

Dairy and Food Process & Products Technology
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Lecture - 16
Physico-Chemical Properties of Milk

So, we have done these laws governing the food and food items, right. We said that in our country there are many many bodies which have come up, one of the apex body was a FSSAI, you remember and any sub bodies like your that milk for many other products, the BIS, then Agmark. So, all these came up and we discussed about there.

So, all the time whenever you are doing something in the processing or product development or you are bringing some new technologies, then all the time we have to keep all these laws in mind. So, that both the processors as well the consumer; primarily the consumer is benefited because whatever you do is primarily for the consumer. Because if there is no taker, no consumption then no point whatever you do, whatever best you do. So, that you have to keep in mind right.

So, after the laws governing the food area arena of food; we now come to that okay as I said earlier also that in one class in one course it is just not possible to cover everything right. But even then we said as and when we come across we would try to cover of them. But for your understanding or and for your information in this under this umbrella of NPTEL, there we floated one course earlier that was very very helpful for fluid flow in food processing and preservation.

Fluid flow that was done, in future maybe we also will be doing heat transfer or thermal as well as the mass transfer. So, this three basic engineering that is fluid flow, heat transfer and mass transfer, if they are not taken as a course, then it becomes difficult for the students to follow up everything. And because you know those are the three pillars on which the entire engineering is, I am not saying that only three pillars, but mainly these three pillars are sustaining the entire gamut of the food process and preservation industry.

So, we have to be very very thorough in that and if you have not taken up earlier that at least fluid flow course you can ask for and register as well and do as a whenever you want. Obviously, I don't know that may be some requirements by this our NPTEL

authorities that minimum so many numbers of students are required for to float already floated one course like that. So, if you demand hopefully they can also bring forward the old things. Of course, you can also do for new things like this one and subsequent things which will be coming up in the food process and preservation and both. So, there it will be very very helpful ok.

Now, you proceed to the fluid we said that this is the course and dairy and food process and products technology right. So, this is primarily a process and product technology, but we are trying to encompass as much as we can depending on our time frame whatever is given to us. So, with now come to this perhaps today you should be the lecture 16 and this will encompass on physico chemical properties of milk. Why we have taken milk? Because in dairy typically milk is the primary product right, because based on milk subsequent things have come up.

So, if you understand milk then you are understanding a major part of the dairy side. So, this is one side another side is since milk is a fluid liquid. So, we also can take this into consideration that any liquid food that could be similar to milk or may be away from milk, but liquid. So, that also can have a similar effect, similar principle of thing may not be the science means definitely the constitution of milk and another product say sub drink, say fruit juice they cannot be identical, but the basic thing is that they are also fluid.

So, that both as I said a mass transfer, fluid flow, a heat transfer, they could be similar right. So, you can you can you can imagine you can deduce you can think you can develop different models different techniques to solve the problems, but the science part is of course, different because the basic constitution of the individual things are quite different. So we start with milk as the liquid food and part of the dairy right, so that the first thing which comes in your mind is that. What is milk? Right.

So, by definition of raw milk this is defined as the lacteal secretion practically free from colostrum obtained by the complete milking of healthy cow, look in this is a all the words in definition number 1 it is the lacteal secretion right. Subsequently when we define again some other then you will see or we extend the what is milk? To understand that so you will see that this is the lacteal secretion means this has to be a mammalian product right.

Definition of raw Milk: The lacteal secretion, practically free from colostrum, obtained by the complete milking of healthy cow.

The term MILK is also used for white colour, non animal beverages resembling milk in colour and texture such as soy milk, almond milk, coconut milk etc.



Other than mammalian no other species can produce milk only the mammalian can produce milk right, have you ever seen the chicken is producing milk no because it's not mammalian. So, those which are under mammalian category they only can produce milk right. So, from the definition that the lacteal secretion practically free from colostrum though we will come again colostrum after words, but since it has come here let us also say colostrum is such a unique thing, ok before that let us say whether you believe or I believe doesn't matter got right.

But, we consider nature scientist to consider nature to be may be god or equivalent to that, nature is the biggest friend, biggest enemy, biggest everything nature we were we are living with nature right, everything is nature. Now, that nature has given such the other day when I was talking about sub stable or semi perishable food, so there you remember that we said that egg right, just now I get the example of chicken. So chicken do produce a egg right and that egg on hatching becomes a baby chicken right. So to form the baby for chicken nature has given its egg.

