Dairy and Food Process & Products Technology
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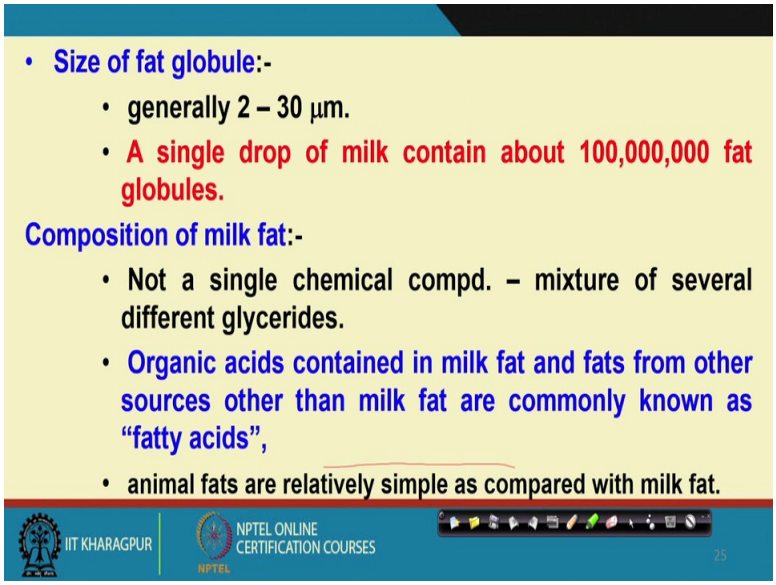
Lecture – 23
Milk Fat (Contd.)

So, we were discussing about triglycerides that is the fat, right. In general we have discussed in many as we said, so today is our 23rd lecture, so in that we will continue discussion with fat, right, so typically milk fat that will discuss.

So, to do that you remember last day we finished at this point that size of the fat globule can vary between 2 to 30 somewhere around this micron in size, there are many which are less than 20, but very few more than 20.



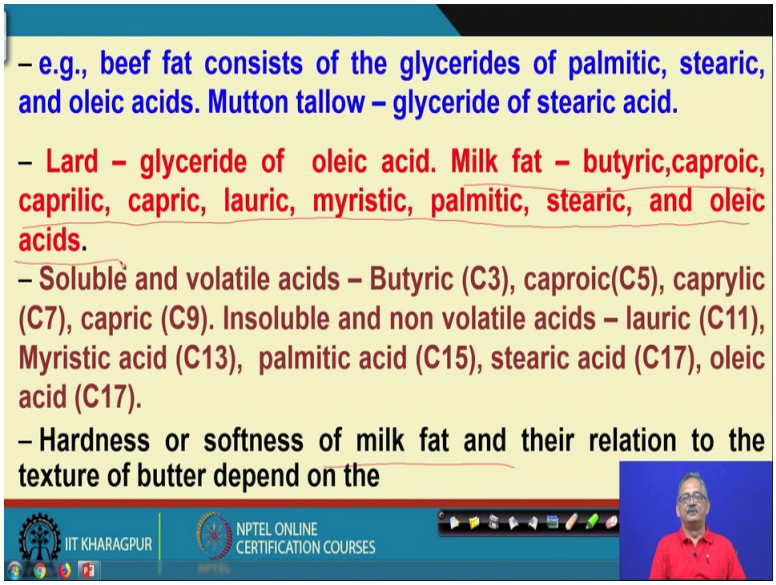
Instead that is why generally it is said between 20 to 2 to 30 microns. And also we said a drop of fat globule and net drop equivalent to I said if you remember that we take in pipette or burette. So, that drop which comes from pipette or burette that is generally taken as a drop and this droplet. So, this droplet size is roughly 0.05 millimeter milliliter, right. Millimeter is the unit of one dimensions milliliter. So, that is the volume. So, that 0.05 one droplet, one that is one what we should write one in drop or one droplet of milk it contains around 10 to the power 8 number of fat globules.

So, imagine so how many fat globules you consume when you are consume a glass of milk, maybe one quarter of a liter or half liter some things like that. So, so many droplet

us you of or so many number of fat globules you are taking, right. So, in this fat globule; so we also said that there is a membrane which protects the fat globule, right. So, that we said fat globule membrane that is FGM, right.

