Course on Industrial Biotechnology
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Lecture 51
Module 11
Cheese Production (Continued)

Welcome back to my course Industrial Biotechnology. In the last lecture I I was discussing about this cheese making process that I told you that how the cheese so what is the purpose of cheese making, I told you the cheese making is the process through which we can preserve the milk protein and fat for the longer period of time and I also told you that the composition of the milk and and also depends that what percentage of because cheese comprises on fats and proteins, so as the percentage of fat, protein increases the yield of cheese also increases also it depends on the moisture content as the moisture content increases yield up cheese will be high.

So and I tried to discuss that what should be the quality of the milk that is how you determine the quality of the milk and what is the major problem that we have in the curd making process I told this is the forge contamination problem because due the forge is kind of virus bacterial virus that attack the bacteria this is not allow the bacteria to grow properly. So this is the major major issue that we have so but this can be overcome there are several measure for that.

So and I told you there are several steps involved for this curd making process those are not only the quality of the milk but also curd making process kind of culture you use rennet (()) (1:54) process those process we will discuss in details in in this lecture.

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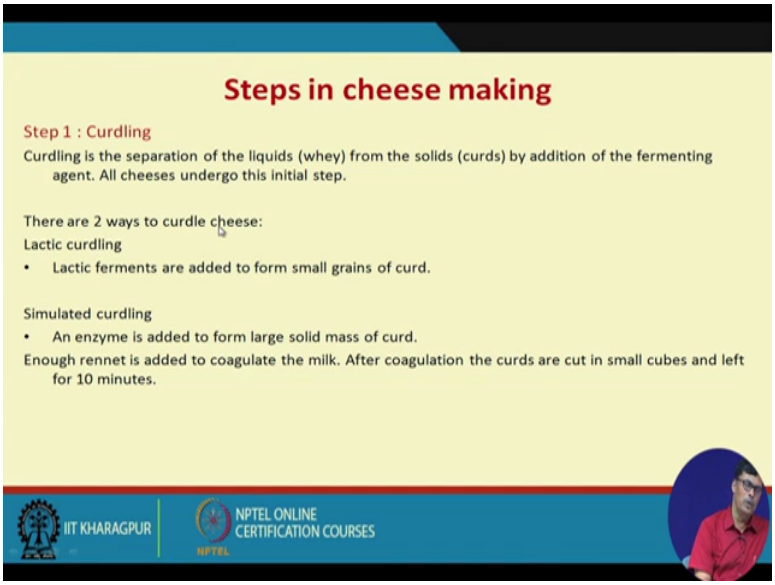

Now if you look at the step 1 that is curdling process what you call curd making process, I told you that first you have to pasteurized the milk and pasteurization is process through which you can keep the pathogenic organism the curdling is the separation of the liquid from the solid by addition of fermenting agent. And all cheese undergoes this initial step. So curd curd making is the initial step op the cheese making industries.

So this is there is two ways of curdle curdle the cheese one is lactic curdle and simulated curdle. The lactic ferments are added to to form the small grains of curd because we use the lactic acid bacteria so that lactic acid in presence I show you that if the PH go when it goes lower 5.2 to 5.3 to 5.2 the the (())(3:02) is is precipitated out and and this is how the solid (()) (3:09) of the that you know the milk protein and fat take place. And enzyme is added in the simulated curdling process what you call rennet to separate out the this protein or coagulate added for the coagulated to the coagulated milk.

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Now step the milk is curdled with the combination of starter culture and rennet both is required for the separation of the to separation milk protein and fat. Starter culture turn the milk sugar to lactic acid. Rennet is added to complete the curdling process. Now the style, texture, flavor of the cheese depends on the starter added and the ageing condition because I already mentioned there are more than 500 different varieties of cheese and cheese has different structure, different texture they have, different flavour they have.

So some cheese we can take directly as a food, some cheese use as the spreader in the milk or we know pizza in the day today life we we take pizza is a quite favourable dish for the children and there is largely used.

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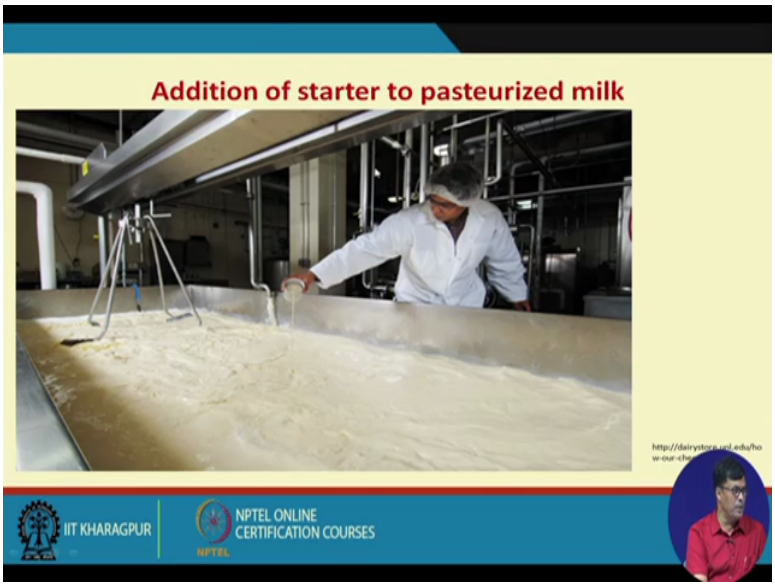

Now this is addition of starter in the milk you can you can in the pasteurized milk we can add the starter here, this is the milk and this is usually done in a vat.

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Then addition of rennet that for coagulation of the milk that rennet is kind of soluble in water we add here rennet for precipitated out the proteins.

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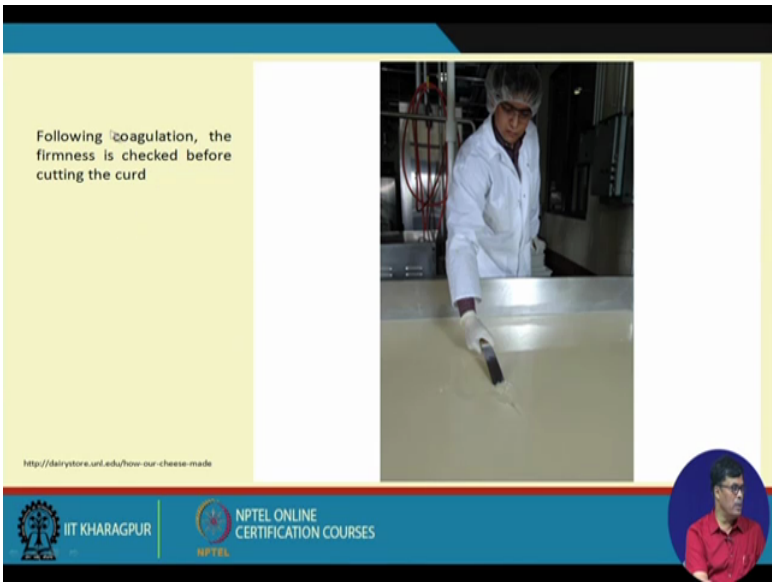

Now following the coagulations and firmness is checked before cutting the curd. So you can with the help of knife you can cut the curd and find out whether it is cutting properly or not because you know that you can you can whether it is spreading or in the whether this formation is the curd making process has come to the maturity form or not because that

cutting process from that we can we can find out that what is the status of the fermentation process.

