Dairy and Food Process & Products Technology

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Lecture - 45
Milk Pasteurization and Homogenization (Contd.)

So, we stop in this Dairy and Food Process and Products Technology that milk pasteurization and organization continuation class. So, there we have said that what are the steps required for pasteurization.

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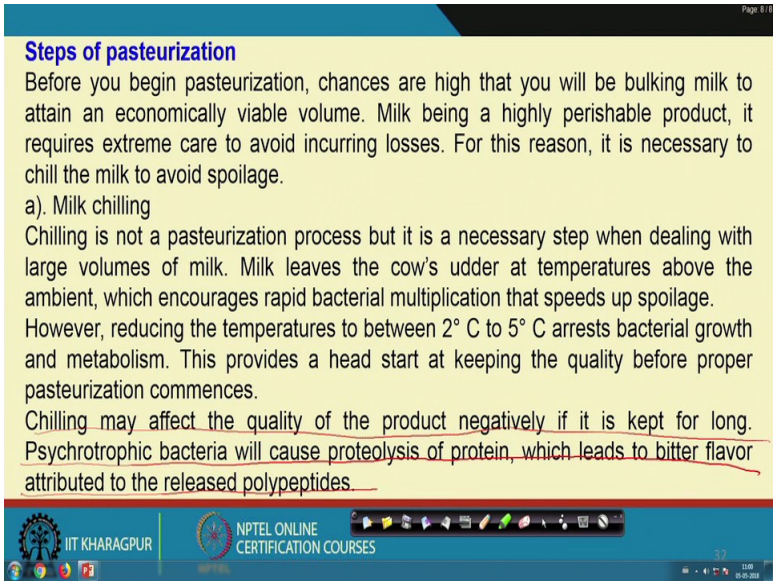

Now, will go quickly because our this 45th class, so 15 more classes already left. So, we cannot we cannot elaborate, so much though these slides will be with you. So, you can also go through, but I will not highlight, so much as we had been doing.

So, milk chilling that is one chilling is not a pasteurization process, but it is a necessary step when dealing with large volumes of milk. Milk leaves the cows under at temperature this is why required because this is pre-pasteurization steps, before beginning of the pasteurization you need to because what you are doing you are in the bulk. When you are getting from different places you are storing them in one place that is why chilling is a must, because already heating has not started pasteurization is the first process where you are heating is being done, but before that when you are a accumulating all milk from

1different sources. So, that that you have to keep them under chilled condition that is why 2chilling prior to your pasteurization is required right.

3So, that more I will not will not follow them right, so chilling may affect the quality of 4the product negatively if it is kept for a long time, because psychotrophic bacteria will 5cause proteolysis for protein which leads to bitter flavor attributed to the released 6polypeptides right; that means, that you thought you will bring all milk from different 7places and then after couple of days you will start doing that processing of pasteurization 8not at all encourage able, because I said earlier that there are three types of bacteria that 9is psychrophilic, mesophilic and thermophilic.

10So, when you are chilling psychrophiles will be there, so they may act on the proteins 11and rest and may contribute to bad flavor odor color etcetera all negative. So, that is not 12desirable, so chilling you do chill, but not for a long time; so, that that those organisms 13can grow and act on your product right. So, this is one very vital step you have to 14remember or keep in mind right.

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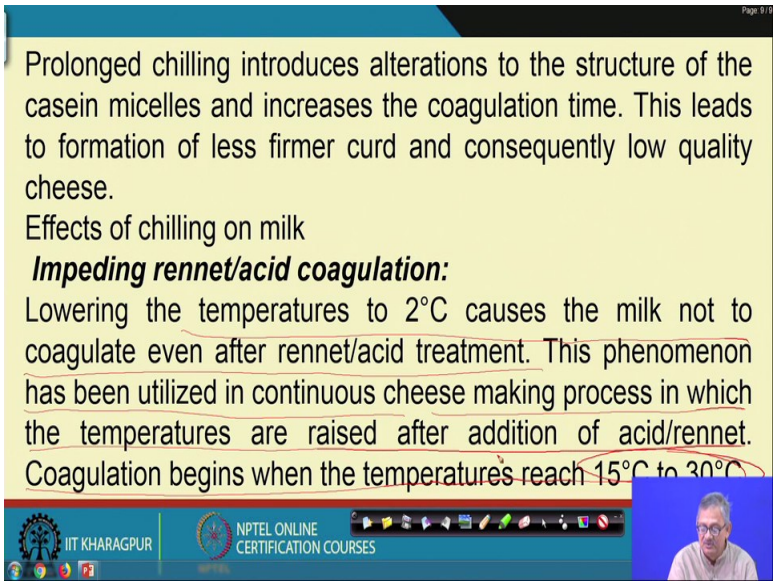

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17Then prolonged chilling introduces alterations to the structure of the casein micelles and 18increases the coagulation time. Now, effect of chilling on milk what are their impeding 19rennet acid coagulation.

