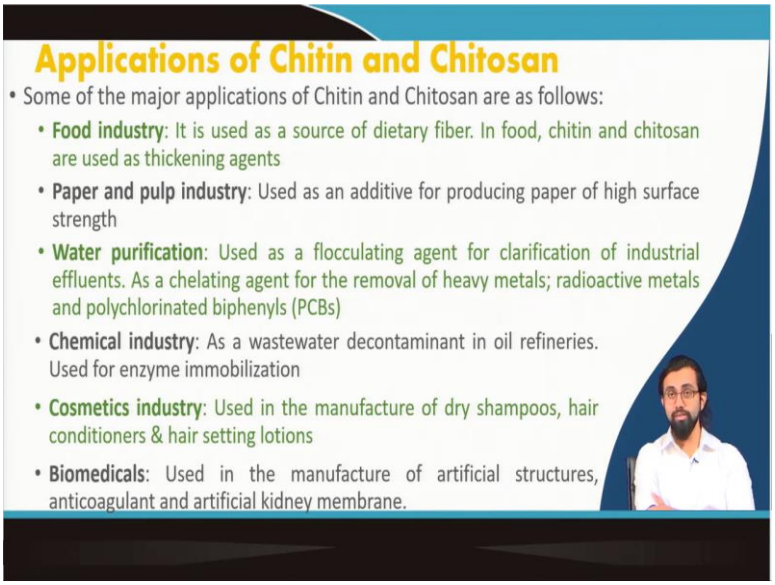

So, what are the applications of this tool? In general, some of the major application of chitin and chitosan are like the food industry, it is used for as a source of dietary fiber in food, chitin, and it is used as a thickening agent. Pulp and paper industry, it is used as an additive for producing the paper with high surface strength, it is a very important additives actually it is very important for Pulp and Paper industries.

Water purification, it is used as a flocculating agent because this chitosan has some ionic resin actually structure it is called with different ionic resins, it is because of its the surface charge that it presents and because of that it can be utilized as a flocculating agent for clarification of industrial effluents and as a chelating agent for the removal of heavy metals, maybe radioactive metals and polychlorinated by phenols, which is PCBs, which is very toxic compounds and which has to be removed from the wastewater before it discharged into the before it is discharged into the surface water bodies.

Chemical industries as a wastewater decontaminant in oil refineries, it used for enzyme immobilization as a well. Cosmetic industry or personal care product it is used for the manufacture of dry shampoo, hair conditioner, hair setting lotions and etc. Biomedical it is used for manufacturing of artificial structures of artificial biological, I mean like bio mimicking structures like anticoagulants, artificial kidney membranes and all. So, there are a lot there are different use of this chitin and chitosan in there in general.

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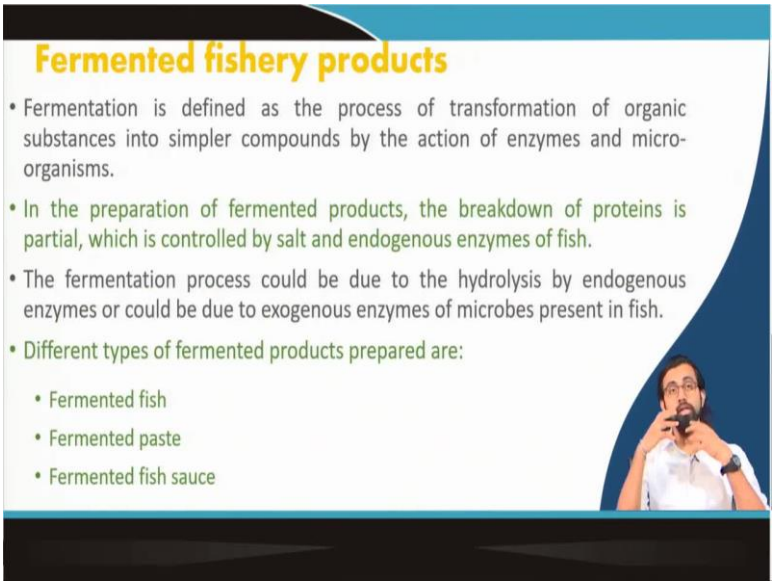

So, next is the fermented fishery products. Fermentation is defined as the process of transformation of organic substance into simpler compounds by the action of enzymes and microorganisms, so the fermentation is done. So, in the preparation of the fermentation products, they the breakdown of protein is partial and which is controlled by the soiled and endogenous enzymes in the fish present in the fish.

This fermentation process could be due to the hydrolysis of endogenous enzymes or could be due to the exogenous enzymes of microbes present in the fish. What are the different types of fermented product that is prepared? Fermented fish, fermented paste, fermented paste or fermented fish sauce, which has different industrial applications and all.

