Dairy and Food Process & Products Technology
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Lecture - 31
Whey Protein

In this class we shall deal with Whey Protein. But if you remember in our previous class when we were covering amino acids, that time we said that there are 20 amino acids and 2 are; 20 amino acids which are having coding universal coding system, they have given code. And that they I could not show you, but today of course I shall show you and that should be in the beginning that we go to that list of amino acids and their coding names.

Amino Acid	Short form	Ciode
Alanine	Ala	A
Cysteine	Cyc	C
Aspartic acid	Asp	D
Gltamic acid	Glu	E
Phyalanine	Phe	F
Glycine	Gly	G
Histidine	His	H
Isoleucine	Ile	I
Lysine	Lys	K
Leucine	Leu	L

20 AMINO ACIDS

Amino Acid	Short form	Ciode
Methionine	Met	M
Asparagine	Asn	N
Proline	Pro	P
Gltamine	Gln	Q
Arginine	Arg	R
Serine	Ser	S
Threonine	Thr	T
Valine	Val	V
Tryptophan	Trp	W
Tyrosine	Tyr	Y

I had shown you earlier different amino acids structures, but their short name or what we call the short not only short name that is called also your when we are making abbreviation. So, this abbreviated names also there and in that we can see that there are 20 amino acids which are listed right and these have the abbreviated name and the code right; this I N O R together. So, I think we should do the correction because it is not fair that this should be there. This is one and we come to that. Yeah so that there was in this mistake C O I or C I O D E that was a mistake typing and because O and I these two keys are side by side.

So, we will see that alanine has abbreviated or short name Ala has a code A, then cysteine with an abbreviation of Cyc, that is with a capital C code, then aspartic acid which is Asp right with the code D, then glutamic acid this is Glu missing glutamic acid and this is also u is

missing it is not cut and paste, but I do not know why did not take it should have been. So, let us make it little this side this also little this side. So, that comes in yeah it has come in.

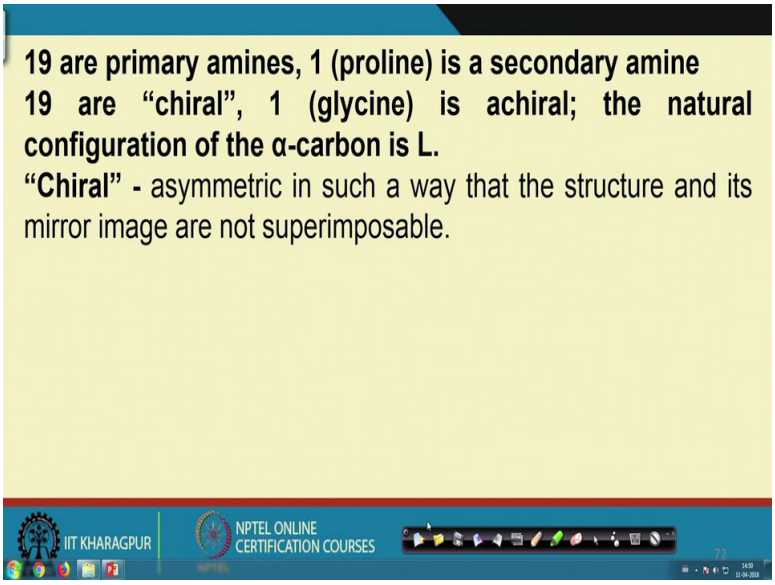
So, we come to that we have now that as glutamic acid this is Glu with E as the code, then phyalanine with abbreviation Phe code F, glycine with abbreviation Gly and code is G, histidine with an abbreviation of His and the code is H, then isoleucine which has an abbreviation of Ile right though this appears to be double l, but not true it is Ile and the code is I, lysine with an abbreviation of Lys and the code is l code is K l is not with lysine. And then leucine that has an abbreviation of Leu and the code is L, then we have methionine which has abbreviation of Met and the code is M capital M, then we have asparagine that has one abbreviation as Asn and the code is N, proline which has an abbreviation of Pro with a code of P, then glutamine with an abbreviation of Gln with a code of Q. Arginine abbreviation is Arg and code is a capital R.