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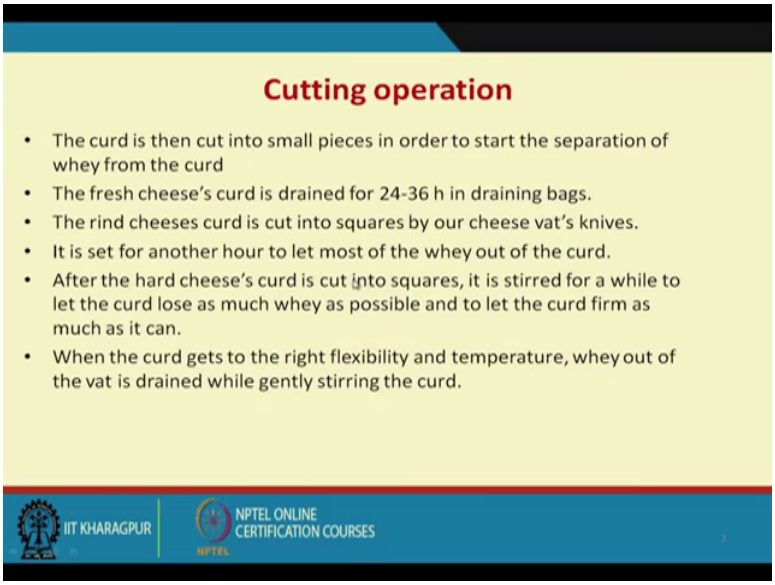

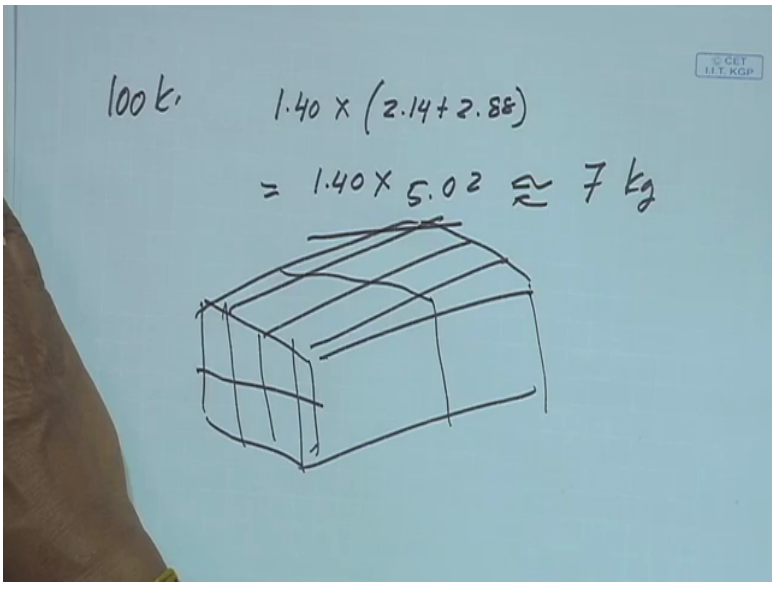

Now the cutting operation the curd is then cut into small pieces in order to start the separation of whey and curd because you know you make it in the small blocks because I can I can I can give the example it is like this so you can if you have milk curd like this with the help of this you know we can cut we can we can make it different blocks, we can make different blocks we can make we can separate out one after another this blocks we can separate out.

This is the fresh cheese curd drained 24 to 36 hours in the draining bag. The rind rind cheese curd into the squares by our cheese vat knifes because rind rind cheese usually the upper surface is little bit harder and it is set another hour to let most of the whey out of the curd. So

after the hard cheese curd is cut into squares, it is stirred for a while to let the curd lose as much as whey as possible and to let the curd form as much as it can.

So you know we we make a stirring like this so that you know most of the water goes out and we get the solid materials stick there. And this curd gets the rightly flexible and then we do the cooking process with that I told you the cooking is the very important operation of the cheese making process as I show you, this is the curd cutting operation you can see how we are cutting you can see the that you know that that that that how some kind of impression is there the cutting impression is cut with the help of knife if this is the kind of knife that we had.

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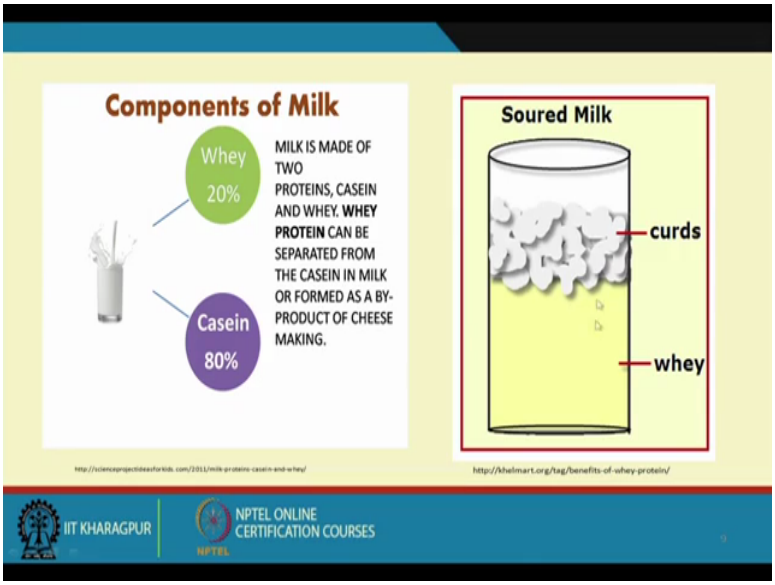

The components of the milk we have 20 percent whey and 80 percent casein that is this is when I told you when the curd making process takes place we get the (())(7:25) whey in the form of liquid and curd is usually the solid form this is how it looks because you know that you can easily visualize from here curd and you can distinguish the whey whey and curd curd the solidified material is like this.

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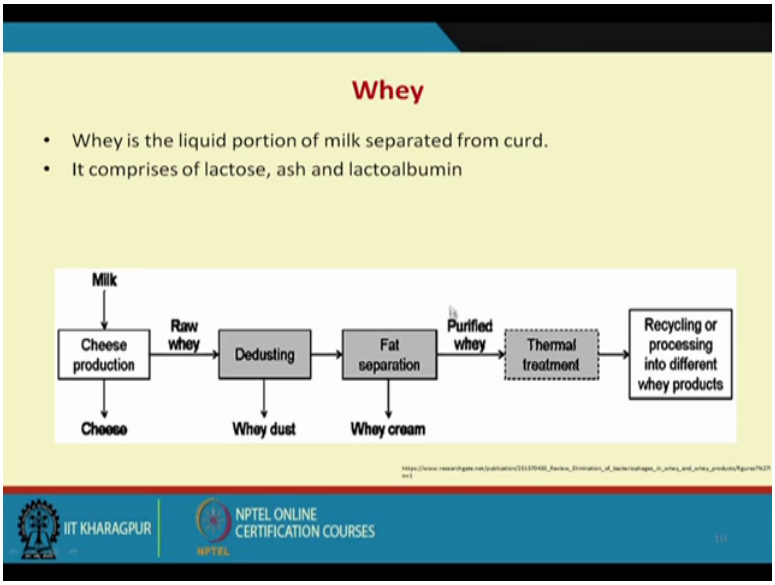

Now the whey is a liquid portion of the milk separated from the curd. It comprises of lactose, ash and lactoalbumin. So it is like this milk that passes through the cheese production we get the cheese, then we have the raw whey, then we pass it through the dedusting where we get the whey dust and then in fat separation we get the whey cream, then purified this whey through thermal treatment recycle or processing into different whey products because this is a very good raw material for the lactic acid production when we are when I discussed the lactic acid fermentation process I already told you that whey is the very good raw material for the production of lactic acid fermentation process.