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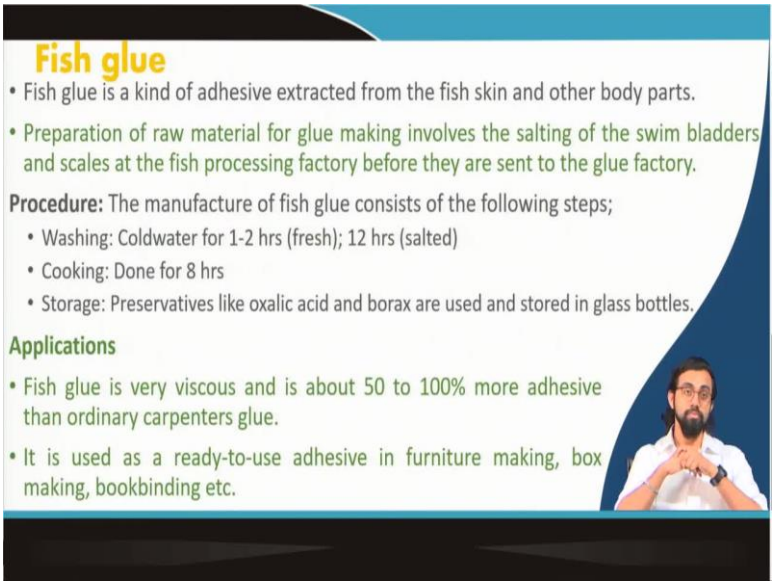

Another important very like you would be very happy to know about this important fact about the fish glue. Do you know it is much better than the regular glue that is present in the ordering carpenters glue that we use, it is much better this fish glues and all. This fish glue it is a kind of adhesive that you can extract from the fish skin and other body parts. It is used for the preparation of the raw material for glue making, which involved in salting of the swim bladder and the scale of the fish processing industry factory before they are send to the glue factory.

Procedures first is the washing, you wash the fish with the cold water at for 1 to 2 hour, if it is a fish water, for solid water 12 hour, then cook it for 8 hours then store it and preservatives like oxalic acid or the borax, which is used and stored in which is and then store it in the glass bottles. What are the applications? This fish glue is very viscous. Because of his viscosity because of its high viscosity it is about 50 to 100 percent more adhesive in nature than ordinary carpenters glue. As I told you like it is very famous actually in glue industry and there are people who actually work on these different kinds of glues and all.

It is used as a ready to use adhesive in furniture making, box making, bookbinding, etc. So, you can use it this as a byproduct and it is very easy to actually prepare, you just need to know the exact method, you collect it from the industry or the market and you can utilize it for glue processing process and all, glue processing like preparing glue and all.

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So, all these things are possible, all this use a fish protein concentrate which is very important as use as a super food, you can take it which is which will give you some like people with a

protein deficiency they should really have it. Chitin and chitosan is used for different industrial application and chemical research in the research purpose as well. Fermented fish, fish sauce, fish paste, so these are used for increasing the food quality or the taste or texture of your food and we are in for different animal livestock application purposes as well.

Fish oil and fish meal, fish oil is used it is very much good for it is used in different pharmaceutical industries and all. Fish meal is added with the fish pellets and all in the fish feed for higher protein availability for your rearing product rearing produce. Fish glue, as we discussed, it is very it is has very high adhesiveness and it can be utilized for different utilisation you can use it for different purposes.

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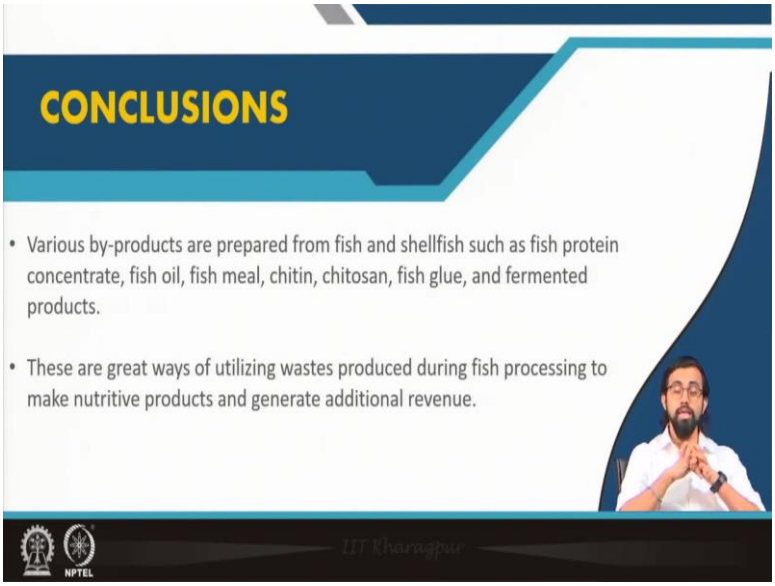

There are lots of other byproducts and the fish byproducts and like are there, due to the time cost and I cannot cover all of it in this lecture material, but in the coming lecture material I will discuss about more in details about some more couple of few fish byproducts which are there for long and people are people can use it and industries can be set up for they can utilize all the part of this fish products so that they can get maximum benefit out of it.

So, in general into to conclude today's this lecture. The various byproducts are prepared from fish, shellfish, such as like fish protein concentrate, fish oil, fish meal, chitin, chitosan, fish glue and fermented products are important. These are great ways of utilising the waste produced during the fish processing to make nutritive products and generate the additional revenue.

