Dairy and Food Process & Products Technology
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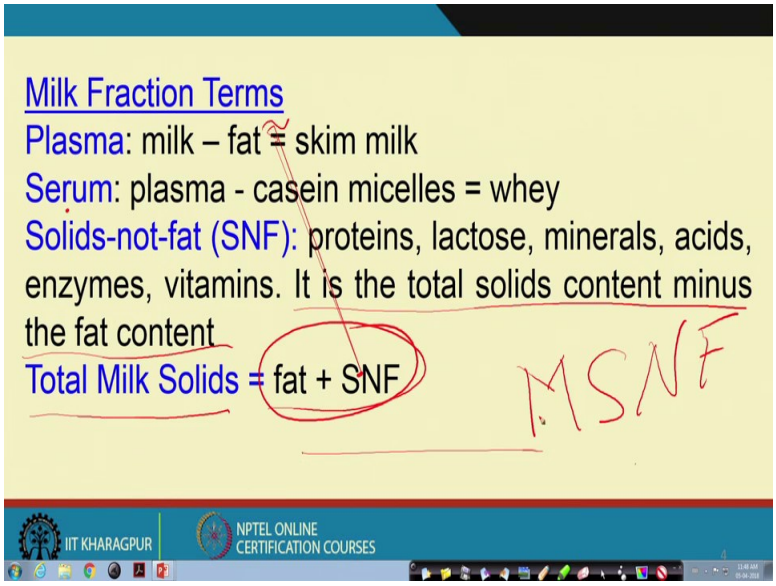
Lecture - 17
Milk - What is it

So, we have seen that the mammalian secretion is the milk right. So, we come to again back to Dairy and Food Process and Products Technology right. Today is the lecture 17 and we will discuss more and more about milk right. There is the dairy product we have said what is the reason why mammalians or why the product milk is so different in different process of sources right.



Now if we you need to know some of the terms, terminology is also you need to know; for example, milk fraction terms we can know that we have heard plasma right. So, plasma is milk other than fat or we can call it to be skim milk. Skim milk is considered to be plasma that is milk other than fat, milk minus fat. That's what we have given as the definition right. Milk other then fat is the plasma or skim milk, then serum. Serum is plasma minus casein micelle right. So, plasma is milk minus fat right.

Now, plasma, milk minus fat; serum, plasma minus casein right, so you have removed two nutrients; one is fat and another is protein. So, plasma minus protein or casein or casein micelles is our whey that is what is we get. So, that is the serum. Serum is the whey, whey is serum. So, that definition that naming we have to keep in mind. Then

Solid Not Fat or S N F normally, we call it to be S N F. So, solid not fats are definitely other than fat whatever else is present is the Solid Not Fat. So, what those are? It could be protein, it could be lactose, it could be minerals, it could be acids, it could be enzymes, it could be vitamins.

So, either singly or as a whole all of them right, depending on where, how much, which is there, so depending on that other than fat, rest of the things are solid not fat right; definitely moisture also does not come into it right because that is not solid. So, solid not fat is other than fat, rest of the things like protein, carbohydrate, vitamins, and minerals, everything that comes into solid not fat right, all including enzymes, vitamins, etcetera.

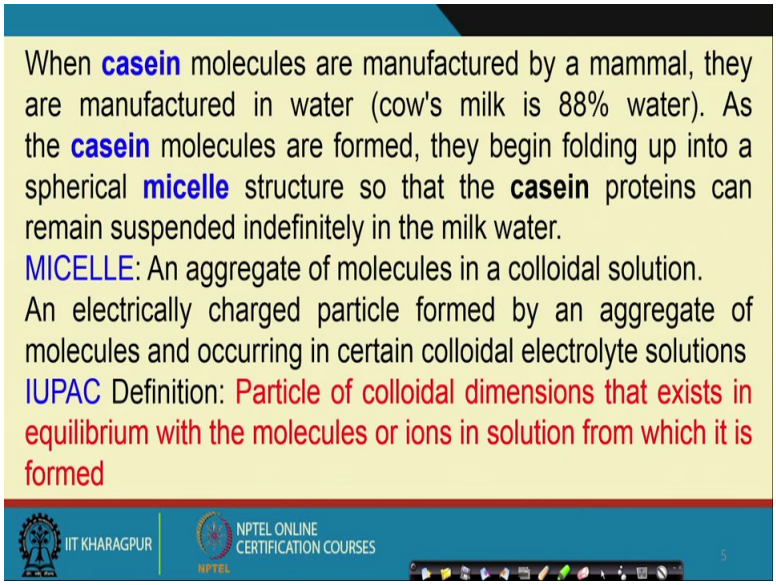
It is the total solid contents; it is the total solid contents minus the fat content right. If you find out T S, total solid. So, that total solid minus the fat content is the solid not fat. So, we can say total milk solid is fat plus S N F right, total milk solid is fat plus solid not fat is the total milk solid. This definition we should keep in mind, I repeat first you said plasma, plasma is the milk minus fat that is skim milk is plasma that milk minus fat is plasma and that is skim milk but when you come to skim milk you will see, the skim milk is not absolutely free from fat but here it is free from fat.