Now, egg that egg is hatch and you are getting the young, but other type of species like human like cow like well like many others those which are mammalian right. It may be controlled I am not sure about well, but yes goat or buffalo all these are mammalian. So, these mammalians when they produce the young they give birth of the young the young has to be protected, because it was in the womb of the mother and when it came out of the womb of the mother, then it is in a new environment altogether different over what when it was or that particular young was in the womb that baby was in the womb that

time it was all together different condition both physical and everything. And the moment it came out to the new environment on the earth is started fighting against the odds.

Now, to protect this baby from the all odds nature has given the first few milking of the mother, whatever it be that mother after first milking of few milking produces this colostrum which contains lot of antibodies and many other properties. Obviously, this colostrum is quite different in test and others from the normal milk right, that is why you will say I do not know whether how many of you have ever gone to any milkman where milk is being milked from the say cow or buffalo whether you had ever gone to those places or not.

Even if you had then you might have seen that the cow which has given the birth of the new cub is not allowed to be milked for some time, because that milk is given to the baby cub, because it contains lot of colostrum which is required by the cub or young which whatever way I am giving the reference of cow say it could be cub. But any other even human milk also that can baby takes the few milk or few days milk from the mother where this colostrum is a part of that and protects from the odds against the surrounding. Because the as I am repeatedly saying that when it was in the womb there it was 1 condition.

And when it has come out from the womb and took birth in the on the surface of the earth lot of other difficulties it we that baby will encounter to protect nature has given that right, so that is the colostrum. So, by definition we say that other than clostrum colostrum free and practically that the lacteal secretion of the mammalian of from the healthy cow or animal or mammalian we should say is called milk by definition right, of course, nowadays other milks are also available other than lacteal secretion.

So, that is why the second definition could be the term milk is also used for white color, non animal beverages resembling milk in color and texture such as soy milk, almond milk, coconut milk, and many others etcetera right. So this is a another kind of milk this is not the mammalian, it is not from the mammalian it is from not from the secretion of the mammary gland it is artificially produced.

Maybe from soy as a source, maybe from coconut as a source, maybe from almond as a source and many many such others, which nowadays are also available a commercially

also as milk that is why this second definition is also important and we have to keep in mind that. That is also milk which resembles which resembles the appearance color texture of milk, but not obtained from the mammary secretion of or from the mammalian right.

Physico-chemical properties and structure of milk and milk constituents

- **What is milk?**
 - Milk is the normal secretion of the mammary gland of mammals providing good nourishment for the young.
 - Sources – cow, buffalo, goat, sheep, camel, mare, etc.
- **Constituents of milk:-**

Source	Water	Fat	Protein	Lactose	Ash
Buffalo	82.14	7.44	4.78	4.81	0.83
Cow	87.27	3.66	3.47	3.66	0.69
Goat	84.14	6.00	4.03	6.00	5.02
Human	87.47	3.76	2.14	3.76	0.31

So, if we see this then let us look into that what milk is we will look into the physico chemical properties, and structure of milk and milk constituents right. So, that is our goal to do that again we come back to what is milk. Milk is the normal secretion of the mammary gland of mammals providing good nourishment for the young right. So, for all mammalians this is true, that the secretion of the mammary gland that comes out, sources it can be any mammalian like cow, buffalo, goat, sheep, camel, mare, human etcetera etcetera, all mammalians maybe the source right.

Now if we look at what it is made of the constituents of milk, if you look at I just have given in a tabular form you see, that from the source it is different like buffalo, cow, goat, human, many many others are there I there is I cannot make the list here because that will take itself a huge time. So, there are many many and the basic constituents and if you remember in the very early class we had said the basic nutrients what we know is fat, protein, carbohydrate, then minerals, vitamins, and water right.

So, all these are the basic nutrients for human body or any right, so in that case this milk which is the mammary secretion of the mammalians is also made of all these nutrients, and depending on the source they are quite different right. Again the reason being you

see in a case where a mammalian is nature is. So, beautiful where mammalian is at in the area where the temperature is very very high may be around 50 55, there are many places right typically in deserts and many others who have the temperatures are very very high.

It is not that there is no creature yes there are some mammals are also there like some other places where the temperatures are the rivers may be -50 or -60. So, in one place it is 50 and in other place it is -50 and in both the places mammals are there. So, that is what I am again and again praising nature that nature has made such beautiful arrangement that the mammals which are in the high temperature region like 50 around which has we said.