And then we have serine with that Ser the other day we were saying right it is serine and this abbreviation is Ser and code is S, then we have threonine with an abbreviation of Thr and the code is T, valine with an abbreviation of Val code is V, tryptophan abbreviation of Trp and code is W and tyrosine with an abbreviation of Tyr the code is W sorry code is Y right. So, we have you see how many numbers we have how many numbers; you have 1 2 3 4 5 6 7 8 9 10 in this side; in this side 11 12 13 14 15 16 17 18 19 20.

So, these 20 amino acids I have the abbreviation as well the code right. In many cases if the code you are not conversion then abbreviation also, because Ala the moment you right abbreviated, then it appears that this is the amino acid alanine right, because the abbreviation is made in the way which you can easily pickup the actual amino acid. For example, arginine it is Arg right though your code is R, but your abbreviation is Arg. So, Arg corresponds to arginine right.

So, this way I just repeat once again; I repeat alanine Ala A, quickly cysteine Cyc C aspartic acid Asp D, glutamic acid Glu E, phyalanine Phe F, glycine Gly G, histidine His H, isoleucine Ile I, lysine Lys K. leucine Leu L, methionine Met M, asparagine Asn capital N, proline Pro P, glutamine Gln Q, arginine Arg R serine Ser S, threonine Thr T, valine Val V, tryptophan Trp W and tyrosine Tyr Y right.

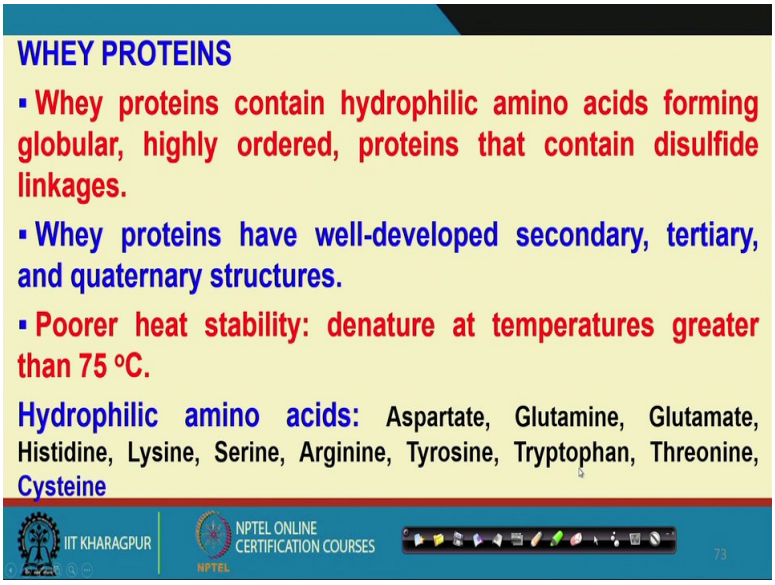
So, this is the abbreviated as well as coded name of the different 20 amino acids right.



Now a small addition I would like to make here that there are 19 primary amines. 19 primary amines and one that is proline is a secondary amine right and there are 19 chiral, these all 19 amino acids are chiral except glycine which is achiral right achiral and chiral then what is chiral? Chiral is that the asymmetric in such a way, there is a asymmetry in such a way that the mirror image is not superimposable right mirror image now this is one hand the mirror image is this right. So, you see that one to one it is coming and that is called the mirror image and this is not superimposable right superimposable we would have been like this or things like that.