So, it could be said, this is rough. This could be said roughly equal to right. This could be said roughly equal to skim milk right because skim milk also do contain a very small quantity of fat right but plasma does means milk minus fat that is the roughly skim milk. Then we said serum, milk serum is plasma minus the casein or protein; casein or protein which we tell to be equivalent to whey because we have removed fat, we have removed protein right and then the remaining is whey that is water and all water soluble things in that is what is the whey right.

Then we said another term called solid not fat or S N F that is or many many times it is also said M S N F right oh. In many times, it is also said M S N F that is M S N F right or milk solid not fat, only solid not fat S N F or M S N F milk solid not fat right.

So that means, other than fat, rest of these solids present in milk is the milk solid not fat or S N F right. It constitutes of lactose, proteins, minerals, vitamins, enzymes, a all inclusive right either singly if it is or in combination as and when it is right. So, all put together is solid not fat other than fat right. So that means, in milk total solid is equal to solid not fat plus fat in milk right. So, these definition we will keep in mind as and when

if requires will in case, we will come back to that right. So, when casein molecules are ok.



When casein molecules are manufactured by a mammalian, they are manufactured in water that is cow milk which contains around 88 percent water. As the casein molecules are formed, they begin to folding up into a spherical micelle. This term micelle again is one which is required to be understood right.

So, casein micelle that is the structure so that the casein proteins can remain suspended indefinitely in water right. It is subsequently when will progress accordingly we will come across that milk is such a unique thing where all 3 phases right, this is not the phase diagram phase, all 3 phases like solution, then colloid, then emulsion, all 3 phases are there in milk right. Some are in solution, some are in colloid phase, some are in emulsion phase.

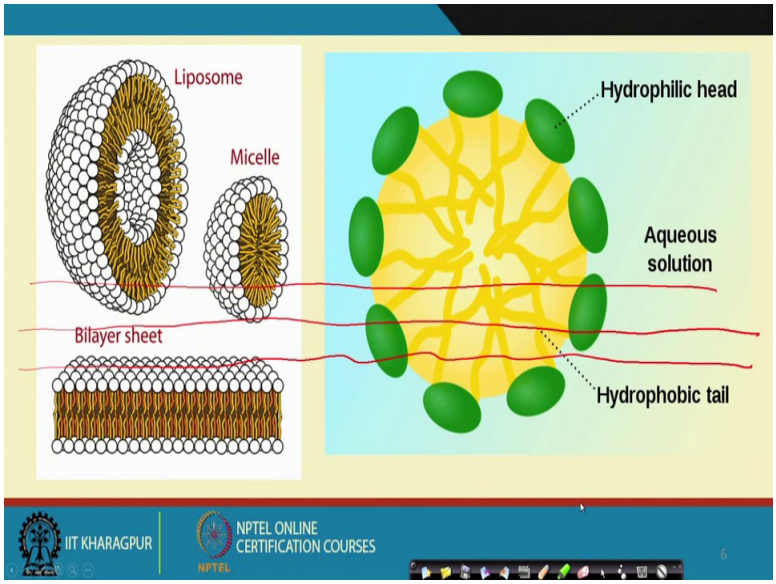
So, this is what we are saying that casein micelle is such when casein is formed, it is in so beautiful way nature has made it that it does not come out that just like that because casein is not soluble in water but in water it is remaining as suspended as in the colloidal form and that is we call casein micelle right. What is a micelle? Micelle is an aggregated or aggregation of molecules in a colloidal solution right. Aggregate or aggregation of molecules in a colloidal solution, this is that micelle is an aggregation or aggregate of molecules in a colloidal solution.