Now, if you come to composition of milk fat then it is not a single chemical compound, it is mixture of several different glycerides. The other day I said that milk fat contains around 98 percent triglycerides, if you remember we had said that around 98 percent triglycerides some sterols and some others maybe phospholipids are there, right. So, organic acids consisted rather, organic acid those are in milk fat and fats from other sources other than milk fat are commonly known as fatty acids.

So, this fatty acid we have already discussed, right. So, animal fats are relatively simple as compared with milk fat. Because they don't have so many complications because so many numbers of fats are not present whereas, in milk fat we said the other day around 400 this your fatty acid groups could be associated if you remember we had said, right. So, it is it is really a worst number of fatty acids associated with the milk fat, but it is not so, tricky or it is not so, complicated in case of if the fat comes or fat is obtained from animal sources, right. So, let us look into.



Beef fat this contains around many triglycerides ok, and they are palmitic stearic and oleic acid, right.; consists of glycerides of palmitic stearic and oleic acids.

Mutton tallow that is glyceride of of stearic acid. So, beef fat mutton fat they are and mutton fat is known called tallow and in some cases they are also called large animals

fat, right. So, they are it is another. So, it is much simpler, you see we said that palmitic stearic and oleic this is for the beef fat whereas, in mutton fat there is a tallow it is only the glyceride of mainly stearic acid blood. So, it is much much simpler. In milk we have seen it is n numbers of such kind of fatty acids are present. So, that is why we said that animal fat is much more simpler compared to that of the milk fat.

Lard another animal fat which is glyceride of oleic acid, right. Lard is a glyceride of oleic acid. Though these of course, if you remember the other day we said saturated unsaturated, so mostly these are unsaturated, right. Saturated fatty acids and that is why they are they are they are they are value is also not so high, right. I gave also the example of the market if you go to the market then you get lot of fats of animal of different animals, right. And they are normally either thrown or may be sold at very very nominal prices, right.

The primarily reason is that they are containing very very simple types of glycerides and mainly the higher number of carbon atoms C 16, C 18 like that. So, the palmitic stearic oleic it normally they confined to these, right. So, if, but in button milk fat if you look at milk fat contains, milk fat contains butyric acid, caproic acids, caprilic acid, capric acid, lauric acid, myristic acid, palmitic acids, stearic acid and oleic acid. So, it consists of everything its small chain carbon with long chain carbon, right.

And if you remember we are said the generally naturally available this fatty acids they range between 2 to 20 around right. Beyond 20 it goes to what? You remember; yeah it goes to waxes, right. Beyond 24 it goes to waxes that class, right, but they are also lipids all are on the lipid family. And here we see both the small chain carbon carboxylic acid and large chain carbon carboxylic acids are present in milk, right.

So, they are butyric, caprioc, caprylic, capric, the lauric, myristic, palmitic, stearic and oleic acids, right. So, because of the presence of so wide variety of your this acid that is the carboxylic acid that is fatty acid. So, there are both volatile and non volatile components of the milk fat which comes out, right. So, milk fat contains both volatile and non volatile as you see those which are soluble and volatile as its they comprise of butyric. You remember the other day I said that odd or even it depends on how you are defining.

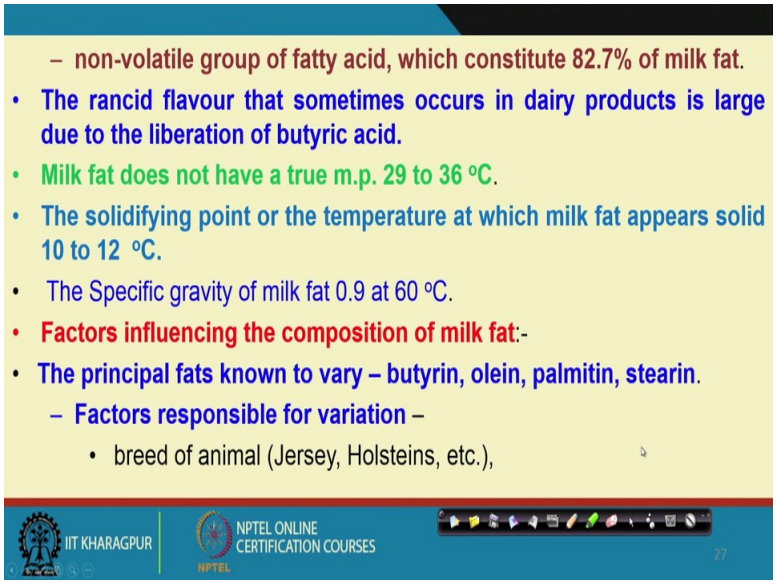
If you define taking carboxylic acid as the unit also then butyric acid becomes 4 C 4, but if you remove carboxylic acid and only concentrate on the chain of the carbon length then butyric acid becomes C 3. This is like in this case we are giving example of C 3 earlier we said that those which are which are which are available in which are available in natural resources or natural sources they are primarily of the even number of carbon, right. But here it is being seen that if we remove that carboxylic acid group then it becomes C 3 for butyric acid.

