Dairy and Food Process & Products Technology

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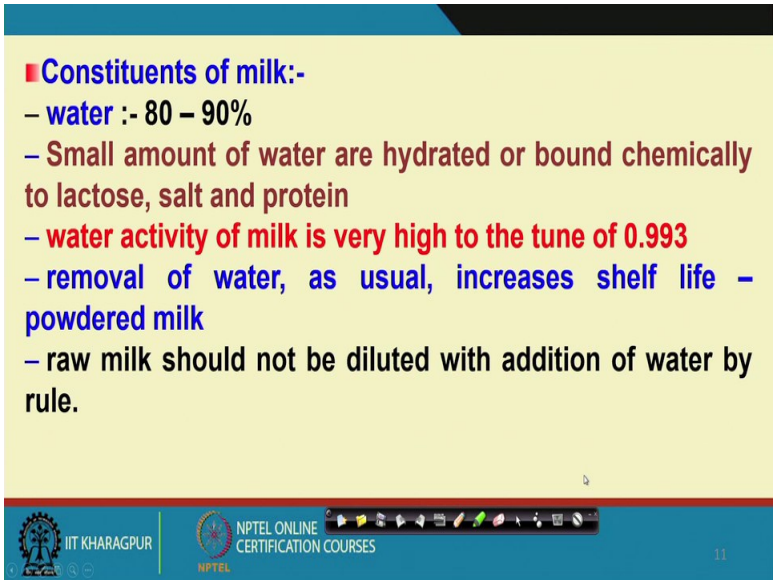
Lecture - 20
Constituents of Milk

In this Dairy and Food Process and Products Technology our course title as and when I am coming and saying that if it is possible for us to encompass as much as we can, because though there is no preamble for this course, but definitely some kind of knowledge in a chemistry food chemistry these things are also required right. I said that engineering I the other day I said if you are interested already we have done on momentum transfer. So, you can also take that course or register yourself.

Then future also many such courses will come up which will encompass many of the engineering site, but simultaneously like technological or science based topic or subject like this one, that also require some basic science knowledge like chemistry some physics, chemistry and mathematics is always all the time. So, that is why I think as and when possible whenever things are coming I am trying my best to explain a little bit more or encompass a little bit more such that you can easily understand, easily correlate, easily rather express yourself in that way.

So, here also we will do similar things like that now we are in the milk constituents right, earlier we have seen what happens, what is the taste, what is the color, what happens when acidification is made etcetera, some of the things which you have done. Now, let us go into the bit further detail of the constituents of milk right. So, that is our headline today that constituents of milk this on lecture 19 will do right.



You know we have said in the previous class that depending on the source depending on the depending on the species you are considering, it may have wide variation of the constituents like the basic constituents which are the basic of the nutrients that water, fat, protein, carbohydrate, vitamins, minerals all these are constituents of any food product it is not that all the time.

Now, since we are talking about milk it is not necessarily that we will talk about milk only and other food products if we come across we will keep it aside. So, that is why when in general we are saying so, these all constituents are the basic constituents of any food it may be somewhere one of the or some of the constituents are predominant somewhere others are very nominal or negligible or may be very very I don't say that it is absolutely 0, but very very in significant in quantity.

So, in that case whenever we are coming into all of them we will definitely try to explain some more chemistry associated with them right this I think it is better we do it. Otherwise understanding because some of the chemistries are also required, I am not saying that chemical formulae or chemical reactions understanding of the chemistry basic chemistry also required right, like if I tell you that glycerol, glycerol is what, try to recapitulate glycerol is yes you are right trihydroxy alcohol right trihydroxy alcohol; that means, there are 3 hydroxyl groups not only there and this 3 hydroxyl groups are connected to 3 carbons right that is why glycerol is a 3 carbon member.

So, like this if some basic things come up as and when we will try to encompass we will try to cover whenever it is possible we will try to again minimize if there be any repetition, but it is very difficult to remember that which one was already told then which one was not.

So, had it been in the same class in a single class then you can remember within all the number of classes it is very difficult to remember which one has already been told a little or in detail and which one not, but we will try as much as we can remember and minimize the repetition if there be any hopefully it will not be, but okay and some of the repetitions are also helpful for you because that gives you recapitulation of the first.

So, it is call brushing up. So, little brushing up it happens and that helps in our experiences that helps in a memorizing because many things are not possible to memorize, but there are some things which hit on your brain or in your. So, called in calical language you call head so, that goes to the head and normally you do not forget. The basic constituents start with the water hopefully in the last class we started it little and because of the time constraint we could not carry forward and milk it contains between 80 to 90 percent water in general it can be little bit more or little bit less depending on this species depending on the places from where etcetera, etcetera many many factors are there right.

