Dairy and Food Process & Products Technology
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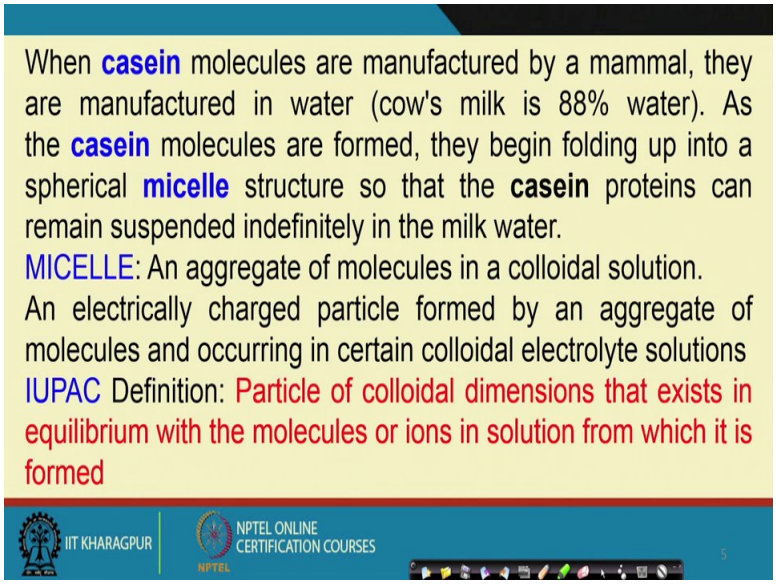
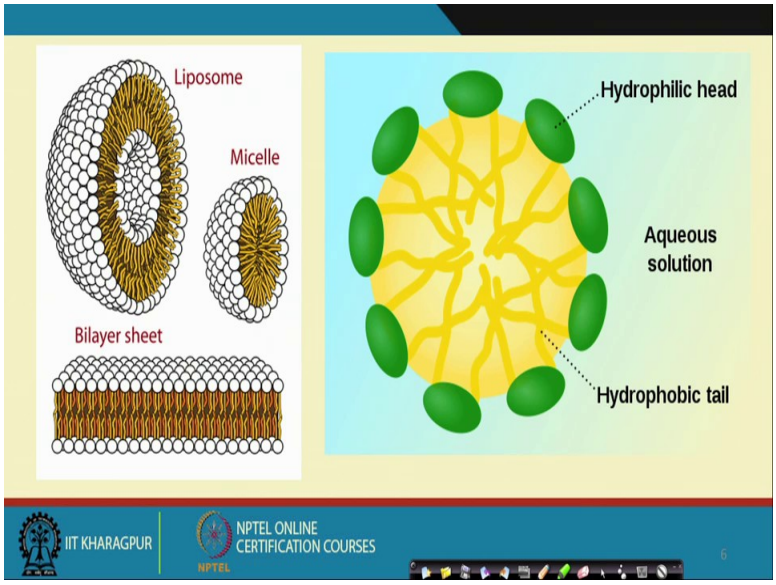
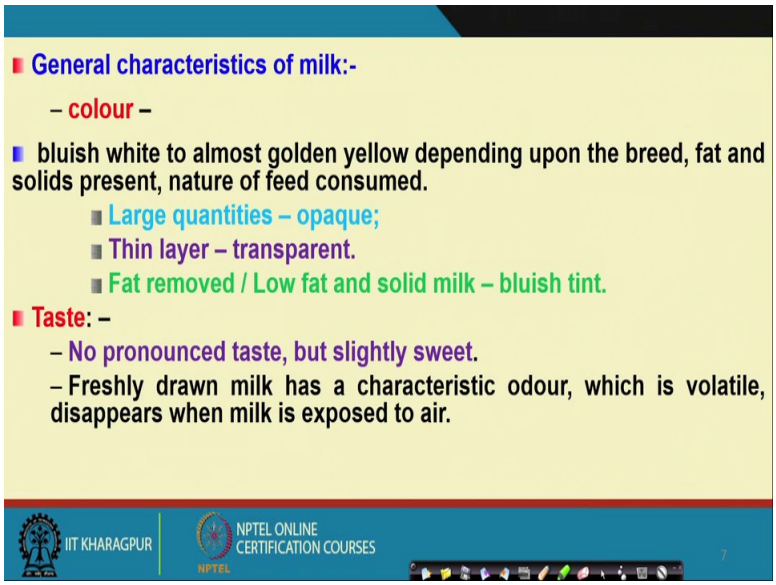
Lecture - 18
Milk - How it looks?