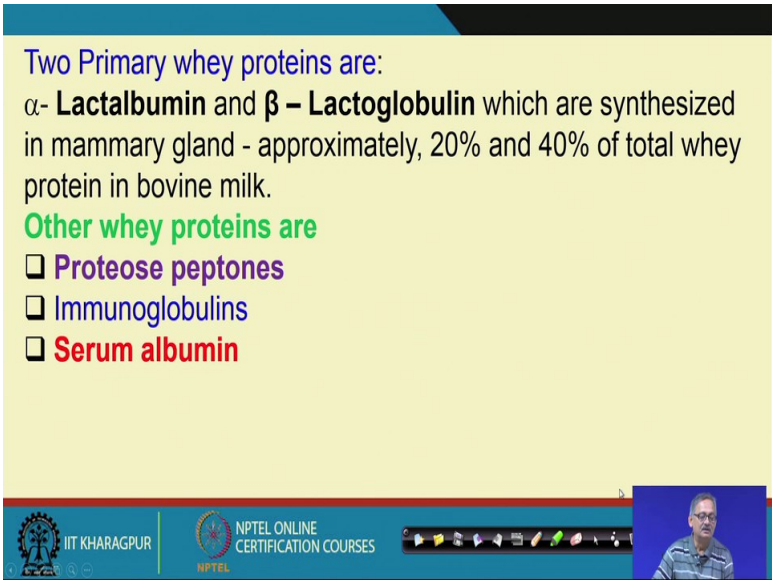
So, the mirror image which comes if because here it is not the mirror both the hands are there, had it been the mirror image then you would have seen that they are not coming into superimposing. So, if that is superimposable, then it is I mean optical activity is different isomerism is different all these are there. So, 19 of these amino acids are achiral chiral, having chiral property or chiral property, but one out of that that is glycine is achiral right. So, chiral we said, it is the asymmetry in which the structure of the original is not superimposable to its mirror image right

So, these thing also adds to the information of the previous class as amino acids right now we will go forward for today that is other proteins right so, that is whey protein right.



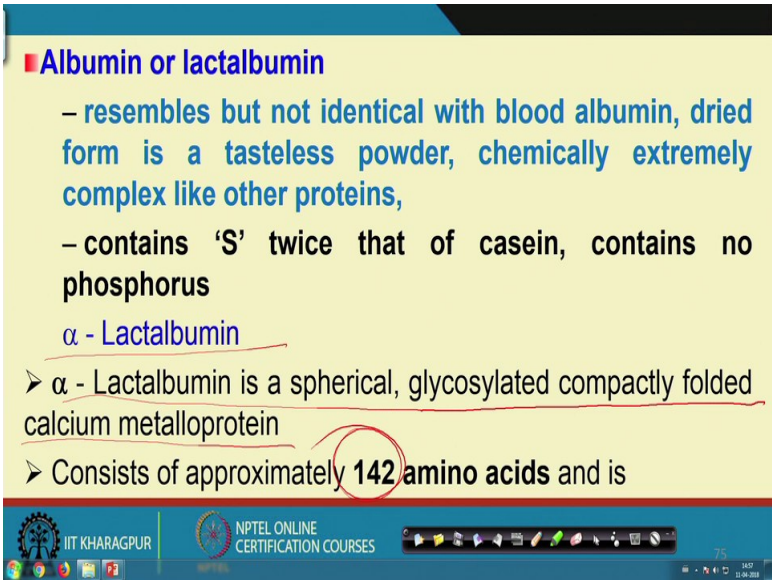
We said earlier when we were talking about the protein that time that protein casein is around 80 percent and whey protein is around 20 percent right. So, whey protein it contains hydrophilic amino acids forming globular highly ordered proteins that contain disulfide linkages. It also has hydrophobic right hydrophobic amino acids also that is why it is sparingly soluble or it is just soluble in water. Whey proteins have well developed secondary tertiary and quaternary structures right. So, we have seen earlier in casein, it has also primary secondary tertiary and quaternary structure. Whey protein also do have secondary well developed, secondary tertiary and quaternary structures.

Poorer in heat stability, but it is much lesser heat stable than that of the casein. You remember we had said casein can be heated even up to 150 degree centigrade without degradation, but not so, with the whey protein. So, it is poorer in heat stability, it denatures at temperature greater than 75 degree centigrade right. Hydrophilic amino acids are aspartate, glutamine, glutamate, histidine, lysine, serine, arginine, tyrosine tryptophan, threonine and cysteine right these are all which are associated with the whey protein right.