Again I will said that what are the results for this different output of the different mammals what are the different reasons, we will try again sometime once we finish all these constituents and others is activities then we will go and with those also because that is also an thing which is required and perhaps there we will tell little bit more about the colostrum which we said the other day, that is the basic of the of the all newly borned baby which is supplied, which who is supplied rather who is supplied with the with the fighting ability with the new environment that is all kinds of supporting mechanisms or all kinds of aglorimization mechanisms to help them some of the things come from there which we will tell in detail when we go for that colostrum.

Now, the basic part is it is with water 80 to 90 percent is water and in that water small quantity of water is also associated with hydration of different salts different proteins different in a different way different hydration this is called binding of water chemically with different molecules like lactose salt or protein all these do have hydration and

hydration the other day I said. We also said about the water activity your milk also has a very high water activity around 0.9 9 more than 0. 9 9 and we said about the water activity the other day right.

Now; obviously, the higher the water content more is the water activity and higher the water activity more is the chance of microbial spoilage or microbes to invent and act on the material whatever it be, whether it is milk or either it is any solid food everywhere it is same right. If the moisture content is very high it is susceptible to be or liable to be invaded by micro organisms, now which micro organisms from where will come that is altogether different and there is not also under this umbrella of a or jurisdiction of this course.

But still when as and when we come across will definitely tell like, typically if we consider milk it is the major where the lactobacillus as the genes right again here I will not go into detail of the microbiology because which is genes which is species etcetera this if we go on again digging into that then no into that.

So, I presume that at least we understand that lactobacillus is the genes from their different species like genes means is family, is the family and like in the family different persons are there as the individual. So, like that different species are there in that genes and they constitute to the whole family genus. So, this lactobacillus genus is definitely act on the milk and they are very much liking milk as the source.

It does not mean others do not because milk is a very good source of all the ingredients all the nutrients required for the organisms to grow since it is available. So, everybody would try to, but as we know from the microbiological point of view that typically for bacteria there are basically three types one is thermophilic, one is mesophilic and one is psychrophilic.

So, depending on that temperature what is the temperature at which you are keeping organisms will come accordingly also, that is also a restricting point or some point where you can demarked. So, if the water activity is high chances of getting contaminated or spoilage is very high to make it more stable normally what you do for any food material you remove the water that is by removal of moisture this is a very good technique which we normally called drying.

So, in this typical for milk it is dried to the powder level where the moisture content is very low much below then water activity level of 0.6 right and we said the other day 0.7 is the datum, for most of the organisms like a including mold, but accessions are there that is why if we take 0.6 as a lower side, then hopefully if things are below the 0.6 what activity then organism growth or contamination with respect to organisms are minimized or can be avoided right.

So, if that be true then you this water if that is removed and brought down to the level which is less than 0.6, which is true with milk powder when we are making powder from milk. Normally, this milk powder is done with spray drying and this spray dried milk powder contains around 2.53 percent not more than that moisture right; though since it has also sugar that too lactose.

So, it is also hydroscopic it can absorb from ambient moisture and that you have to take care that is why you will see that I do not know how many times you have seen that whenever this bottles or this the containers from where this dried power milk is taken the then either mummy or seniors do tell put the lid closed. The moment it is then normally, they do not keep it open for long because by the time it will grab some moisture from the surrounding atmosphere and it will get moisten and local moisture will grow up and that may lead to some contamination right.

It is not necessarily that in the whole container of dried milk that the entire milk has to be hydrated or it should adhere moisture and increase the moisture level then only organisms will come it is not, see if a small portion inside is getting moisture absorb and local moisture there it that becomes more than the critical level of the water activity.

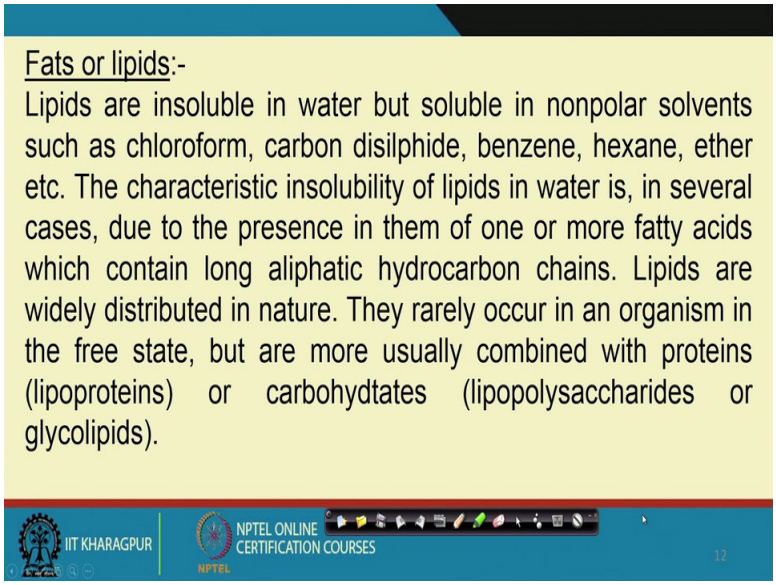
Then either organisms can come and grow into that or invent it is not that coming like that we go from here to there it is always all the time everywhere we are not able to see, but that why it is micro and since we are not able to see and since they are coming they are they can this is called invading.