An electrically charged particle formed by an aggregate of molecules and occurring in certain colloidal electrolyte solution right and you might have heard that casein is the slightly charged particle right and this is what we are saying here also that the casein micelle is an electrically charged particle formed by an aggregate of molecules and occurring in certain colloidal electrolyte solutions.

So, by I U P A C definition, I hope we have not forgotten the full form of I U P A C right. This is called international union, international union for of practical and applied chemistry right, practical and applied chemistry. So, that is I U P A C. So I U P A C, that is an organization for chemistry who were is, there are many other bodies also. I am not saying this is only, there are many other.

So this is, worldwide renowned and accepted or acceptable, that is why I am giving that reference that I U P A C has defined this as the particle of colloidal dimensions that exist in equilibrium with the molecules or ions in solution from which it is formed. I repeat, particles of colloidal dimensions that exist in equilibrium with the molecules or ions in solution from which it is formed, that is the micelle right.

So, this micelle word or casein micelle, you use a typical and very very complex. So, when we come across, we see that when we come across, we see that it is like this right.



You see you see. So, this is not, this is these are the, I should say some models there are innumerable models for casein micelle right. Innumerable models for casein micelle, this is one for easy understanding or which looks simpler, which looks easy to guess, easy to

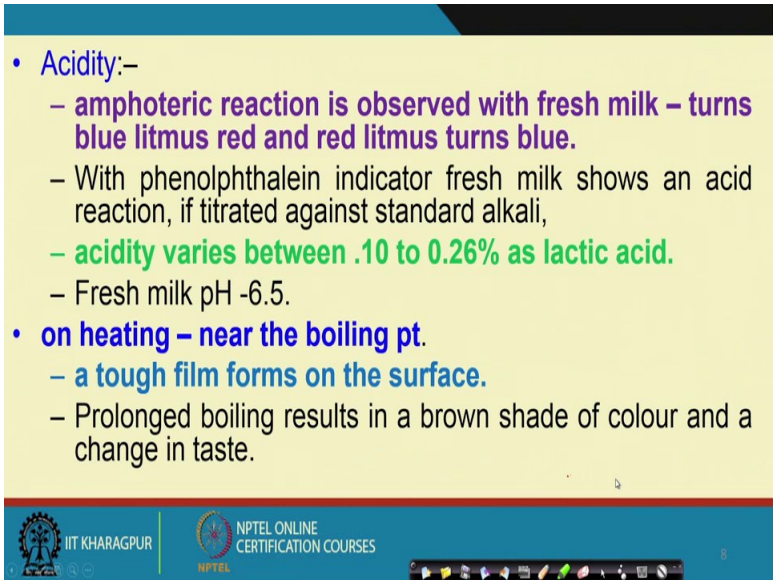
identify, easy to remember, things like that right. I again I am saying that casein micelle models are very very high in number.

There are many models available and based on that one a one such model I am just showing you of course, this is based on the available resource from the net. So, internet available resource from there, this is one. So, liposome is one micelle is like this, bilayer sheet looks like this right where that fellow has gone ok.

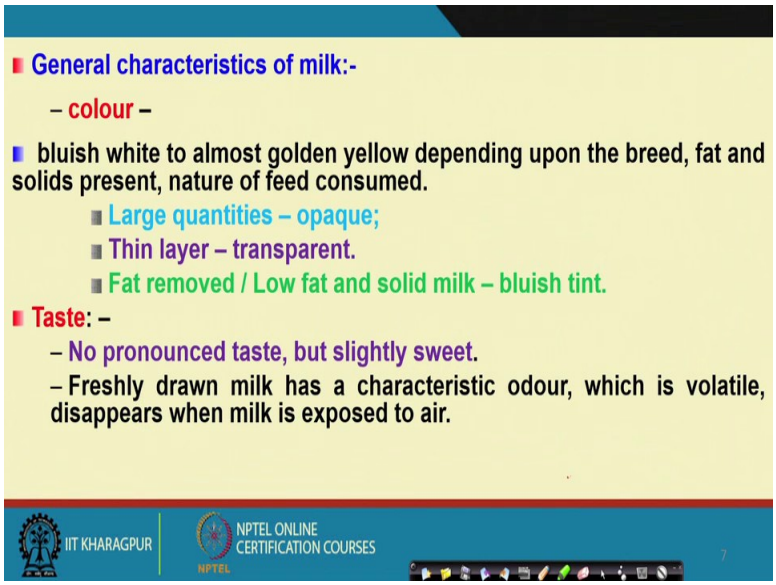
So, my this is then micelle, this is the, this is the micelle right, you see these are like a small small threads right or yeah threads that connected, this is liposome where both this outer and inner these are connected through the thread like structure. This is bilayer sheet also like that right and if we look at the part, you see there are hydrophilic head as well as hydrophobic tail.