Then there are two types of primary whey proteins two types of primary whey proteins. So, one is alpha lactalbumin and the other is beta lactalbumin right. So, this alpha and beta this lactalbumin, they constitute around they synthesized in mammary gland, they are synthesized in mammary gland and approximately 20 and 40 percent of the total whey protein in bovine milk is composed of alpha and beta lactalbumin 20 and 40 percent respectively; alpha lactalbumin 20 percent beta lactalbumin 40 percents.

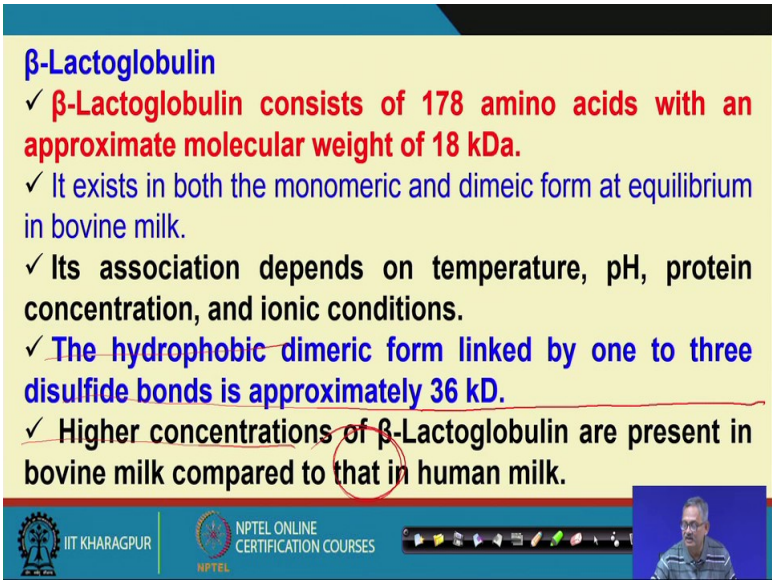
So, this 20 and 40 you have are there, in the total protein present in milk right. And they are synthesized in the mammary gland of the mammals right. Other whey proteins are proteose proteose peptones immunoglobulins serum albumin etcetera some more we will come subsequently as when we are proceeding right; so proteose peptone immunoglobulin and serum albumin.



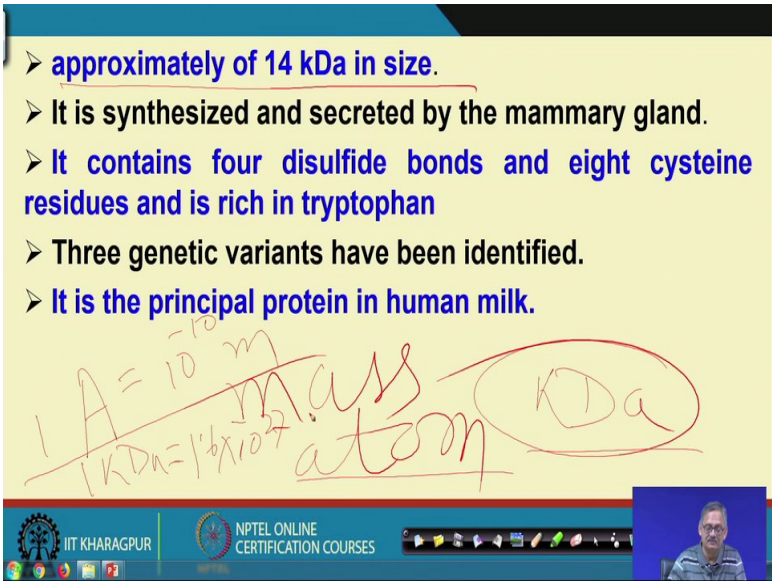
So, then albumin or lactalbumin it we will look at it resembles, but not identical with blood albumin. I don't know how many of you have seen or undergone blood test where this albumin is also there. So, thats why it resembles the blood albumin, but not identical with the blood albumin right. Dried form is tasteless powder chemically extremely complex like other proteins. We have seen that proteins they do have big big structures or polymer of many many amino acids, many types of also amino acid depending on the protein. So, there it is also complex in our alpha or lactalbumin right. So, it contains sulfur twice that of the casein and it contains no phosphorus.