So, they are invading and they can grow and spoil, but normally it is chances are low and don’t say rare low because you then take care of it is not that it comes in atmosphere and all the moisture from that atmosphere goes we because here also then it comes to that heat and mass transfer that those concepts right. So, it is not just like that it goes from

moisture and all moisture from the atmosphere goes into the product and spoils that it is not it takes also time that is why after taking it is getting closed right sorry I am so, sorry.

Normally this is one way of extending the life of milk by making it dried product and milk powder is the best example of that by removal of moisture. So, it is coming under the umbrella of moisture, another one is definitely very very useful from the point of view of the law that you are not allowed to add externally water without the knowledge of the customer.

If customer says or you are the customer if you for your consumption if you think that I will dilute it no problem I will concentrated it no problem it is your. Your baby you can do anything you like, but the seller they cannot. So, it is not recommended that external addition of moisture to the milk it should be there so, that is prohibited right by the law.



Now, we come to the from the first constituent water the next constituent as fats and lipids right, next constituent we come to fats and lipids here I would like to spend some time on fats and lipids what is that right perhaps in one of the class I said that all lipids are not fat, but all fats are lipids right.

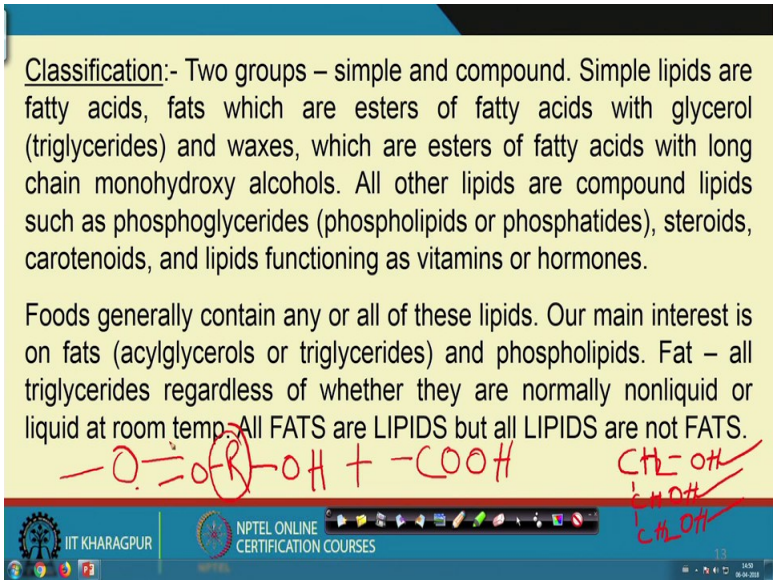
So, lipids are what, lipids are insoluble in water, but soluble in non polar solvents all lipids are insoluble in water, but soluble in non because water is a polar solvent that is why in milk that fat milk fat is not in solution because it does not go into solution. So, it is not soluble in water, but soluble in non polar solvents like organic solvents they are soluble such as chloroform, carbon, disulfide, benzene, hexane, ether etcetera. The

characteristics solubility of lipids in water is in several cases due to the presence in them of one or more fatty acids this solubility is a function of the presence of one or more fatty acids and in that we will come in detail in that fatty acids which contain long aliphatic hydrocarbon chains right.

So, depending on how long or how small the chains are solubility also may differ right; obviously, you can imagine that a big fat chain or long chain aliphatic fatty acid the that when it goes to the solution; that means, it has to go into the water and in a way either hydration or some a similar things can be done.

So, one molecule may not be good enough to hold that entire big molecule of the fatty acids. So, that is why it is expected that high molecular weight fatty acids or long chain fatty acids their solubility will be much lower than that of the smaller molecular weight or smaller chain fatty acids right. Then lipids are widely distributed in nature they really occurred in an organism in the free state, but are more usually combined with proteins as lipoproteins or carbohydrates as lyposaccharides or glycolipids liposaccharide or it may be also called glycolipids. So, these are they are not available in the free state as the lipid.

So, they are always associated with either some protein or carbohydrate so, depending on that it may be termed as either lipoprotein or glycoprotein or lyposaccharide etcetera etcetera right. So, they are not available in the free state this statement is very very important that they are not available in the free state always associated with others like proteins like carbohydrates, they are always associated as lipoprotein or liposaccharide.