So, lowering the temperature to 2°C causes the milk not to coagulate even after rennet acid treatment. So, even is too cold then even if you do rennet that is one type of enzyme available in the in the calf your that in the calf belly from there it is coming stomach of the calf it is coming and or rennet or other coagulant like your lactic acid producing organisms even then they are or even if you directly put acid they are not. So, good to separate the fat, protein that is channa. So, very low temperature is also not desirable for different purposes.

So, this phenomenon has been utilized continuous cheese making process in which the temperatures are raised after addition of the acid coagulated big and that begins when the temperature reaches around 15 to 30°C that is one application right.

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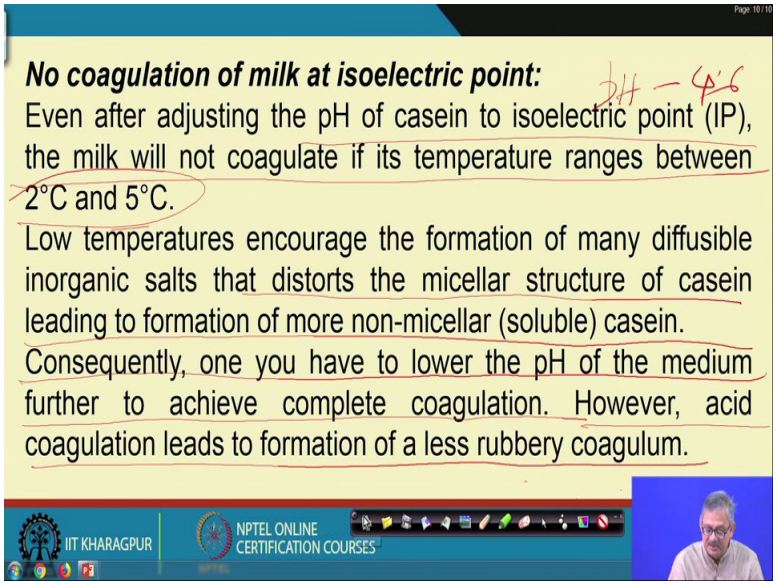

Then no coagulation of milk is at isoelectric point, so even after adjusting the pH of casein, casein to isoelectric point the milk will not coagulate if the temperature ranges between 2 to 5°C. So, you have brought down the pH 4.6, that is the isoelectric point, but even then coagulation is not taking place, so that is the bad part of the chilled right.

The best example at home you ask your mummy that when you are making channa, if the milk was in the freezer, I do not say that in the deep freezer if the milk was in the freezer which is in good condition and if the temperature is too low. Then if whether she had put any time any acid like maybe generally at home you acid citric acid that is the cite coming from even orange or lemon and coming from the lemon. So, that citric acid is

1added whether coagulation took place or not to ask and most of the time she will say no 2she prefers, before adding to heat that milk and bring it to the certain temperature and 3then add then only coagulation takes place. So, this is a negative part of the too cold.

4Low temperature can encourage the formation of many diffusible inorganic salts that 5distorts the micellar structure of the casein leading to formation of more micellar or 6soluble casein. Consequently, one you have to lower the pH of the medium further to 7achieve complete coagulation. However, acid coagulation leads to formation of a less 8rubbery coagulum right.

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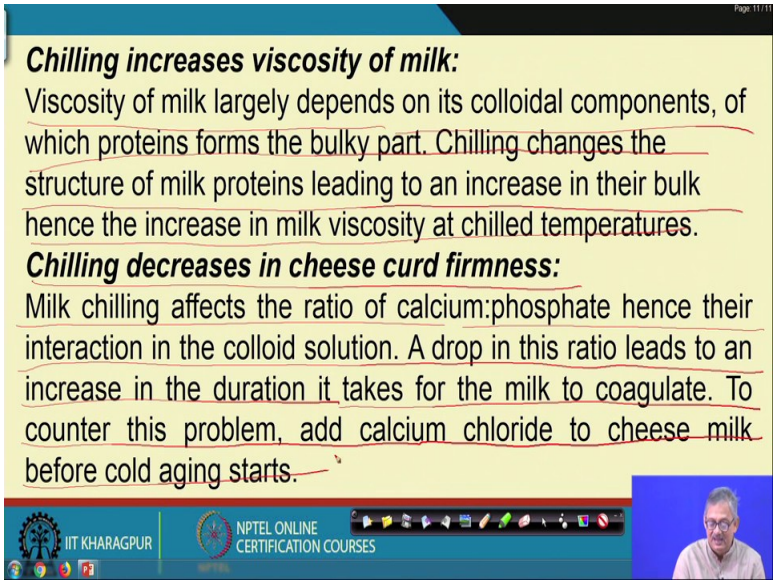

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11We are moving fast because chilling increases viscosity of milk that is true this is more 12prominent when you will understand much when your ice cream mix is being chilled 13after pasteurize homogenized and aged, for couple of hours to increase the viscosity. So, 14when you go to ice cream hopefully we will deal with better or in a bigger way right.