So, they will have they will have their consequence much different than that those who which who are at around -50 very very cold very very low temperature right, and both are for the sustenance of the young which is taken birth, for the sustenance of the young which has taken birth, for that this is their nature has made such. So, that is why I have given some example for like that here if you look at sources we said buffalo let me see whether depend works or not.

Buffalo then cow, goat, and human. These are the 4 species we have given and the nutrients basic water, then fat, then protein, then carbohydrate, and then ash, this ash contains all minerals may not be the vitamins because vitamins are very very heat labile heat sensitive. So, it is very difficult to just point out vitamins like that, but ash content generally corresponds to the mineral contents right of that typical food right. So here you see and one more very very unique thing again nature has given can you name any food material, any natural not artificial. Artificial you can do anything right.

If you ask that you do one product for me which is the 100 percent carbohydrate no other things you can manufacture, or if I ask you that you please make one thing which is 100 percent protein only you can manufacture may be the test may be the appearance may be the other parameters may be are different, but you can do, but that you are artificially doing, but can you name any product any food which is naturally available where you will get what we said the basic nutrients the fat protein carbohydrate minerals or vitamins and water right.

So, can you name any such food product where you have any one of these other than water? Water is one of the major constituent of all the foods, which you have said earlier

also one of the major constituent of all the foods that is water unless that is a dry product right. All normal foods are constituted of major portion with water, so my say content maybe high maybe low depending on the food case by case. Now, as I said that can you name one food item where any one of these constituents like fat protein carbohydrate these three minerals vitamins living aside water living aside.

Basically fat protein carbohydrate any one of these is there is a single component present in any food, can you name any perhaps you cannot you search all over natural I am again and again highlighting, that this is natural. So, any natural product you will not find where fat or protein or carbohydrate is as a single component present except in milk. Milk is the only natural product where you can have one of these component one of these nutrients as in a singular form as a single component.

And that is the carbohydrate in milk and this carbohydrate in milk is present as lactose that is why I am highlighting I am giving much more emphasis on this that. This is the only natural product where you have single nutritional component as carbohydrate as in the form of lactose right. So, if that be then let us look into that you see buffalo contains water around 82.14 percent, cow around 87.27. This is not the exact if you think that all buffalo will have that all cow will have that not like this.

This is at representative values it gives you idea that cow milk will have more water than buffalo milk right. Goat around 84.17, human around 87.47 these are water content, fat content you see it various 7.4 for buffalo then 3.66 for cow, 6 for goat, 3.76 for human, protein is around 4.78 for buffalo, cow around 3.47 for protein 4.03 for goat and 2.14 for human being, lactose and 4.81 for buffalo, 3.66 for cow, goat 6 and human being for 3.76, ash varies for buffalo 0.83, for cow 0.69, for goat 5.02, and for human 0.31.

Of course you are you are young maybe somewhere around 20 right, or may be seniors are also there, we heard and it was also in media in newspapers that one of our old very very round personnel who used to take goat milk.

So, then it comes why because you see it contains around 5.02 percent ash that is the high mineral component mineral content is so high maybe that particular person could have been managing the source of fat protein or carbohydrate from some other sources, but here also use see fat content is very high is around 6 right, fat lactose protein all are very high.

So, goat is also I don't know how the test is I have not taken ever, but yeah it may have a difference test could be, but it is full of nutrition. So, that might be one of the reason why that typical person used to. Of course, I am not talking the name because this is a known fact right. So, what we summarize, what we come across how what we conclude that wide range of water, wide range of fat maybe from 3 to 7 or 8 wide range of protein, but this variation is not so high.

It is between say 2 to 5, but wide range of lactose say around 3 and up to 6 and very very wide range of ash around say 0.3 to 5 depending on the source of the milk it is coming right. So, you must look into that why they have why nature has given such variation as we said in the beginning that depending on the requirement, depending on these situation, depending on the environment the mammals do secret accordingly so that the newly born is protected by all the nutrition nutrients, so that it can survive that is why this variation is so high right, but this is a very very wild saying of the reason for variation, there are many reasons for variation of course, if we come across if we get time we will also discuss what are the reasons or even this is for species we have said buffalo cow.

If you look into only cow there are many cow varieties, species, then they are also the producing different constituents of the nutrition. So, all depends on many many factors those we will come across subsequently okay today time is up

Thank you.