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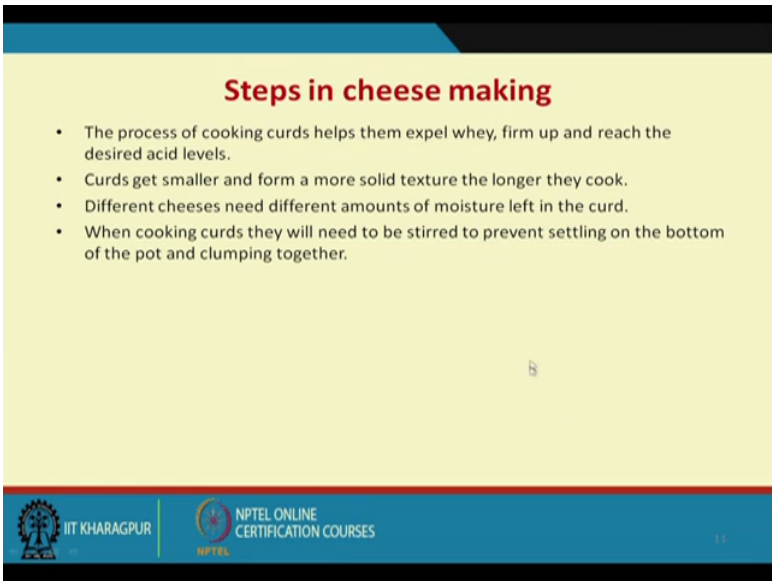

Now step for cheese making the process of cooking curd helps to expel the whey, so when you heat it that will help the water to goes out and firm up if the structure will be more firmed and reach the desirable acidity. Then because the acid acid lavel you have to if you take the most watered out then acid level will be low. The curd gets smaller and form more solid texture the longer they cook. This is shown you I have some picture picture afterwards I will show you that how this texture looks, how texture of the cheese looks.

Different cheeses need different amount of moisture left in the curd when cooking curd there is the need of starring to prevent the settling on the bottom of the pot and clumping together.

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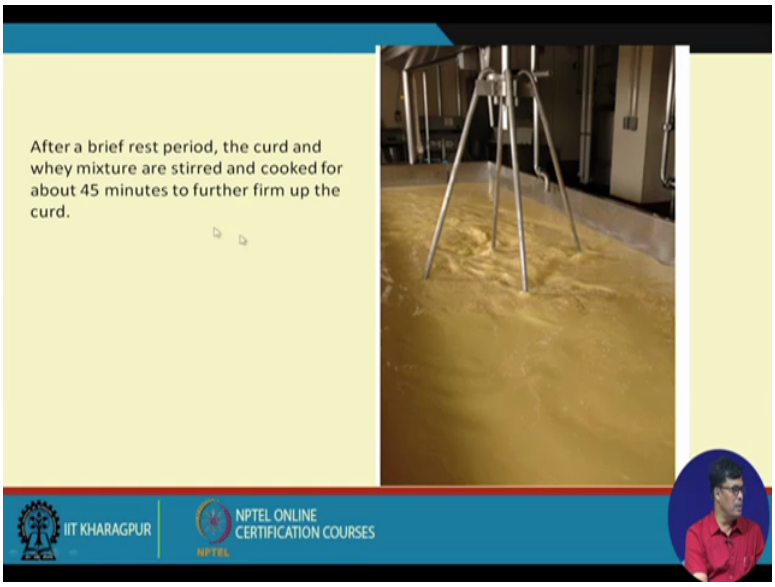

So this is like this after after brief resting period the curd and whey mixture are stirred and cooked for about 45 minutes to further form the curd this is this is done.

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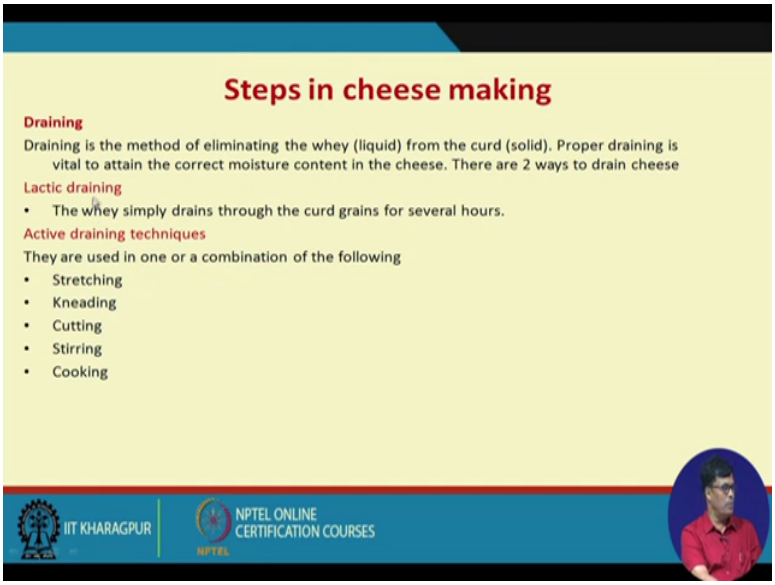

Now after that we do the draining process draining is the method of eliminating the whey from the curd and proper draining is vital to attain the correct moisture content of the milk because because (())(9:59) question come then how you preserve the milk protein and fat in the form of cheese one is the we reduce the moisture content, another we increase the lactic acid concentration and this is the two vital factors that increase the storable characteristic (()) (10:16) characteristic of the milk protein and fat because this is the how it is done.

So you have to remove the whey accordingly because if you if you remove more whey that means you can assume the moisture content in the cheese will be less but if you remove less than moisture content will be low. So it depends on the because and and I already mentioned I have shown the calculations how the moisture content effect the yield of the cheese. Now lactic draining the whey simple drain through the curd grains for several hours for several hours.

The active draining techniques they they are used one of the combination of the followings stretching, kneading, cutting, stirring and cooking these are the different process through which we can remove the whey from the curd.

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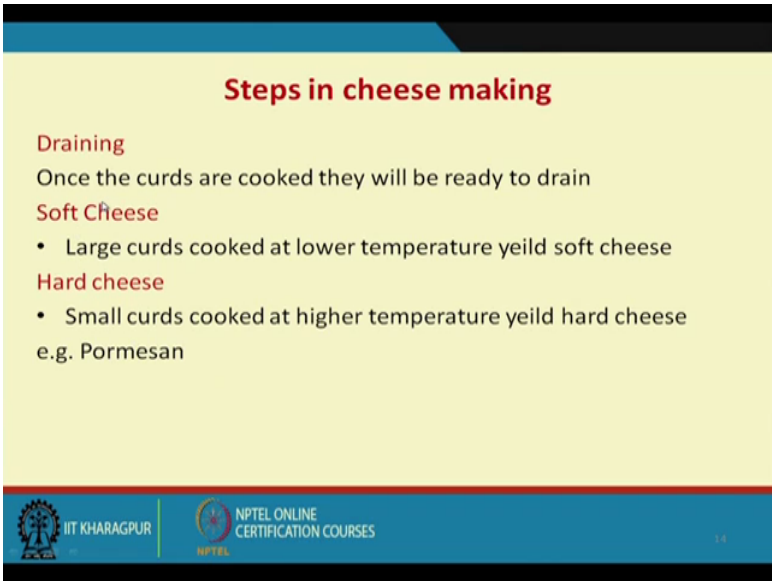

Now draining once the curd is cooked they will be ready to drain. Soft cheese that large large curds cooked at low temperature yield the soft cheese. Then hard curd hard cheese is the small curd cooked at high temperature which yield the hard cheese.