15So, viscosity of milk largely depends on its colloidal components of which proteins 16forms the bulk part chilling, changes the structure of the milk proteins leading to an 17increase in their bulk, hence the increase in milk viscosity at chilled temperatures 18chilling decreases the curd firmness, cheese curd firmness. So, that is another 19disadvantage right, so milk chilling affects the ratio of calcium to phosphate, hence their 20interaction in the colloid solution a drop in this ratio leads to an increase in the duration it

1takes for milk to coagulate to encounter this problem and add calcium chloride to cheese 2milk before cold aging starts right.

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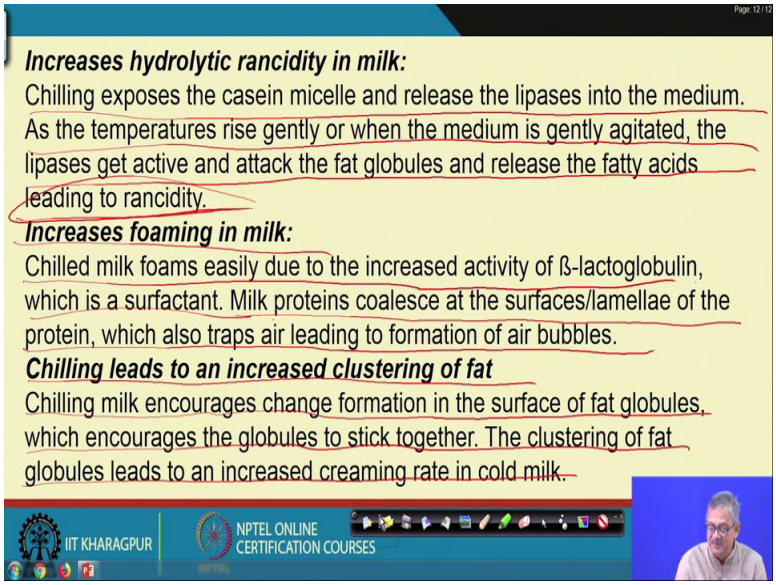

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5Then increases hydrolytic rancidity in milk chilling, chilling exposes the casein micelle 6and releases the lipases into the medium as the temperature rise gently or when the 7medium is gently agitated the lipases get active and attack the fat globules and release 8the fatty acids leading to rancidity, so that is also bad.

9Increased foaming in milk chilled milk foams easily due to the increased activity of the 10beta lactoglobulin. Which is a surfactant and milk protein coalesce add the surface or 11lamellae of the protein which also traps air leading to formation of air bubbles. Then 12chilling leads to an increased clustering of a of fat, chilling milk encourages change 13formation in the surface of the fat globules which encourages the globules to stick 14together the clustering of fat globules is leads to an increased creaming rate in cold milk.

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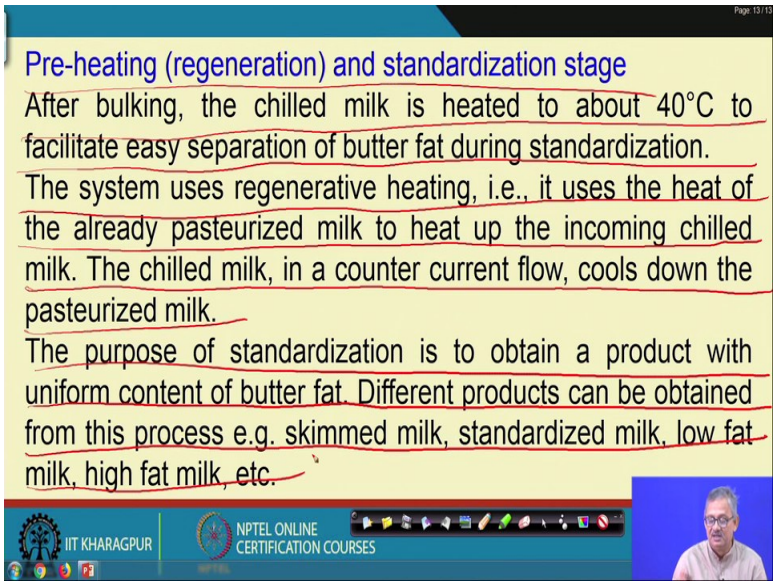