So, in casein we have seen we have some sulphur and phosphorus, but in particularly this lactalbumin there is no phosphorus, but sulphur is twice that that present in casein sulfur content is very high, but phosphorus is not there right.

So, out of which we have said that this is alpha lactalbumin and beta lactalbumin right. So, if you look at alpha lactalbumin if you look at alpha lactalbumin, alpha lactal lactalbumin is spherical glycosylated compactly folded calcium metalloprotein right. It is spherical glycosylated compactly folded and calcium metalloprotein that is alpha lactalbumin. And it consist approximately around 142 numbers of amino acids 142 numbers of amino acids are present in this right.



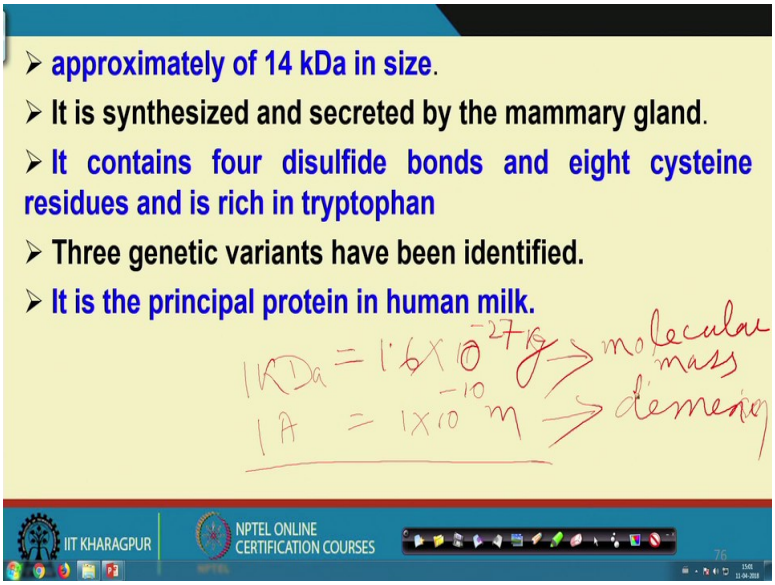
And not only that and this is approximately 14 kilo Dalton in size 14 kilo Dalton in size.



So, approximately 14 kilo Dalton right; now, in this respect let me confess that the other day perhaps by mistake, I had said that kilo Dalton: kDa is an unit of the unit of the length or something like that, but it is not I am if I had done, I apologize that was totally mistake which I after was realized, but by the time the class was over subsequent class I did not come to my mind since that kilo Dalton has come again today.

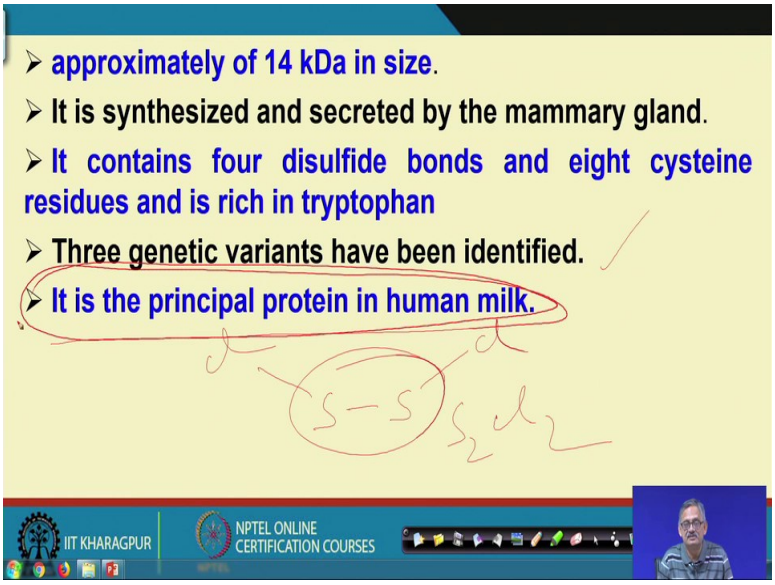
So, I say that please correct and that that is kilo Dalton is the unit of mass of the atom. This is mass of the atom is express in kilo Dalton whereas, the length or that dimension right length or that dimension in molecular level is said in terms from in terms of armstrong A right. So, one armstrong is equals to 10 to the power minus 10 meter right. One armstrong is 10 to the

power minus 10 meter whereas, this 1 unit of kilo Dalton is equal to 1 kilo Dalton is equals to. So, far I remember it is one point something 6 may be into 10 to the power minus 27.