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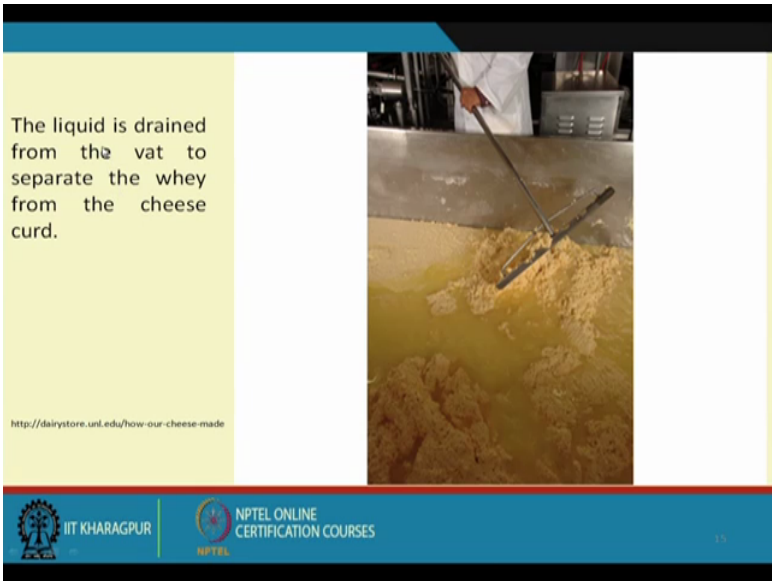

Now liquid that is you know this is now you can see the grain size here how the solid particles is separating out from this you can find out this liquid is drained that fat to separate the whey from the cheese curd you can see how it is this is the liquid and this is the solid that we have.

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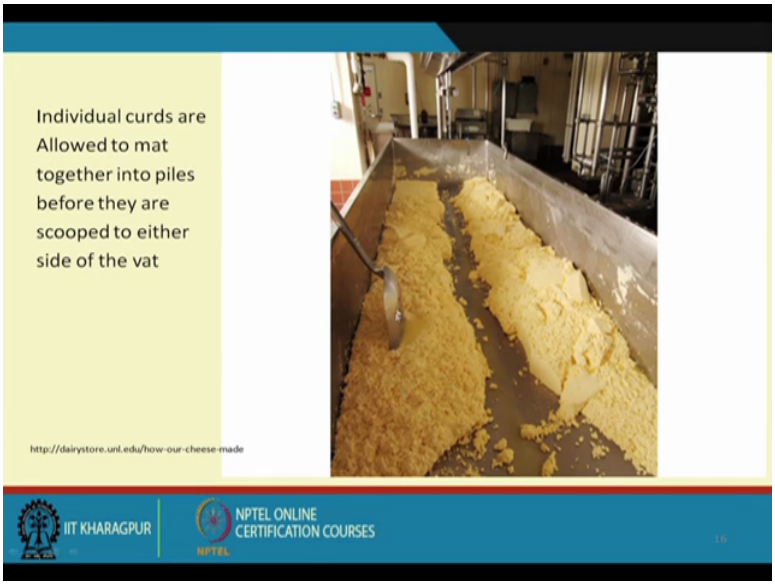

And this is individual curd is the finally it comes in this form is the solid form you can see this is the solid form it has come.

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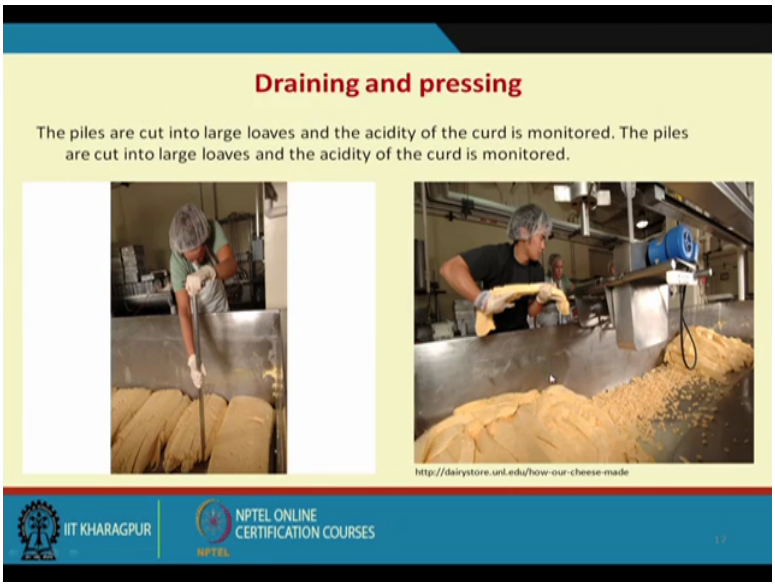

And then we can make it the piles are cut in the loaves and acidity of the curd is monitored because time to time we measured what is the acid concentration because it is very vital for the preservation of the milk protein and fat the piles are cut into large loaves and acidity of the curd is monitored. So this is this is very important this is you can easily find out how the cheese looks this is the we we we we we maintain different acidity and moisture as per our requirement.

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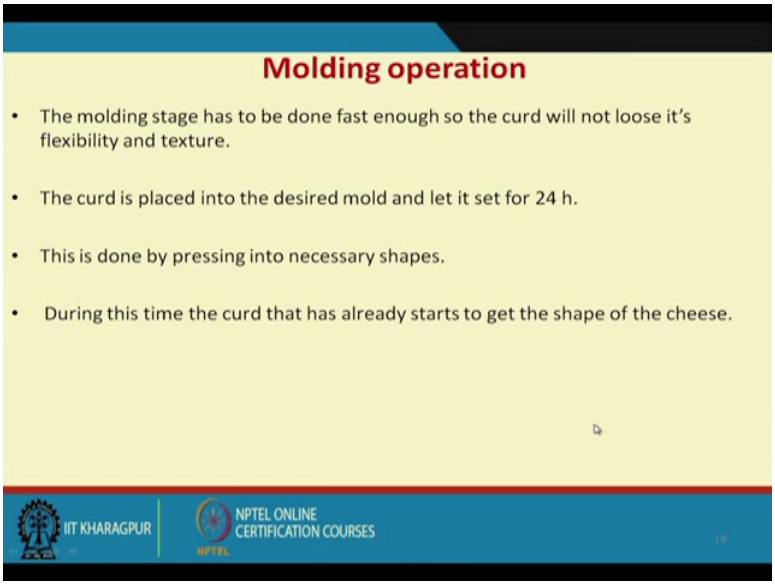

Now molding this is very important operation molding means u give different save to the cheese cheese you give different save and if that means you put the cheese in different moldes so that it comes out in different shapes. So it is like this the molding stage has to be done fast enough so that the curd will not loose its flexibility and texture you have to do very fast. Curd is placed into a desired mold so mold I do not have to tell what is called mold you know that.