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3Pre-heating or regeneration this is another, but so chilling part we have finished that pre 4chilling if it is too cold if it is for longer period what is the bad effect those we are dealt 5with right. Now, I go to pre heating you remember we have said that in most of the most 6of the pasteurizers commercial. The pasteurizer because pasteurization what do you are 7doing you are heating. So, when you are heating and after eating you are cooling them 8sharply. So, if you are doing that, so you are then heating and cooling simultaneously.

9So, lot of lot of energy you are employing to overcome this if you can utilize that you are 10you just said that you have you have accumulated from different sources milk and this 11milk when you are pasteurizing heating before that you have chilled. So, that temperature 12is low, so before it is going to pasteurizer if this temperature could be used by the heat 13exchange that is called regeneration by regional heating, because already pasteurized 14milk that can act as a pre heater for this chilled milk that is what here we are doing.

15So, pre heating pre heating and standardization stage, after bulking the chilled milk is 16heated to about 40 degree centigrade to facilated easy separation of butter fat during 17standardization. The system uses regenerative of heating, that is it uses the heat of the 18already pasteurized milk to heat of the inoculum or incoming rather incoming chilled 19milk, the chilled milk in a counter current flow cools down in the pasteurized milk, 20purpose of the standardization is to obtain product with uniform constituent of butter fat

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1different products can be obtained from this process for example, skim milk, 2standardized milk, low fat milk, high fat milk etcetera right.

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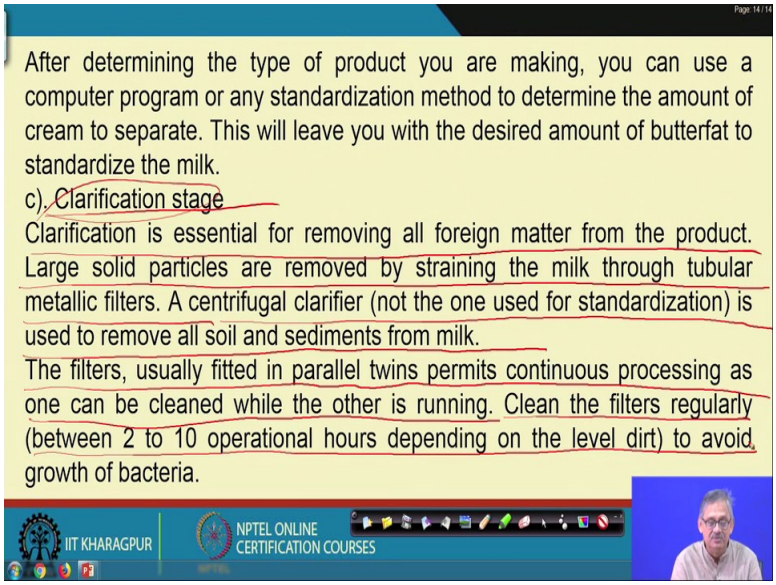

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5Then after doing this pre heating or regeneration you are going to after determining the 6type of product you are making, you can use a computer program or any standardization 7method to determine the amount of cream separation or amount of cream to be separated, 8or to separate this will leave you with the desired amount of butter fat to standardize 9milk.

10Then this step comes in is the clarification right, clarification stage because if you are not 11clarifying the milk that if it contains some undesirable things which are visible or which 12you can fill, so that has to be separated. So, that is done under this segment that is 13clarification stage. So, in this what you are doing clarification is essential for removing 14all foreign matter from the product large solid particles are removed by straining the milk 15through tubular metallic filters a centrifugal separator also or clarifier not the one used 16for standardization is used to remove all an all soil and sediments from the milk.

17The filters usually fitted in parallel twins permits continuous processing as one can be 18cleaned while the other running. So, that is the use ease, so one both are in parallel. So, 19one it is running and another is being cleaned and another is running the former one is 20being cleaned, so that is when clean one.

1So, clean the filters regularly between 2 to 10 operation hours depending on the level of 2that relevant encountered to avoid growth of the organisms. So, otherwise if you are not 3cleaning then what will happen this milk which was residing inside? So, that will be a 4very good source of the organisms to grow. So, that may contaminate that may 5unnecessarily add the microbial population or microbial load to the milk right that is not 6desirable.