Similarly, for caprioc acid it is C 5, for caprylic acid it is C 7, for capric acid it is C 9, for insoluble and nonvolatile is say this. So, the soluble part soluble volatile part is between C 3 to C 9 less than C 10, or if it is in odd even number then with the acid we can say C 4 to C 10 not including the carboxylic acid group. But if it is without the carboxylic acid group then it is C 3 to C 9, right. Like butyric caproic capric caprilic all these are soluble volatile fatty acids.

Whereas, insoluble and non volatile fatty acids are consisting up of comprises of C 11 that is lauric acid, C 13 that is myristic acid, C 15 that is palmitic acid, C 17 that is stearic acid, and also C 17 for oleic acid, right. So, all these are non volatile fatty acids components whereas, volatile fatty acids components are less than 10 and more than 10 are non volatile.

So, this 10 I am referring with respect to both whether it is odd number or even number. It does not matter whether it is odd number or even number it is a less than 10 does not matter whether it is odd number or even number it is higher than 10 greater than 10 for insoluble once, right. Now, again hardness or softness of milk fat and their relation to the texture of butter that depends primarily on.

No, it is went to. Non volatile group of the fatty acids, right which constitute around 82.7 percent non volatile group of fatty acids.



So, non volatile group means more than 10 carbon length, non less than 10 was volatile. So, non volatile group of fatty acids that is between 11 to C 17 without the carboxylic acid group, right. And out of that around 82.7 percent is the non volatile fraction of the milk fat, right.

Next we come to that the rancid flavor that sometimes occurs in dairy products is is largely due to the liberation of the butyric acid. I don't know whether in any of the lab laboratory you have seen on you go and see that butyric acid generally in chemistry labs this is available. So, you go and get butyric acid and take a smell of it you just cannot it is so obnoxious, so obnoxious that you just cannot the moment it comes to automatically you will get jump or you will take a jump, right.

So, that is primarily because butyric acid is very very bad very very off flavor. So, that is what is liberated when milk becomes rancid, right. And rancidity can be cause by many many things like it can be enzymatic rancidity or it can be oxidative rancidity. So, depending on what, but generally the products could be similar or alike. So, it is butyric acid is one of this product which comes out from the rancidity and that causes very very off flavor. So, if milk is not consumed and if it is getting rancid after sometime then the off flavor which comes out from the milk is primarily because of the butyric acid, right. So, this you keep in mind.

Milk fat does not have a true melting point. Why? Because whenever you are finding out melting point, whatever be the process method whenever you are finding out the melting

point you have seen that the melting point can be determine if you have a single component exactly, right. You can tell ice has a melting point of 0 degree centigrade, right.

But if you have ice dry ice combination then can you say that it has a 0 degree melting point, not at all because that is a mixture and both of them have different melting points. So, it is not a single isolated melting point as it is. So, that is what when we are considering milk fat it does not have any single point melting point because it contains many many triglycerides many many fats and that is why it is not a single component it is a range and this range varies between 29 to 36 degree centigrade, this range varies between 29 to 30 degrees 36 degree centigrade, right.

The solidifying point of the temperature the solidifying point or the temperature at which milk appears solid that also varies and this is between 10 to 12, for the same reason as the melting point is different solidifying point is also different. Of course, normally what we know like for ice we know that it is melting and also solidifying both at 0 degree centigrade because that is a single component it turns, but here it is a mixture. So, that is why the ranges are different and melting and solidifying points are also quite different, right. So, the solidifying point or the temperate at which milk fat appears solid is around 10 to 12 degree centigrade.