So in the previous class, we have said about how you can identify the constituents of milk, but primarily fat, protein, and carbohydrate right. I have never said that you can measure like that you can identify, identification and measurement are altogether different right. Generally fat in milk is identified and also measured by the method called Gerber centrifuge method, but these will come afterwards as and when it appears.

So in this class again we are in the Dairy and Food Process and Products Technology, and in lecture number 18, we come to milk how it looks like right, how it looks like we have already said that this colour of the milk which we have all said that this is blue in colour, and maybe white in colour, maybe a little golden yellow in colour, depending on the source depending on the constituents.







Primarily, if it is defatted milk, then it may be used your bluish tint, may be there or things like that, but if it is high fat milk then it could be your golden yellow colour also we said that if it is thin in quantity, then it may appear to be translucent or transparent, or if it is huge in quantity large in quantity, then it becomes opaque right. This opaqueness or is of course, because of the lights scattering through the different particles of the milk right.

Then we come to taste, so no pronounced taste but slightly sweet, there is no as such pronounced taste, but it is likely sweet. Freshly drawn milk has a characteristic odour, which is volatile and disappears when milk is exposed to air right. As a characteristics milk has a characteristics odour right, and the other day we had also said that how when

we were saying about quality, how odour and flavor this distinction we had made right we are not bringing back to those again.

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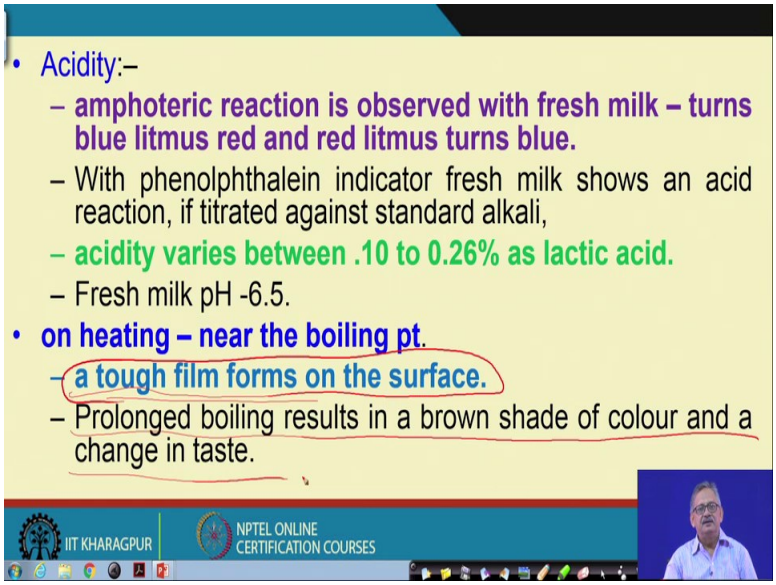


So it disappears when it is exposed to air right, now in terms of acidity milk is normally amphoteric in nature. The amphoteric means what is amphoteric? Amphoteric is that which gives both red and blue litmus, it turns both red and blue litmus into either red to blue, blue to red that it turns both the litmus paper right. So in that case we can say that it is amphoteric, that it is having both acidic as well as alkaline behavior, but by and large generally milk is acidic in nature for many of the reasons. If it is freshly drawn milk, then also it appears to be slightly acidic very rarely you will get that it is amphoteric or alkaline in nature that is very very rarely in typical case it may appear, but by and large it is turning or it is acidic in nature right.

So blue to red, red to blue both are possible theoretically, but again in all practical purposes we call it to be slightly acidic in nature right. With phenolphthalein indicator fresh milk shows an acid reaction if titrated against standard alkali. Now as we said just now that though we call it to be amphoteric, but in all practical purposes even if we put little; I understand we know that acid base reactions. So in that phenolphthalein is given as indicator and if phenolphthalein indicator is given and if we titrate we spied it to be acidic in nature right.

So acidity varies between 0.1 to 0.26 percent in terms of lactic acid right. So point 0.1 to 0.26 percent in terms of lactic acid. So when we will progress in this topic in this subject, so we will see that there are various reasons why the acidity will go up right why the acidity will go up or goes up why it becomes more acidic gradually that we will come up afterwards, but generally freshly drawn milk has acidity to the tune of 0.1 to 0.26 percent of acid in terms of lactic acid.