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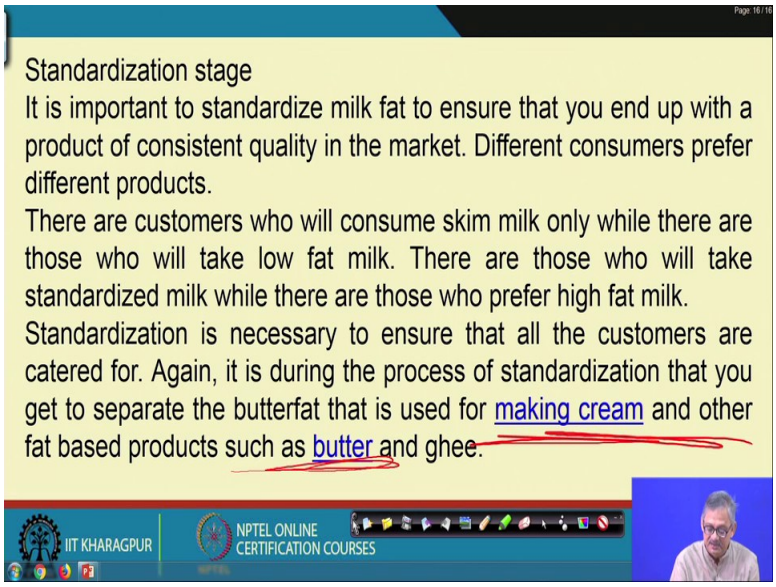

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9Then after this perhaps you are going to standardize, now standardization is a process 10which is in most of the cases in commercial food, commercial milk is required because 11unless you standardize because you remember you are got from the different sources 12different milk.

13So, they content different quantities of fat, protein or SNF all these. So, if you are adding 14them then you can never be sure that what is the your final constituent. So, after adding 15you must know what is the composition and then you already have decided, I will sell I 16will sell market with this that is this quantity of fat, this quantity of solid not fat etcetera. 17So, that is standardize, so that is why standardization is a must.

18So, it is important to standardize milk fat to ensure that you end up with a product of 19persistent quality in the market different consumers prefer different products there are 20customers who will consume skim milk only while there are some who will take low fat

1milk, there are those who will take standardized milk while there are those who prefer 2high fat milk.

3So, lot of variety of customers you have to handle that is why standardization is must 4with respect to their product, standardization is necessary to ensure that all the customers 5are created all the customers are catered for again it is during the process of 6standardization that you get to separate the butter fat that is used for making cream right. 7So, cream making you are using separation of the fat and other fat based products such as 8butter right and ghee for that you separate fat if you are making skim milk. So, this fat 9you can use for butter making for making cream etcetera right.

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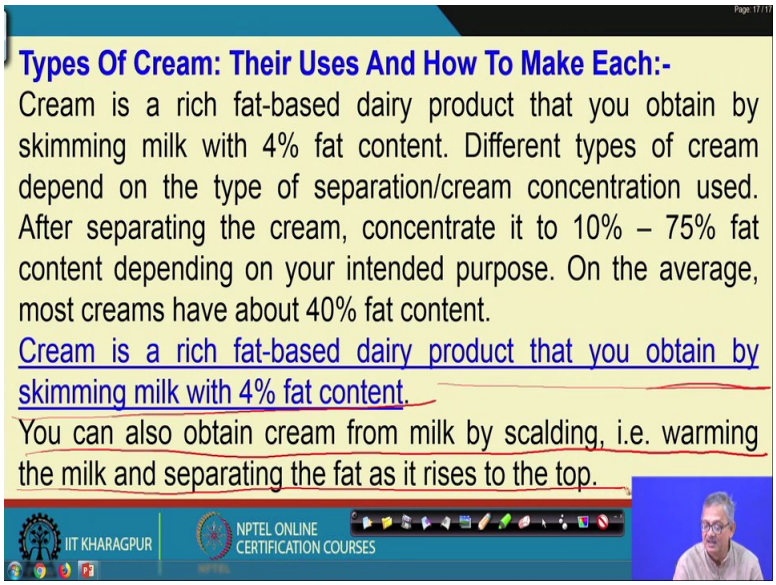

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12So, it comes to the level of standardization, types of cream there are different types of 13creams their use and how to make each of them cream is a rich fat based dairy product 14that you obtain by skimming milk with 4% fat content. Different types of cream depend 15on the types of separation or cream concentration used after separating the cream 16concentrate it to 10% to 75% fat content depending on your intended purpose.

17On the average most cream have above 40% fat content. Cream is a rich fat based dairy 18product that you obtained skimming milk with 4% fat content you can also obtain cream 19from milk by scalding that is warming the milk and separating the fat it raises to the top.