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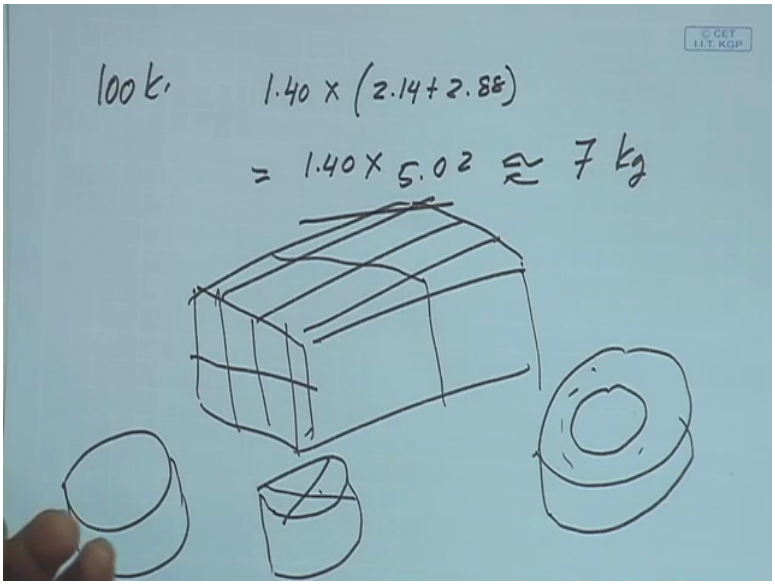

Suppose you have mold like this so so like this that so if u put the cheese here so you will get a circular type of what you call that cheese. If the mold is different if you have simple this kind of containers like of containers like this so you you will get the mold that cheese of this

size then you can cut is like this and sell it in the market, this is this is usually done. The curd is placed is in desired mold and and let is set for 24 hours.

And this is done by pressing into the necessary shape. During this time the curd has already start to get the shape of the cheese because this is very important.

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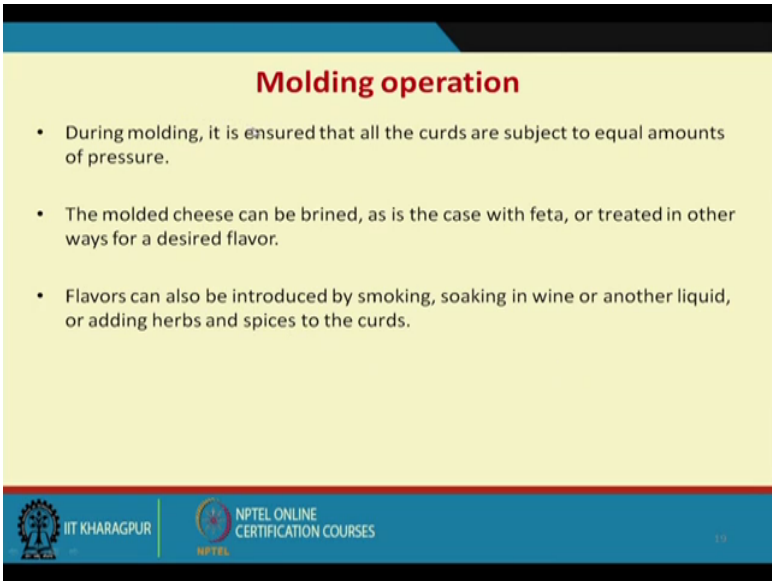

During molding it is ensured that curds are subject to equal amount of pressure. And molding cheese molded cheese can be brined we can put some kind of salt here as in the case of feta, or treated in other way for the desirable flavor because I told you some some cheese cheese we required some purposefully add some kind of colour to have a typical colour in the cheese I will show you later how it is done.

The flavour can also be introduced by smoking lot of people like the smoke flavour, soaking with wine or another liquid, or adding herbs because we had some herbs which has some medicinal value and spices to the curd. You know that it has it is to give you the different type of test.

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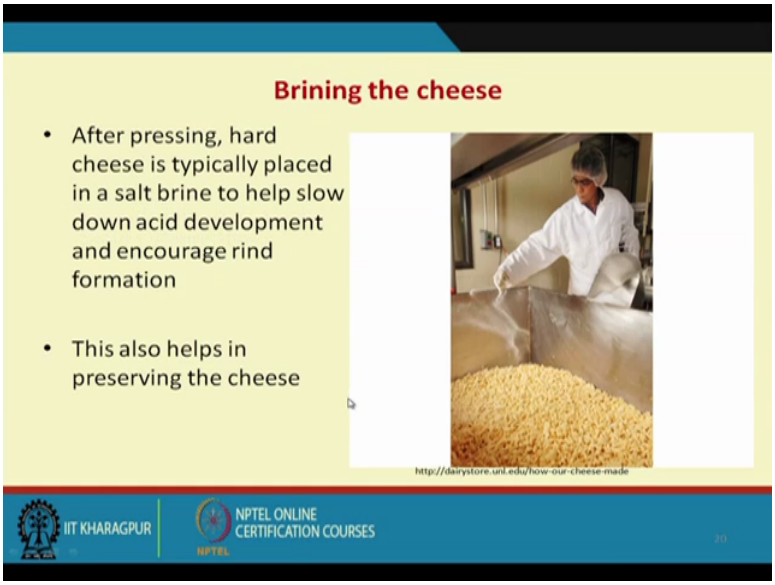

This is how different type of cheese is manufactured. The brining after pressing, hard cheese is typically placed in a salt brine to help slow down the acid development and encourage the rind form. Rind I told you rind mean hard structure because you know that if the structure of the cheese you know that upper upper structure of the cheese is hard then contamination problem will be less.

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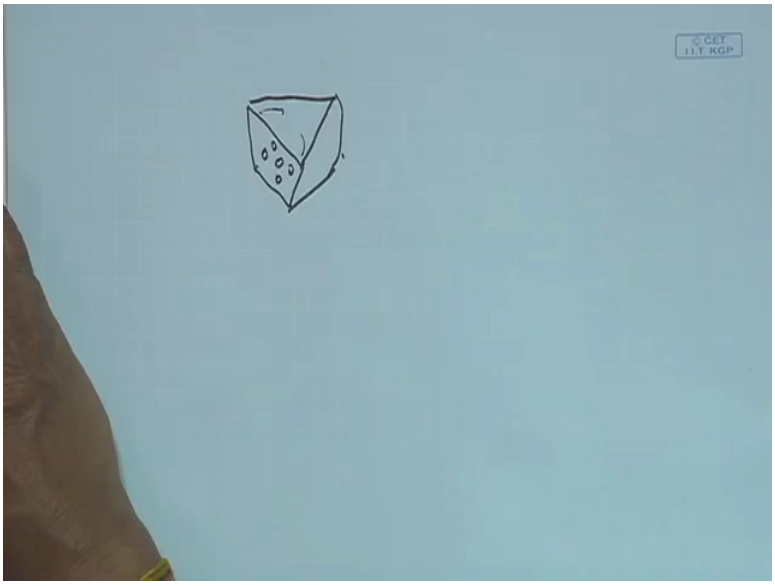

Suppose this is the kind of cheese we have, so if the structure is hard then the contamination problem will be less, so you know that is called rind. The rind is there development. So this is required this will help for preserving the cheese, this is the brining operation is very important as cheese making is concern.

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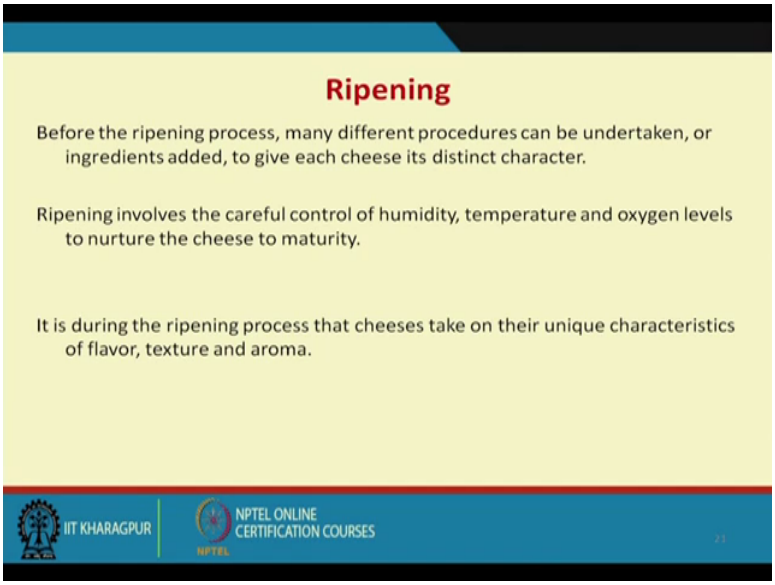

Then another operation is the ripening because in case of different wine and wine and other bear making industry I mentioned the maturating maturating of this process they pass through the ageing or maturation process and through the maturation process what is happening the acid the pre organic acid they in combination with alcohol they form the (())(16:21) and this is responsible for developing the good flavour and acid acid gives sometimes the hard flavour, so that is not desirable.