Now why it is said in terms of lactic acid, why not in terms of citric acid, or any other acid because milk contains lactose, that we have seen and this lactose by bacterial decomposition it produces lactic acid right. Since, it produces lactic acid so that is why the acidity in milk is expressed in terms of lactic acid.

So 0.1 to 0.26 percent lactic acid or in terms of lactic acid is normally present in milk, that is why if the acidity is low we call it to be a good milk, if the acidity goes up maybe that milk might not have gone wrong. Wrong why we are saying, we are coming to that wrong means there will be a precipitation. So which we have seen we have said the other day for identification that you have put some acid and something has come out. So that may happen if the acidity goes up right.

So that is why it is not desirable that the acidity of milk is high right, normally freshly drawn milk has low acidity around 0.1 up to 0.26 it is said acceptable, beyond that it may not be because then there are many other tests by which this acidity also can be that is called platform test. Someday we will also tell that right someday sometime in some period, we will also tell that there are some platform test right. I still remember like the other day, I said I was in some industry there are lot of milk used to come and the quality control people used to may access them because they have to did and tell whether it is good or bad right.

So they used to take it, consume it and orally they used to test which is not a of course scientific, but you just cannot do it you imagine room full of milk containers and in 2-5 minutes you have to either tell them yes if they will go in or they have to thrown out or discarded. So that decision has to be given, then which may not be possible for any such test by which they can or they used to do it which I objected but however this is what is the reality in industry. Of course I am not saying that that is bad part of the industry, but people who are working they have to survive they have to also tell they have to decide on

work right, if it is to be totally on scientific basis then it will take lot of time and the way things are coming it is not possible to handle in very short period. So they used to have. So that is what the test because the acidity you can also tell you can you our taste buds can tell whether one food is bitter, or sour, or sweet, or salty, this taste buds we have and we can identify very easily that is why they might have been using their taste bud for contouring or for measuring this.

However, the acidity of milk is between 0.1 to 0.26 if it is freshly drawn, freshly drawn milk also has a pH of around 6.5 right. Now another typical thing which we will now say is which we have come across we come across everyday because milk is one such product one such food product which almost every house or all the houses do have everyday almost. So in that case you might have noticed that when milk is being heated or boiled that time and there is a proverb of course, in many cases many people do say that milk is a second wife right, or second wife means is so shy that turn your face if you turn your face from milk when it is being heated then it is said that it becomes very much angry and that is why it spills out and this is an experience which everybody must have or must have come across in the life.

So this is because when you are heating milk then what is happening some part of fat some part of protein they are coming up and forming a layer on the surface and this fine layer on the surface does not allow moisture or vapor to come out from interior of the milk. The moment this vapor is not allowed to come out in from the interior to the outside ambient then what is happening that barrier is coming up and if you don't take care, then it spills out right, that is why milk gets spilled out during boiling and that is why you have to take lot of care while you are boiling milk and that is why that proverb is said right. So this you have to also keep in mind that when milk is being heated that crust is formed and this crust is made of fat and protein which comes out from the milk during boiling right.

So that's what we are saying here a tough film is formed and that is on the surface of the milk container and that comes out that prevents moisture to come out or vapor to come out and its spills away right. So on prolonged heating boiling brown shade colour is there and a change in taste is also there. You might have seen at home mummy and many seniors, they are making different milk products, different dishes for with milk, maybe I

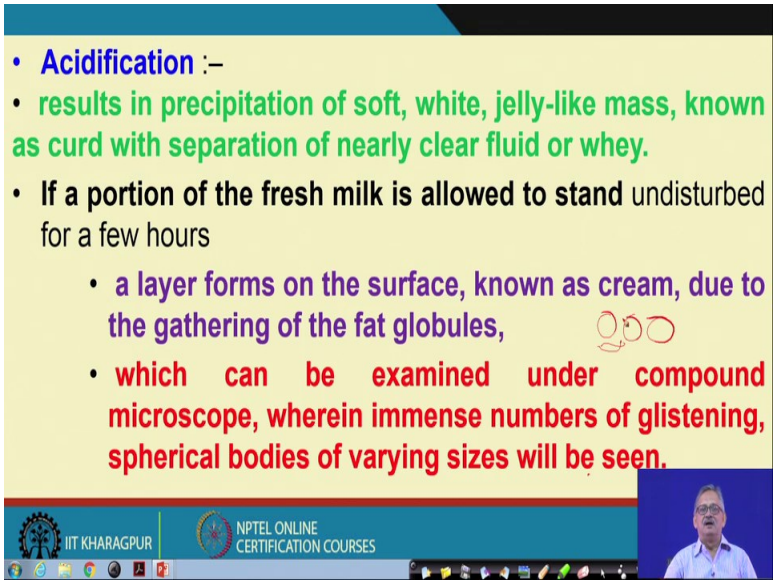
do not know whether what you call payasam or kheer or things like that and for that they are boiling milk for a long time without adding anything.