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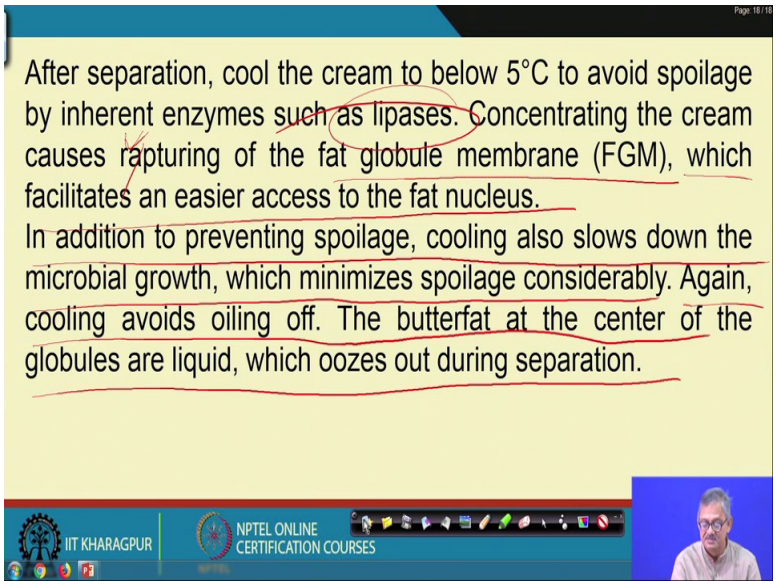

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3Then after separation cool the cream to below 5°C to avoid spoilage by inherent such as 4lipases concentrating the cream causes rupturing of the fat globule membrane or FGM 5which facilitates an easy access to the fat nucleus.

6So, lipase enzyme will be there, so you have to protect against that in addition to 7preventing spoilage cooling also slows down the microbial growth, which minimizes 8spoilage considerably again cooling avoids oiling of the butter fat at the center of the 9globules are liquid, which oozes out during separation.

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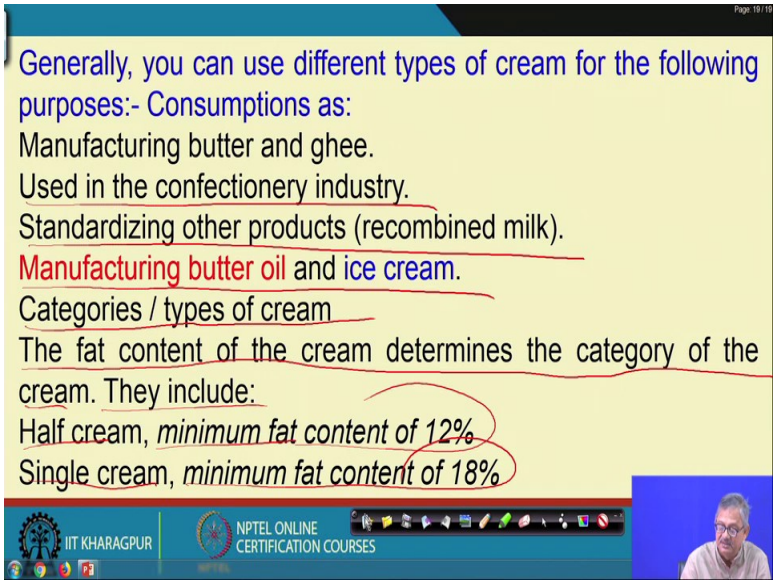

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1Generally, you can use different types of cream for the following purposes, like 2consumptions depending on that manufacturing of the butter and ghee you can use the fat 3.Used in the confectionary industry that fat standardizing other products that is 4recombined milk, manufacturing butter oil and ice cream you need fat or cream, 5categories or types of cream there are different types which you are said earlier also.

6Fat content of the cream that determines the category of the cream this includes half 7cream minimum fat content of about 12%, single cream minimum fat content of about 818% the then.