So that is why this is pass through the maturation process. Here similarly that the cheese we pass through the ripening process before ripening process many different procedures are taken I have mentioned already ingredients are added to give the cheese the distinct character we can add spices, we can add herbs, you can have wine, you can have brine whatever you can as per your requirement you can do that.

And then ripening involves careful control of humidity, temperature and oxygen level to nurture the cheese to maturity. It is during the ripening process that cheese checks the unique characteristics of flavour, texture and aroma because here also during this storing process the different type of chemical reaction that biochemical reaction will take place that improves the flavour and texture of the of the cheese this is why ripening is very important.

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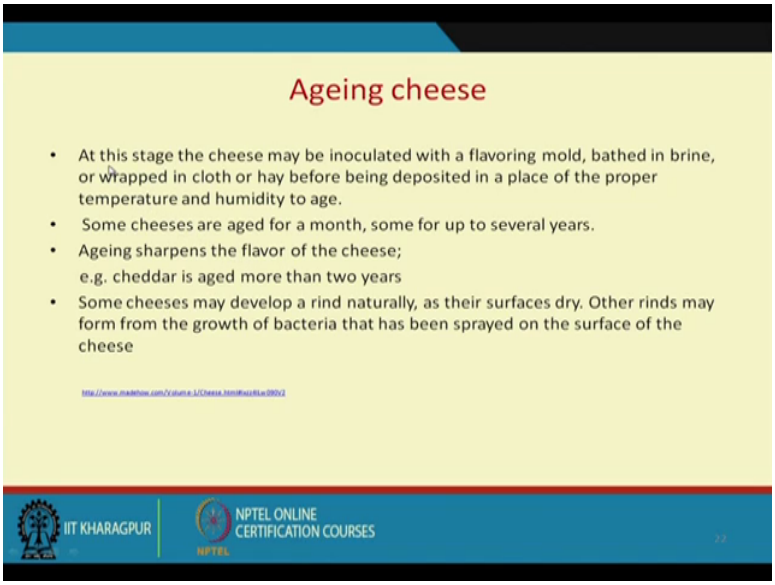

Ageing of cheese is also very important, this is at this stage the cheese may be inoculated with a flavouring mold, bathing brine, wrapping with cloth or hay before depositing in a place or proper temperature and humidity. Some cheeses are aged for months, some upto for several years. Ageing sharpen the flavour of the cheese, cheddar is aged more than two years. Some cheeses may develop a rind naturally as their surfaces dry I told you the rind means there is the process through which the surface of the cheese is little bit harder, so their contamination problem will be less. And other other rind may form due to the grown of bacteria that spray on the surface of the cheese.

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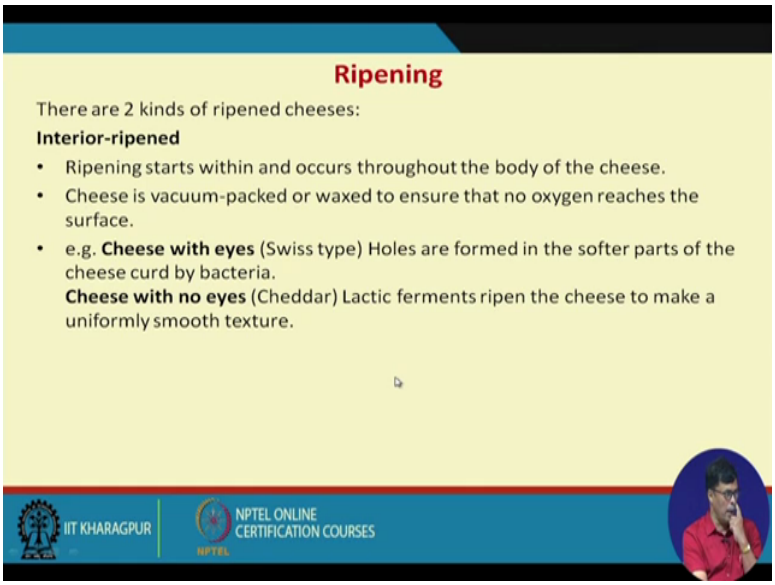

So the ripening may be done in of 2 kinds one is the interior ripening. The ripening start within and occurs throughout the body of the cheese, cheese is vacuumed packed in or waxed to ensure that no oxygen reaches the surface. So you might be here here I hope everybody knows that there is the important things is there happens to the food material that is called rancidity. Rancidity is kind of degradation of the fat molecules because fat when undergo rancidity it produce some kind of organic acid and you know that different organic acid they are responsible for developing different type of bad flavours that is undesirable that is usually take place in presence of oxygen.

So when you do the waxing that will give a kind of barrier for the oxygen to come in contact with the food material with the cheese material. So the rancidity of the cheese will be will be reduced, so possibility is reduced to a great extent. The cheese in vacuum packed and waxed to ensure that no oxygen reaches the surface. The cheese with eyes the Swiss type holes are formed in the soft part of the cheese curd by bacteria. Cheese with no eyes because inside the inside the cheese you will find some kind of hole, this is this is called eye this is eye of the cheese.

So this is not desirable so some cases cheddar should be uniformly smooth structured that it should be there.

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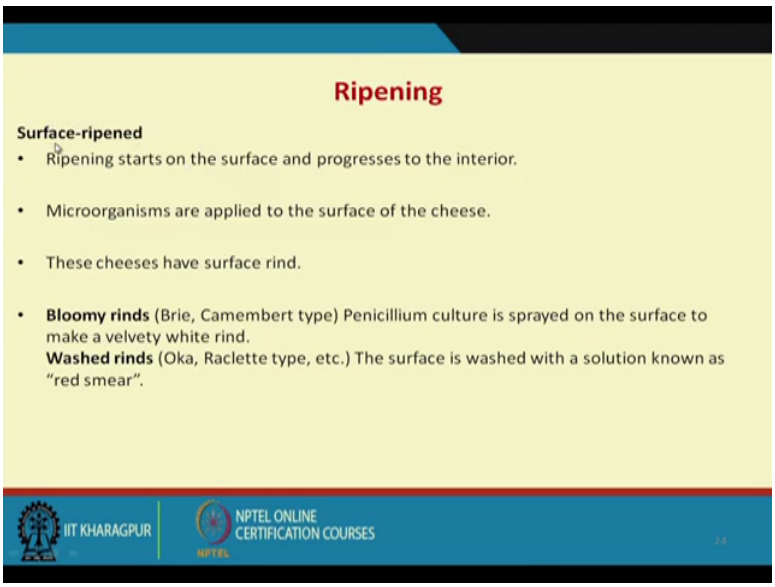

Now another is the surface ripening, ripening started on the surface the (())(20:10) the interior ripening means it ripening take place throughout the this cheese but in surface ripening it is taking place only on the surface and progresses to the interior. First it occurred at the surface

then to the interior part. Microorganisms are applied to the surface to the surface to the of the cheese and then cheese are surface rind.