And you might have observed that when you are heating or to start with the boiling the milk they might have started with white milk, but when it is getting concentrated then gradually the colour is getting changed from this white to say maybe some brownish or some yellowish deep brownish colour in; that is because of course, there is because with that we must know that this chemistry also, that when you are heating milk contains what milk contains you have seen fat, protein, carbohydrate. Carbohydrate in the form of lactose right and this is of course, a part of chemistry that lactose is a sugar and when you are heating sugar then there is if it is directly being heated then there is a reaction goes on and that is called caramelization.

This caramelization produces that red colour or brown colour not red browns colour and this brown colour is one of the reason is caramelization and another vital reason particularly in milk is that this sugar milk also contains lot of protein that we have identified. So this protein and the sugar they will react and they form caramelized product as well, the maillard product or maillard reaction happens that is called when sugar and amine they are together, being heated then they form this reaction that is the caramelization and in the maillard reaction and both forms melanoidins which are brownish in color.

This is a chemistry of course, this is true for any whether it is in milk or any other this is true that when sugar is being heated and that is why I do not know whether you have observed or not a mummy and other who are making dishes for you so during preparation, they do add a little bit of sugar, it is not for sweetening you it is not maybe sometimes for some people may be for sweetening, but primarily not for sweetening, primarily that this sugar when it is being heated. Then it forms caramelized, it under goes caramelization and that caramelization produces some color as well as some flavor.

So which are adding to the dish right that is what, so and also in many other cases where you have both sugar and means nitrogen in the form of amine right nitrogen in the form of amine, then this sugar amine reaction that is called maillard reaction that happens and that causes both color and flavor in the material food right, in milk it also happens right. So its results in brown shade of color and the change in taste.



Now, on acidification we have said in the previous class acidification, we had done by in the milk we had put some acid, and we have seen some precipitation has come up. So that is what it also happens here that this acidification results in precipitation of soft, white, jelly like mass and this is known as curd with separation of nearly clear fluid, or whey right. So the other day other class we said that how to identify the protein and fat and other parts of the milk constituents. There we add that is acidified we saw that some white thing has come out and there of course, fat was separately taken up but here we have not taken up fat separately.

So if you acidify then it produces mass soft white jelly like mass and this is known as the curd which separates out from the whey, remaining part is called the whey and this is in principle we call it to be chhena right in principle, you recall it to be chhena at home, you might have seen mummy and others they are making chhena by putting some acid that could be citric acid or some salt or maybe some nimbu pani that is also the citric acid.

So all these are added such that, the separation or sedimentation of the curd takes place and this is known as chhena right, which we will also come afterwards. If a portion of fresh milk is allowed to stand undisturbed, then a layer forms on the surface known as cream due to the gathering of the fat globules, which can be examined under compound microscope wherein, immense numbers of glistening, spherical bodies of varying sizes will be seen. This I just said the other day in other class that if you look under microscope then you see that fat globules are dancing right, that is what we are talking about that fat globules are dancing.

So if you just keep for sometime milk undisturbed then you will see something has come out, and this thing which has come out is known as the fat, fat gets separated. Why and how we will come afterwards, but still we tell that from the Stoke's law, you can tell that for a given time how much quantity of fat will come out just like that if you keep it like that right from the Stoke's law, there you have to know certain parameters like density, viscosity etcetera, those things have to be known diameter of the fat globules these things have to be known, but you can predict right.

And this is because when you are keeping the milk just like that for sometime right. A layer forms on the surface known as cream due to the gathering of the fat globules. Again, I will tell you one more thing that you might have come across with your age that by chance by accident of course, you do not do it purposefully by accident if thermometer gets broken and thermometers are normally made up mercury glass thermometer right.