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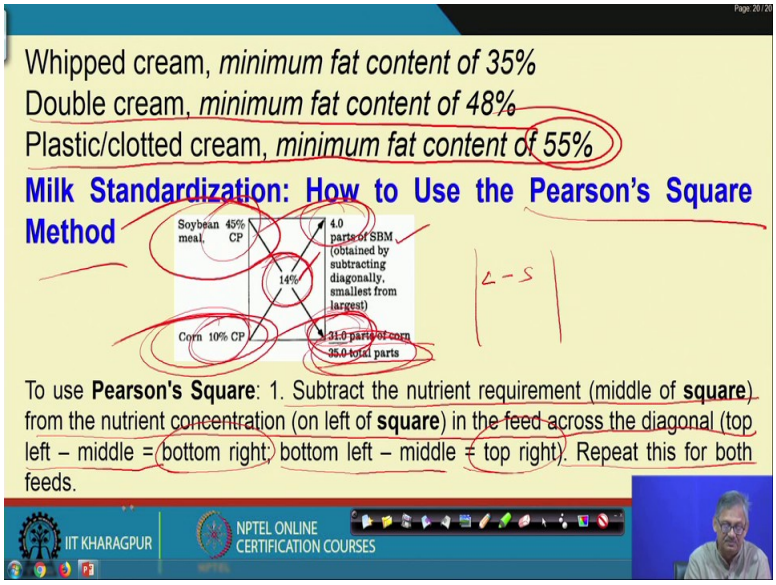

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11Whipped cream minimum fat content around 35%, then double cream minimum fat 12content of around 48%, plastic or clotted cream where minimum fat content is around 1355%, already earlier also you had given.

14Now, when you come to standardization there is there was a unique system developed by 15the by scientist called Pearson. And this method was used before calculate another thing 16schema this was very much useful in the in the in the dairy industry, because they did not 17have calculators like today you just go back to 3 decades 4 decades or 2, and half 2 4 18decades, during that period or earlier to that calculators were not there. So, that time 19people use to use it very effectively this is this you also should know that is how this 20standardized, so this call Pearson square method right.

1So, if you have say soybean milk having 45% right, and your corn around 10%%, cream 2in both the cases. So, 45% soybean meal with 45%, cream and 10% corn cream. If you 3are adding then how much you need to add you know that your finished product should 4have 14% right.

5So, 45 minus 14 is 31 and 14 minus 10 is 4, this is the product which you need the parts 6of that soybean milk and that is obtained by subtracting diagonally smallest from the 7largest this is simply just called mod right. So, the difference between the larger one 8minus the smaller one right value, value wise.

9So, and here also 35 minus 14 that is 31, So 31% of corn right your adding, you are 10adding getting 35 percent by 35 plus total you are getting right 35 percent total you are 11getting and you can say that four parts of 45 percent soya bean cream and 31 parts of 10 12percent corn cream, if you are adding then you get 35 parts of 14% cream of the from the 13two right.

14So, to use Pearson's square 1 is subtract the nutrient requirement middle of the square 15from the nutrient concentration on the left of the square in the feed across the diagonal 16top left minus milk that is the bottom right and bottom left minus middle that is the top 17right. So, repeat this for both feeds right this is the unique one which was developed by 18Pearson right.

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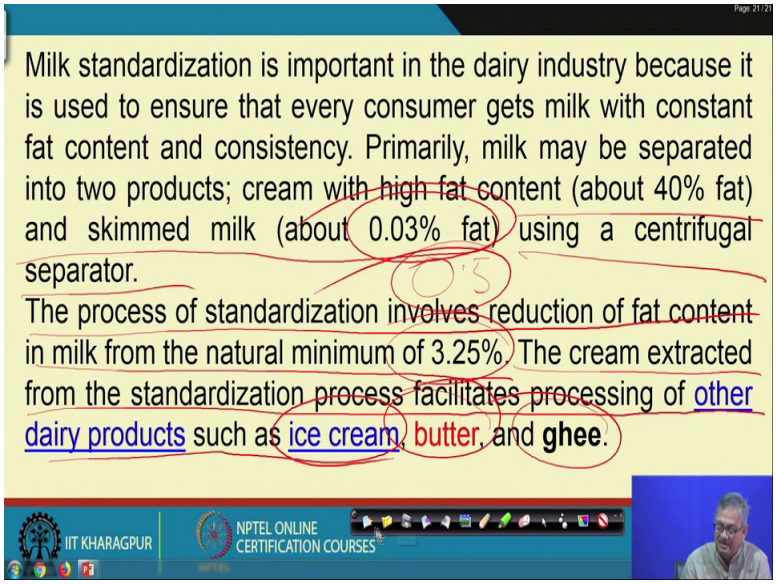

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1Then milk standardization is important in the dairy industry because it is used to ensure 2that every consumer gets milk with constant fat content and consistency primarily and 3consistency primarily milk may be separated into two products, that is cream with high 4fat content about 40% fat.

5And about 40% fat and skimmed milk about 0.03% fat, this can be 0.32-0.5, even 0.5% 6fat we also call to be skimmed milk using a centrifugal separator. This will come the 7process of standardization involves reduction of fat content of milk from the natural 8minimum of 3.25%, the cream extracted from the standardization process facilitates 9processing of other dairy products such as ice cream, butter and ghee right.