The examples are bloomy rind and washed rinds, this is two type of rind we have this is occurred by using the penicillum culture is spread on the surface.

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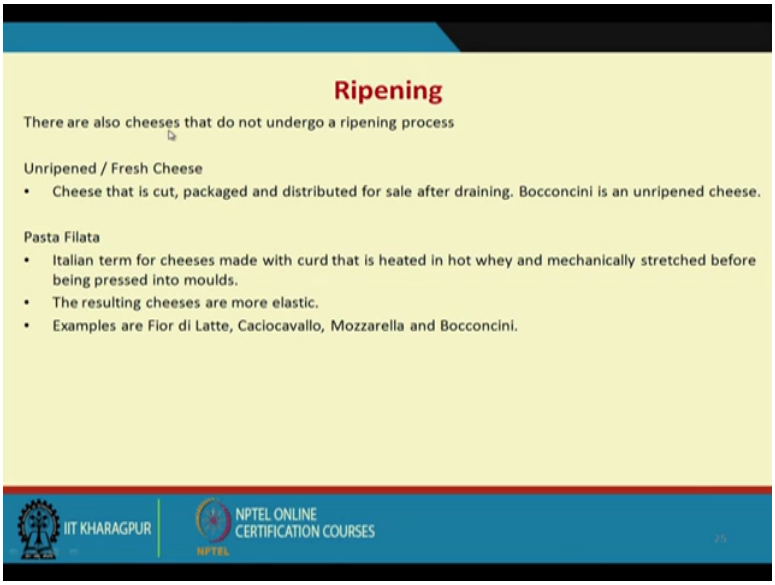

Then ripening there are also also cheeses which does not undergo ripening process what you called unripening or what you called fresh cheese fresh cheese that is cut and packaged and distributed for sale after the draining and Bocconini this is unripe cheese, I already discussed at the beginning of my lecture that what do you mean by fresh cheese in case of fresh cheese I I mentioned that high acid formation take place and due to high acid formation (())(21:24) the storability of the things is increases and it can directly goes to the market this is the unripe it does not go in the ripening process.

So in case of Pasta Filata this is Italian term of cheese made from the curd that is heated in hot whey and mechanically stretched before being pressed into mold. So the resulting cheese is more elastic, examples are the Fior di Latte, Caciocavallo, Mozzarella then Bocconini. This is Different type of cheese.

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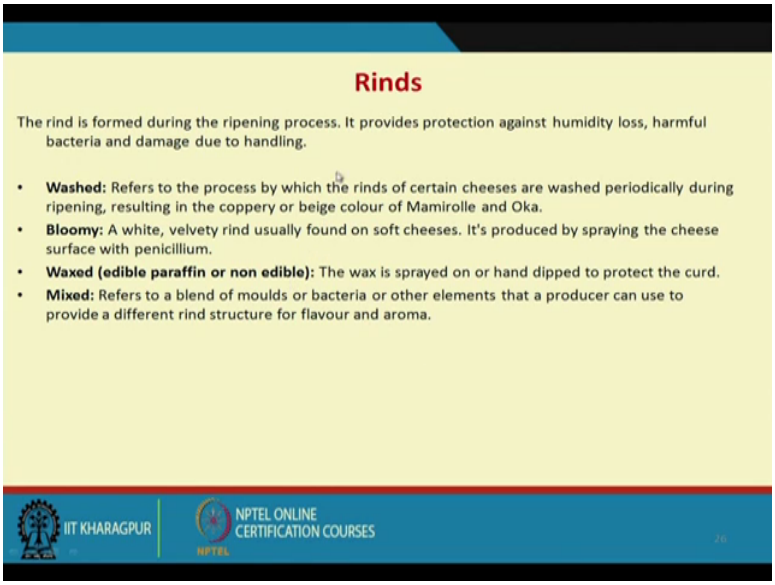

Rind there is solidification of the surface I told you it provides the protection against the humidity loss, harmful bacteria and damaged due to handling. So these are the different purpose whatever the rind operating is carried out one is washed referred to the process by this the rind of certain cheese are washed periodically during the ripening and resulting the coppery of beige colour of the Mamirolle and Oka.

Then Bloomy a white, velvety rind usually found in soft cheese, it is produced by spraying the cheese surface with penicillium. Waxed this is edible paraffin and non-edible both can be used but usually we prefer the edible paraffin, waxed spray on or hand dipped to protect the curd. Mixed we have referred to blend the mold of bacteria and other elements that produce can used and provide a different rind structure and flavour aroma.

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This is the this is the ageing of cheese you can see this is the cheese we keep it in the different rack, we can we can keep may be weeks to year one year you can keep and during this process some kind of chemical organization take place and develop different flavour, sharpness of the cheese that takes places.

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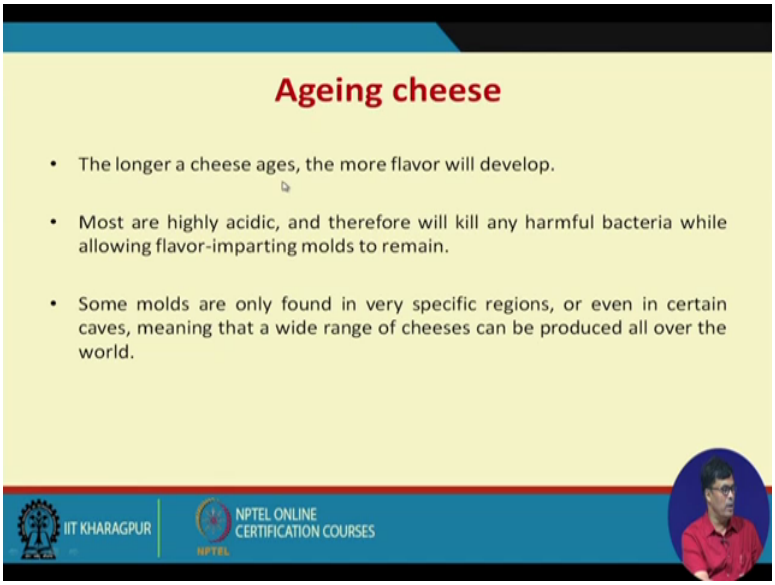

The ageing longer cheese is more flavour development, most most are highly acidic therefore will kill any harmful bacteria while along the flavour imparting mold to remain. Some mold are only found very specific region or even in certain caves meaning that wide range of cheeses can be produced all over the world that is that is the ageing of cheese that is very important.