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And as a takeaway message I would I will tell you that needs which we can get from the small fishes and fishes with a very low consumer demand can be utilized for the preparation of the fish protein concentrate and once you convert it to the fish protein concentrate it can be sold in a much higher value, it will give you much high economic return and it will definitely used for nowadays people are very much concerned about their health and all this diet and also it is a very important dietary substances that you can replace to, I mean like I would not say replace but definitely you can use it if you have if you feel like if you have a deficiency in protein or if you want to supplement it with protein for some specific purpose for your game or for your muscle development and all.

The waste like scales bones, heads with trash fishes can be used to use the used for fish milk production. Fermented products which are delicacy in the Southeast Asian countries have very high nutritional value and other products have controlled autolytic degradation in the presence or absence of salt, this fermented products or sometimes we call them pickle products as well.

Anyway, So, though that is scientifically wrong pickle is different and fermentation is different. These fermented products are very much very famous in places like Indonesia, in places like Cambodia, in places like Japan and all. Shrimp and other crustacean wasted are can be used for the preparation of chitin and chitosan, which have got industrial as well as domestic applications.

So, other than that we already we also discussed about the fish glue, which you really hope you will be really surprised and we will be very happy to know more details about all these byproducts and how you can use those things for developing your own and entrepreneurship if you want in future.

How we can think about, like how we can utilize this technology this wonders for your developing your own entrepreneurship in future for or in this sector because there are a lot of opportunities that lie in the sector but in India there it is actually it is a very unorganized sector and people are not putting much of an effort and there is there will be a high bloom in the coming decade in this particular sector and I hope you will be the person who joined this race fast enough to get the maximum gain.

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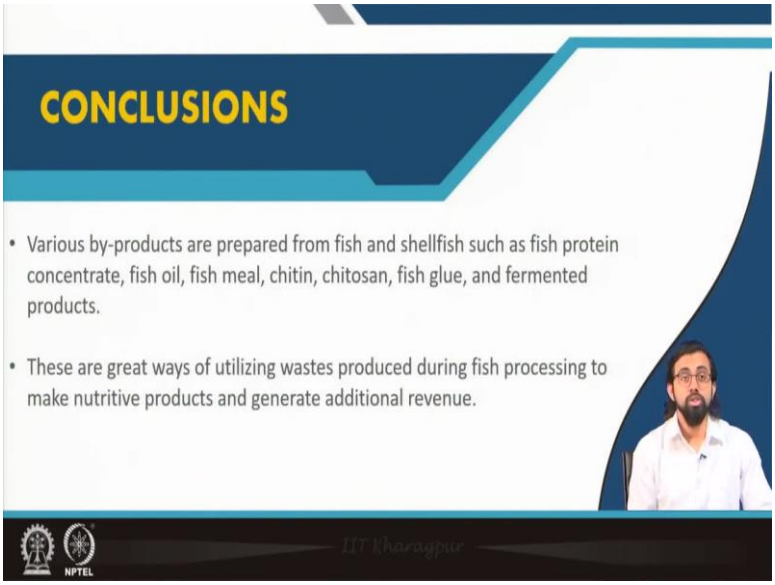

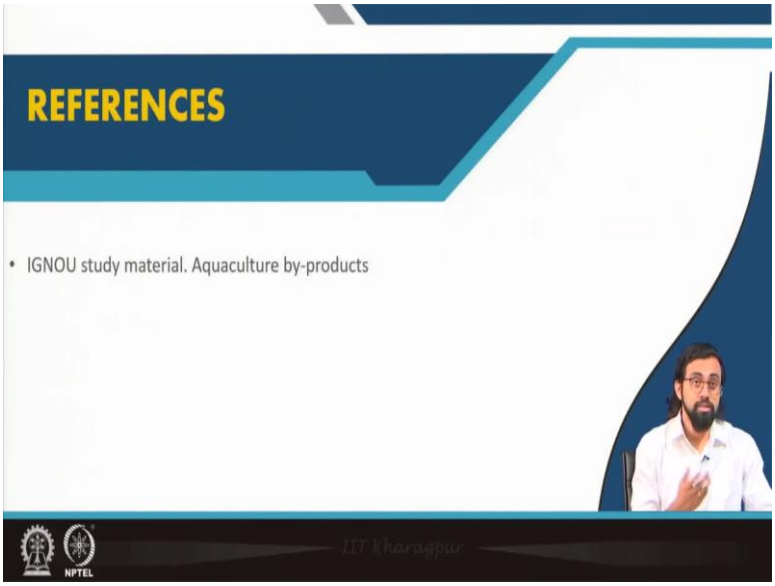

So, that is it for the day these are the conclusion. So, I mean, these are the references that you can go ahead for more details. I hope you get to know some important information from this lecture and I hope it will definitely help you to gain gather more knowledge in future and if you can, if you want to again, I will be very happy to help you. Thank you so much. See you in the next lecture.