Specific gravity of milk again specific gravity is a function of temperature; I hope you have not forgotten that in school you have measured specific gravity in a specific gravity bottle. And if you would remember that in that bottle it was specifically written that at should such and such temperature, right. Because why? Because your specific gravity bottle you when you have taken you say this is the specific gravity bottle by any chance if this is a specific gravity bottle you have taken the liquid inside.

So, the weight which you have taken is not changing with temperature, but what is changing with temperature the expansion or contraction that is the volume. So, since the volume is changing so that is why the, that is why the specific gravity is always mention at a given temperature, right. You will see the same material will have different specific gravity at different temperatures that you just look into any substance, any material you take we eat food and non food does not matter, but it is that a specific gravity is a function of temperature, right.

So, specific gravity of milk is 0.9 at 60 degree centigrade, at 60 degree centigrade it is 0.9, right. The. Now, factors which influence the composition of milk as we said that there are many many factors some of them we discussed here if possible in future if we come across similar topic then we may discuss some in more. But the fact in primary factors for which the composition of the milk fat varies are because of the principal fat known to vary is because of is butyrin, olein, palmitin, stearin these are the principal fat or principal fat which are responsible for majority of the fact that is butyrin, olein, palmitin and stearin.

Now, factors which are responsible for variation of the these fat content are breed of the animal we said earlier breed of the animal say you are taking cow. So, that breed whether it is jersey breed holstein breed or say some Indian breed obviously, the fat contents are quite different. I do not know we all we had one dairy farm in our institute and there we had seen that from Australia this jersey cows came and their size is so big, so beautiful health, so stout and they used to also they used to give both the quantity wise much more as well the fat content was very high compared to when we are considering from our house to house some or other kind of cow animal, right.

So, it depends on the breed for the same animal breed. And after words you will see from the same breed species to species. If that breed whether it is Indian variety or Australian variety or Netherland variety whatever we eat the same breed of different species, right. So they will also very differently this will come.

Then stage of lactation, stage of lactation. So after the birth after the birth of the animal so that is called the lactation period and this is generally up to 1 year and this is the that varies this lactation period because of the lactation variation of the lactation period the contents that is butyric acid contain declines from the beginning to the end of the lactation period, right. In the beginning with a butyric acid content is high whereas, towards the end butyric acid content is much much lower, right.

So, that is why I don't know how many of you again I am referring to this how many of you have ever visited any such units where at home or domestically the animals are reared and you went there and took the milk from the cow, and that time your seniors if you are first time or may not be that much experienced in bringing milk every day. So, then you might have been told that be sure that in that house there is some cow has given

some birth of the calf and do not take milk from that, right. That could be the smell of that is a quite different, the fat contents are different, all are different that is why lactation period is a major cause for the differentiation in the fat content as well as the composition of defect.

Then primarily feed, feed is a very very vital component for the variation why because in our particularly in our country all over the country you will see that yeah in a in many many cities or metros nowadays those kind of milk house rearing facilities are not allowed because of the urbanization. But in villages you will see lot many are there. And what do they do? They allow the animal to go here and there and get whatever food they want.

But this is not so, in any developed countries in an developed countries they do rear commercially and there are maybe hundreds and thousands of animals are being reared regularly feed, with the good food which is suitable for them and those animals do also payback the output as well as the fat content of the milk. So, that kind of commercialization in our country I do not know when it will come, unless several decades where there was white revolution by courier our respected Kurien and after that such kind of revolution or such kind of thinking is not coming up.

So, I hope my students who are now, listening if they come to the apex body they will take care of such this kind of problem that the let they are be, let they are be consolidated rearing of the animals so that the rearing become also easier as well your this thing becomes very very fruitful. So, feed is one such it is not that they go around and take their food accordingly.

Now, feed, so increase in olein content produces soft fat with low melting point. For cottonseed meal increase in olein is counteracted by the decrease in butyrin. Feeds result in higher olein content rich in vegetable oils such as linseed meal, soybean meal, etcetera. Grass pasture increases olein content feeds with low vegetables oil, but rich in carbohydrates produces less olein content that is firmer, firmer fat is available, right and nutrition that is decline in the volatile acids and increase in the olein content. So, these are the some of the, some of the different reasons why the variation of fat content both in quantity as well as composition for the for the milk it varies, right. So, here we stop because time is up. We stop it here.

Thank you.