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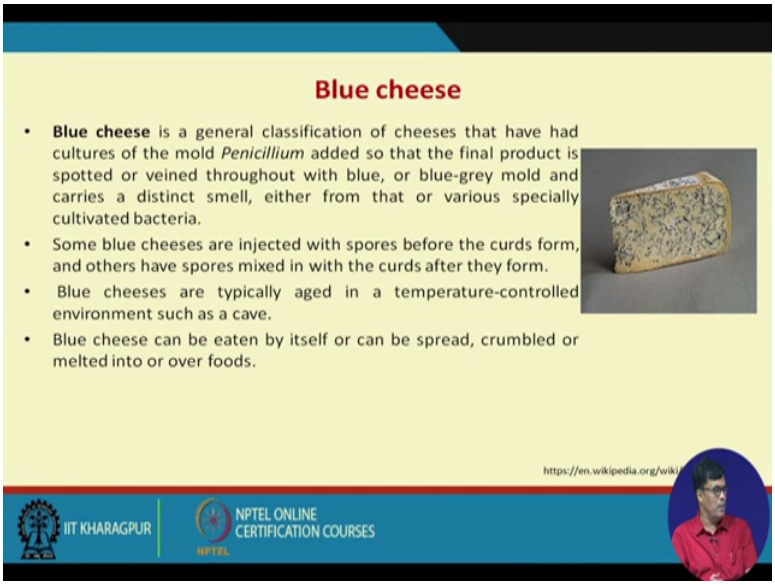

We I told you that different colour, different types of cheese I told you that one example is the blue cheese that blue cheese is generally you can see the see the structure of the cheese the lot of blue colour is there inside the cheese that is not perfectly you know or white the blue cheese is generally classified as the cheese that have the culture of mold penicillium we have little bit greenish colour the it gives some kind of bluish type of colour so that final product is spotted and veined throughout the blue or blue-grey mold and carrying the distinct smell, either from that or various type of cultivated bacteria.

Some some blue cheese are injected with spores before the curds are formed and other other spores mixed with the curd after the after they form. The blue cheeses are typically aged in a in a temperature controlled environment such as caves. The blue cheese can be eaten by yourself and can spread, crumbled and melted into or over the food.

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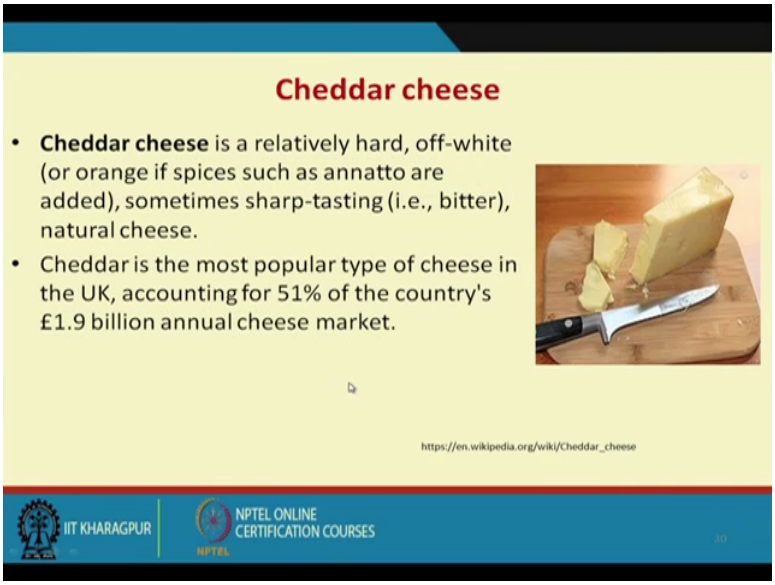

The other example similar example the cheddar that we have this is I told you this is very hard cheese, this is usually used in UK and this is they have very week market that is 1.9 million dollar million pounds that that world market that we have that the UK market that we have with the cheddar which looks like this, so it is largely used during the breakfast.

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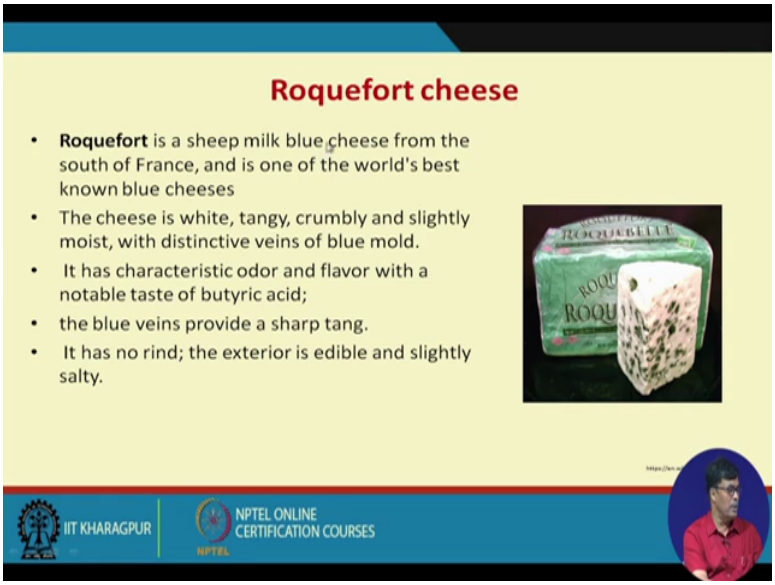

And this is the another another type of that cheese also largely used this is what you called Roquefort, this is the cheap as they produce from sheep milk blue cheese from that the south France south of France and is one of the most of the worlds best known blue cheese. And this cheese is white, tangy, crumbly and slightly moist with distinctive veins of blue molds. It has the characteristic order and flavour with a notable taste of butyric acid.

Then the blue veins provide a sharp tang and it has no rind hotness will not be there, exterior is edible and slightly salty. So this is this is this is the things that we have.

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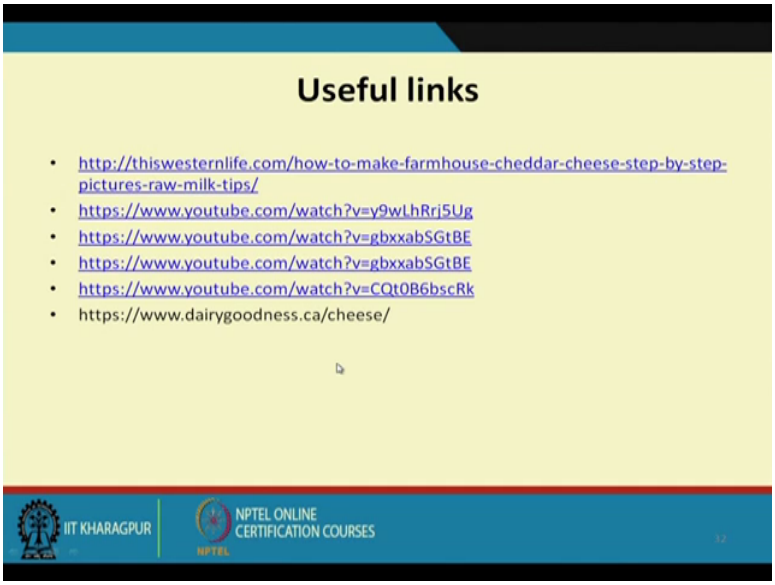

And there are several links we have if you visit this link you will get more information on the cheese making process and you will find this is very interesting. So in conclusion what I want to tell that cheese is a very important product nowadays as well biochemical industry or biotechnology industry is considered concern that cheese is largely available throughout the world and it is it is it is available in different types, different characteristic of cheese are there we have hot cheese, we have soft cheese, we have semi soft cheese, we have fresh cheese, we have process cheese.

As per our requirement we can use that and I can tell you particularly pizza is a common item that you use in the that is largely used by the by the people that is usually made from mozzarella cheese or you know other cheese also which has some kind of (())(28:00) that you know elastic property. So this that you know I told you the cheese making process depends on the water that milk quality, it depends on the the starter that we use, it depends on the enzymes the rennet that we use, it depends on the cooking temperature, it depends on the salting process.

So different type of ripening process rind that we have so different steps as different steps are involved, different processes are involved before we get the cheese final cheese product in the market. So the main purpose again I am telling you for the cheese making industry is to is to is to preserve the milk protein and fat for a longer period of time, so that because it is very

good it has very good nutritional value so for human food so that we can use for a longer period of time, not only that is a very good texture and flavour and test. So lot of people like this, with this I would like to conclude this cheese making process, thank you.