So, in aqueous solution, this is there that there are hydrophilic head and hydrophobic tail. Of course the meaning of hydrophilic and hydrophobic we know, hydro philic, anything philic means loving, any philic is loving. So, hydrophilic means hydro loving, hydro means water. So, water loving is hydrophilic. Similarly hydrophoby, any phobic phobia is fear right or there is a tussle or there could be repulsion. So, that is call phobic phobia from that, phobic is such where there is repulsion that is afraid of or fear of things like that is here in this case, it is hydro that is water that is water fear. Those water afraid of water. So, that is call hydrophobic right.

So, hydrophobic end that is at one end, hydrophilic end that is at other and all are in the water as the aqueous solution right. In aqueous medium, it is like that. So, it has one hydrophilic end and one hydrophobic end. So, this is what we get right. So, if you look, this is what casein micelle looks like right.



I hope we have given more than one ok.



So, now we come back to the milk again. So, milk general characteristic, how it is? Colour is bluish white to almost golden yellow depending upon the breed, fat content, solid present, nature of feed consumed. So, all these parameters all these factors cause influence on the colour of the milk which is produced.

Of course, you are I don't know how many you of you have because nowadays those a particular in urban areas, those places where cows and buffalos, they are rare. The those places are no longer perhaps visible in particularly urban areas, but yes in may be villages or interior of villages, still may be there. And if you have come across with them

then you might have seen the there are many milkman who are taking milk of different colour, may be white, may be bluish, may be yellowish, may depending on the that right.

So, where I am not saying those which are adulterated or those which are already mixed with something, they are all together different. Naturally it can be anyone of these colour bluish white to almost golden yellow depending upon the breed depending upon the fat and solids present and the nature of feed which are consumed by the mammalian right.

Again, I don't know whether you have seen or not, observed or not that, if you take a drop of milk on a I hope you have you have seen microscope that I presume that you have seen microscope and when microscope anythings are being seen. So, there is a slide right, small slide, when you people do blood test, there also you have seen that blood is taken there and two slides are, two slide are slided like that right and get those blood the different parameters are measured right, like that a slide if you take a slide and put one drop of milk on it right you can see that the through the slide, the other part of the slide you can see right.

This tells what that milk could be transparent, isn't it; that you have taken a drop of milk put on a slide and you see that slide, you can see the other side of this slide very easily and; that means, that it is like a transparent like water right like water if you take in a glass you can see the other side also right.

But if you take that same milk, same source, same milk if you take in a test tube and try to see the other side of the test tube, you cannot see; that means, in small quantity in thin it appears to be translucent or transparent but in large quantity it appears to be opaque right. So, this is again you beautiful nature of milk that in thin, it is translucent and transparent or if it is thick or all large in quantity, then it is opaque right.

So, thin layer is transparent and large quantity is opaque and also if fat is removed sorry again if fat is removed, also if fat is removed or low fat milk is there, then also it can form bluish tint okay by the by, today we have only another 5 minutes that is good enough for to say this. If you take milk right, we said in the beginning in the previous class that milk is constituted of fat protein, carbohydrate, vitamins, minerals and water right, water of course you, you can identify very easily that separating everything, the remaining one is colourless water right.

But if you want to identify this constituents of milk, though it is not a part of it but still we are handling with the milk. So, I must also tell that how we can identify milk constituents. So, you take a test tube of milk and then you must have a centrifuge. So, in that centrifuge, two test tubes are given in opposite direction otherwise, there will be imbalance of the weight. So, two test tubes are given in opposite direction in the centrifuge and you centrifuge it for say around 10, 15 minutes right.