Now, if we classify lipids it can be classified in two groups, one is simple and the other is compound; obviously, simple is the one where fatty acid that is the fats which are esters of fatty acids with glycerol right and or waxes, glycerol's and waxes.

So, which are esters of fatty acids with long chain monohydroxy alcohols all other lipids are compound lipids such as phosphoglycerides or phospholipids or phosphatide, steriods, carotenoids and lipids functioning as vitamins or hormones. They are all complex if possible sometime will also show some may be one or two this figure which may be very very required right.

So, in that case what I mean to say that those which are glycerides. So, glycerol so, let me open a open a page glycerol or I can use this much this much is good enough that it is CH 2 OH CH OH CH 2 OH so, this is the glycerol right. So, it has 3 hydroxyl groups right one in the top second in the bottom and third in the middle right.

So, all these hydroxyl groups if they are and we also know that this is the hydroxyl, hydroxyl group is what, OH group is hydroxyl group and one it is reacting with CO OH this is the carboxylic group right. So, when this hydroxylic group and the carboxylic group they are reacting then what happens, one molecule of water goes away and there it forms ester.

So, ester means through O right this kind of reaction happens and when it is happening that time definitely we can call it depending on whether single hydroxyl group is a stratified or 2 hydroxyl groups are esterified or all 3 hydroxyl groups are a esterified, if it

is single hydroxyl group then we call it to be and these are all compounds of glycerol salt compounds of glycerol with the acid.

So, or esters of the glycerol so, in that case if it is only one hydroxyl group then we will we call it to be mono glyceride, if it is with the 2 then we call it to be diglyceride and if it is all with 3 then we call triglyceride and you remember in the first class in milk we had said that almost around 98 percent is out of the fats in milk almost around 98 percent of them are in the form of triglycerides right. So, mono di may or may not be there depending on it is I am not talking about milk in general mono or di glycerides may or may not be there, but that also constitutes the fat.

So, the fats are when we are getting the hydroxyl groups of the triglycerides esterified with a fatty acid then that becomes the mono or di or tri hydroglyceride right. So, depending on that mono or di or triglycerides we call it to be the glycerides or gliss simple fat simple fats right. And we also said that the complex fats are those which are associate with either very very long chain carboxylic acids or maybe not directly associated may be associated with some other proteins or lipids proteins or carbohydrates like sterols, then we said carotenoids, then lipids functioning as vitamins or hormones all these are complex or compound lipids simple lipid is the mono or di or triglycerides of glycerol with fatty acids right.

Foods generally contain any or all of these lipids our main interest is on fats that is acylglycerides now the acylglycerols or triglycerides acylglycerols or triglycerides, no another new word has come up I can skip right acyl what does it mean right acyl. So, here it is with O and here with R and it could be any other thing.

So, this could be normally with the methyl group or any such substitute anti carbons right so, then it is called acyl right so, that acyl hydro compounds are acylglycerols or triglycerides are there phospholipids are also there. So, fat where all are triglycerides regardless of whether they are normally non liquid or liquid at room temperatures right.

So, all fats are fat all triglycerides regardless of whether they are normally non liquid or liquid at room temperature they are fat, I said the other day the difference between fat and oil primarily is that that fat is solid at room temperature and oil is liquid at room temperature this is by and large general classification or general distinction between the fat and oil.

So, fats are solid at room temperature and now; obviously, room temperature which one you call because room temperature cannot be uniformly same all over the world somewhere it is 20 degree, somewhere it is 10 degree, somewhere it is 30 degree, somewhere it is 0, depending on the location, depending on the places, but by and large room temperature we call to be somewhere close to 20 right, by all means it can be taken as. So, around 20 if they are solid then normally it is fat, if they are liquid then normal it is oil right.

We will not see that even in very winter the oil which you have bought from the market for domestic preparation or domestic consumption those oils do not get certified right, those they don't get frozen right because their freezing point could be much much lower. So, that is why they are not solid at even very at even winter or low temperature right whereas, fat what do you called to be the solid if they are somewhere is at the high summer peak summer could be going into the liquid phase, because they can be melted at even at 40, 45 degree centigrade they can be even melted.

So, there and you if you take a little fat to say butter in your fingertip and keep it for some time you will see that it started melting because your body temperature is somewhere 37 degree plus minus 37 degree so, at that temperature this starts getting melted.

This you can try may not be in winter because in winter your body temperature external not internal external maybe somewhat low because of the surrounding temperature right, but even then if you keep for sometime it will get the circulation blood circulation, and the temperature will be automatically maintained and in that case they are also it may take some more time and it will be melted right. So, you have to be careful that which one to be fat, which one to be oil, those which are solid at room temperature fats, those which are liquid at room temperature are oil ok.

So, we have no more time today. So we will continue in the next class.

Thank you.