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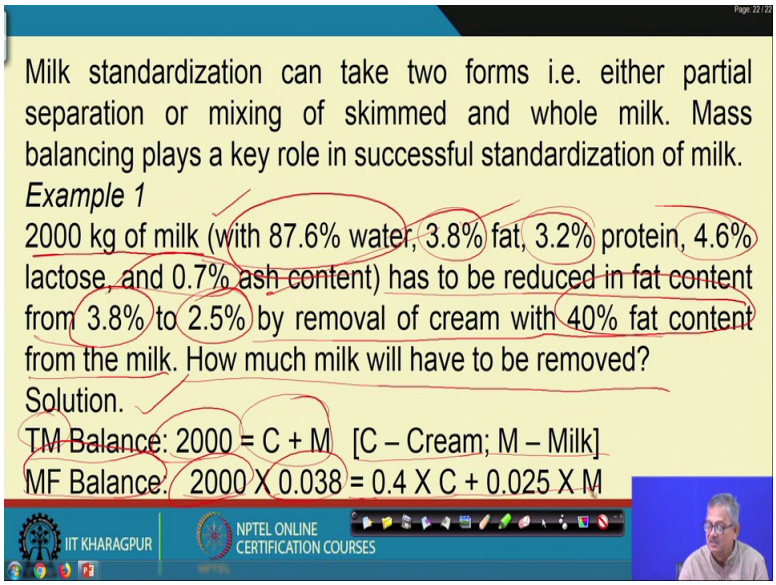

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12So, milk standardization can take two form that is either partial separation or mixing of 13skimmed and whole milk mass balance plays a key role in successful standardization of 14milk right. So, we can we can do a small example that that if you take 2000 kg of milk 15with 87%, 87.6% water, 3.8% fat, 3.2%, 4.6% lactose and 0.7% ash content this is one 16has to be reduced in fat content from 3.8%, which was there to 2.5% by removal of 17cream with 40% fat content from the milk, how much milk will have to be removed 18right.

19So, this can be done simply by the by mass balance that TM balance:2000=C+M Where 20C stands for cream and M stands for milk, MF balance: 2000×0.038=04XC+0.025×M.

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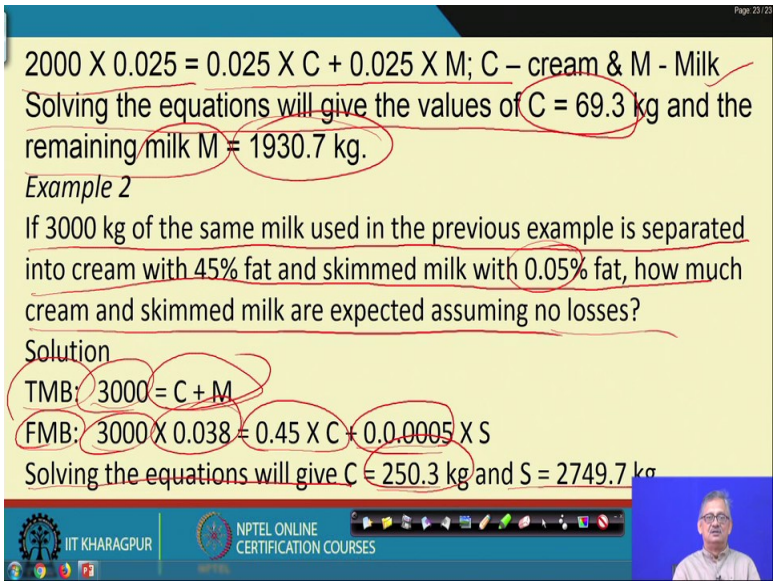

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3So, if we add if we you solve this then we get 2000×0.025 = 0.025×C+0.025×M right of 4course, C for cream name for milk which you have already said. Solving this equation 5will get C=69.3 kg and remaining M=1930.7 kg right. This is one example and another 6example let us do very quickly, so that our time is utilized.

7If 3000 kg of same milk is used in the previous example is separated into cream with 45 8percent fats and skimmed milk without with 0.05 percent fat, how much cream and 9skimmed milk are expected assuming no losses? Again total milk balance, if you do 3000 10was C plus M that is cream plus milk FMB, that is if we do that fat balance right milk fat 11balance that is 3000 into 0.038 is equals to 0.45 C plus 0.0005 S right. Now, solving the 12equation will give C is equals to 250.3 kg and S equals to 2 point 2749.7 kg right. So, 13like that we can do by simple mass balance this also can be done with the Pearson square 14method, right to do with Pearson square method you will get the same right.

15So, let us stop today here because time is over we will then come to the next class thank 16you.

17Thank you.