So that mercury bulb if it gets broken then mercury drops and the moment that mercury drops lot of globules of mercury they are formed and of course, mercury is bad mercury is very poisonous. So if it comes in contact with any cut surface that is very very bad right and if you gather those mercury globules and if you see that 1 mercury globule is here right 1 mercury globule is here and another mercury globule. So 1 mercury globule is here and another mercury globule is nearby. So these 2 attract each other and they become a bigger one right this is called coalescence right similar thing happens in fat globules also.

When fat globules are nearby then what they do they do coalescence and form a bigger molecule right. As I just said the Stoke's law where you will see that separation of this fat globule is a function of diameter, and that to a square of the diameter right. So that means, if the bigger the diameter is the more the coalescence is there the more this fat globules agglomerate the bigger is the size more will be the separation that's what it happens when you are keeping milk just like that undisturbed right.

Now if the fresh milk is allowed to remain at ordinary temperature for 15 to 21 centigrade for 24 hours or longer right. It will have a pronounced acid taste again here it comes here we have given a small temperature and time given about 24 hour, 15-20 degree centigrade is very small. In our country normal temperature in summer roughly somewhere around 35 40 or even more right.

So one day you brought the milk from milk man or some supplier as given and you came to the class forgot to take care of the milk and the whole day, you were very much busy and the temperature is very hot summer say 40-45 degree. So in the evening you went back and you wanted to have the milk you wanted to boil. The moment you started that you saw that milk has gone wrong. This is an another thing which is associated with milk very very frequently. Typically for the people like our like we are in our country rather where the summer is a very very high temperature summer.

So that it happens that it gets curdled this is we call it to be curdling right milk got curdled and in most of the cases apart from few cases which is not I don't know whether that is justifiable or not it should not be from the point of view science, it should not be, but some people do consume even then, but they should not be because you don't know when the accident will happen. What happens in it when it is getting you have taken the milk you have put it in the not refrigerated just like that in outside ambient where the temperature is very high around 45; 40-45 degree centigrade.

And you got around 4-5 or 7-8 hours. So in that what we have seen that it got curdled and if this curdled milk is taken I am not saying there will be accident, but there is a probability. So why to take the chance because you do not know mummy has made curdling by giving known thing that is citric acid or nimbu pani or some salt. So that curdling was chhena is known you have done it, but here you don't know you have not

given anything it was in the air for couple of hours or may be 8 to 10 hours and after that you have boiled it.

So you have boiled it; that means, whatever was there by the term of pasteurization or sterilization everything you have killed all the organisms. So you can consume it that is what many people do some people not many some people will do, but you never know that where to where the products during curdling being formed because these curdling was primarily by the organisms, which were invaded into the milk from the surrounding and this surrounding may contain lactobacillus or many other because milk is a very good source for organisms to survive or grow because it has all moisture, fat, protein, carbohydrate everything.

So very easy lot of food is there for the microbes to grow, so they invaded into it, multiplied into it, and then produce lot of acid and that acid curdled. Now dealing this production of the acid whether some other unwanted materials were also formed or not, is not known, so that is why it is never advisable that if a milk is curdled just like that then you consume it because you don't know what the other materials are also formed other than acid. Acid could be one, but many others may also might have also formed that is not desirable may be some aldehydes, ketones, which are not desirable and you have no control over there. So that was done just like that by the nature, in this case nature is negative acting as negative.

Because invention of the organisms which were not controlled by you. So you don't know normally as we said earlier that lactic acid producing organisms or normally called lactic acid bacteria. So they do transform lactose into lactic acid, but here you have not and that is if you give lactic acid culture then it will be done. What mummy does in many cases you might have seen that in some cases that whey which is left over is also used for the acidification or for the separation of this curd in many cases it is done, that is because that might have some bacteria which is known that is lactic acid bacteria that will produce.

But when it was done by keeping it for such a long time at high temperature, we do not know which are the organisms invaded. So it might not have only produced lactic acid, it might have produced many other undesirable, and which may be bad or which may be

what we call poisonous, or which may be bad to consume or harmful to consume so that is not desirable.

So what we learned that anything curdling just like that from milk is not supposed to be consumed by the people right. Only when you have curdled it by giving your own known quantity known things then only you can consume it right, but never consume any such curdled milk if it is done by nature keeping it just like that for many hours right ok. So the time is over.

Thank you.