So, after this 10, 15 minutes of this centrifugation, now you, you will get you stop it and then you take out that that test tube, you will see on the top of the test tube of the milk, you will get one yellowish colour, yellowish colour like biscuit colour or golden yellow colour or thick thing is may be a small, may be a small portion depending on what is the percentage available in that. So, a thick solid is appearing on that right and if you pour if you want to pour the milk or the rest of the liquid, you till you will not be right; obviously, if you go on doing like this if you are giving lot of energy lot of lot of forces, then there everything will come out but just like that you want to decant you will not be because that solid is giving the protection on the top.

Now, you make a small hole by the side of the test tube right, small with the needle you pierce it and the moment you pierce it, you decant it to another test tube. So, by decanting what you are doing, you have taken away the you have taken away this remaining part of the milk other than that solid which was there of golden yellow colour. Now, if you take this golden yellow coloured material and if you touch, you will see that it is slimy, it is very very slimy and also if you take very minute quantity into with that I said earlier about the slide, microscopic slide.

So, take on a microscopic slide, put a very small quantity of this this yellow part and put 50 percent of glycerol glycerol means glycerine 50 percent glycerine, you put there and smear it. Smear means you make like this. So, that is called smearing and put one cover sleep on that immediately and then look under microscope, then you will see that some things are dancing right and this dancing is corresponding to your the free movement of the molecules right.

So, free movement of the molecules that is called dancing. This is dance that whatever is dancing that we know this information that milk fat is slimy is nature, milk fat is yellowish in colour and milk fat if it is diluted and then saw under microscope, then you

will get that dancing of the fat molecules for some time till it settles down right, till it's settle down you will get that right and this is how you can identify fat.

So, this is that yellow portion we call it to be fat. Then comes rest of the thing, rest of the thing was your yellow, white right rest of the things was your white coloured milk and now you have taken that white coloured milk and you put some acid say sulphuric acid hydrophilic acid acidic acid or even citric acid whatever acid you have in your hand.

You take that put it sufficiently you don't have any other measuring thing. So, put it sufficiently. So, then an and warm it a little because that makes it faster but it is all ph dependent. So, when ph comes to 4.6 then that you cannot measure but that is why you have given extra, you will see some sedimentation occurred right something has come up, come down rather not up something has come down on the lower part of that test tube and now you filter it after filtration you will do what you will make a portion of that a sediment that is the solid or residue, a portion of residue take and test for nitrogen by Kjeldahl method right.

You will get if by Kjeldahl method if nitrogen is not there, you will not get that nitrogen. So, if from here it comes to be nitrogen and if we know that the by Kjeldahl method normally 6.25 is multiplied. So, that gives the protein content or 14 percent protein present.

So, you can finally, say that that white marks which came out is the casein right, another part of the milk. Now you have filtered after the separation of this casein, you have filtered and after filtration, you got again this residue of casein and the filtrate.

So, from the filtrate again that is a colourless filtrate, you take it and warm it around 80, 85 degree centigrade, then you will see that it has become turbid, again you filter through a good filter paper and take very small quantity from that because it will be also quantity wise very small because it has become only turbid. So, quantity wise it is very small. So, that turbid thing will come out and you can test it for nitrogen through Kjeldahl method.

So, you can say that is also a protein and this is called whey protein. Now, remaining solution after filtration, you got and now you warm it put Fehling's A and Fehling's B right; Fehling's A and Fehling's B in equal portion and then heat it you will see but don't put very excess because Fehling's A and Fehling's B both together, it becomes a very

very bright blue colour right cuprammonium complex. So, that just on the back side of this whatever is there in the TV.

So, that is similar or even more dense colour, blue colour like that. So, that when you are heating. So, that's why I said when you are making Fehling's A and B do not put in excess, then that colour will be merged. But now if we are putting some filtrate into it and heat it, then you will see there is a brick red colour precipitation. This brick red colour precipitation is due to cuprous oxide and which is because of the presence of sugar or reducing sugar present and we know milk contains lactose.

So, that is how we can identify fat protein carbohydrate present in milk. It is difficult to identify vitamins minerals and others because that takes long time long time maybe a day or two for individual experimentation. So, it is easy you can identify for this fat protein carbohydrate in milk. Today we are running short of time.

Thank you.