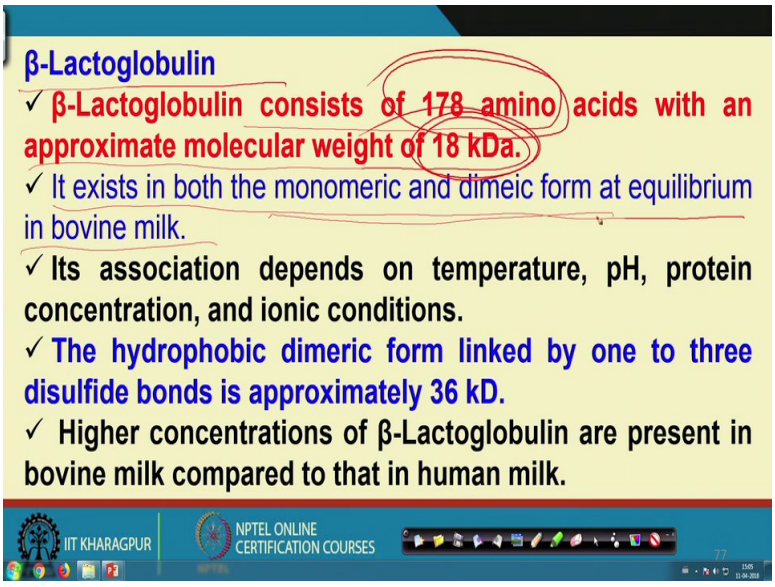
So, let me write again that this is one kilo Dalton is equals to 21.6 into 10 to the power minus 27 right 27 what kg right whereas, one armstrong is equals to 1 into 10 to the power minus 10 meter. So, this is the molecular mass, which I made a mistake in the in some class and I after that when it came to my mind, because that time perhaps I made the mistake.

So, it is better to accept it, because mistake is mistake that can happened and it is rectified now that this is 1 Armstrong is the unit of the size in the sense it is dimension length or breadth or whatever right. Length breadth or whatever that is the dimensional. So, it has approximately what we said 142 numbers of amino acids and approximately 14 kilo Dalton molecular mass.



It is synthesized and secreted by the mammary gland it contains four disulfide bonds again that disulfide if you remember we had shown like this that with chlorine and chlorine, this is the disulfide bond right. So, that is S 2 c l 2 is this molecular formula right.

So, that is there that disulfide bond is there, it 4 disulfide bonds are there and 8 cysteine residues and is rich in tryptophan. Three genetic variants have been identified for this alpha lactalbumin and it is principle protein in human milk. So, this is the principle protein in human milk right. So, because it is easily digestible and thats why nature has provided like that. So, how you said the study of nature, some other class also the uniqueness right.



Then beta globulin right: so beta globulin is sorry beta lactalbumin sorry beta lactalbumin and this beta lactalbumin is around 172 amino acids are there. So, it is composed of beta

lactalbumin around 178 amino acids with an approximately molecular weight of 18 kilo Dalton right. It was 14 kilo Dalton for the alpha. So, it is 18 kilo Dalton that is the approximate n. There it was around 142 amino acids here it is 178 amino acids right.

So, thats why may be the molecular mass is also different. Of course, number does not matter in that way, because may be huge number, but the molecular mass could be less depending on the assembly of the amino acids. But molecular mass is very high, but number is also low there also can happen depending on the individual amino acids, which are making the protein or this alpha or beta lactalbumin that is the protein right. It exist in both the monomeric and dimeic form at equilibrium in bovine milk right. Both the alpha and beta it exist in both the monomeric not alpha beta one only, both monomeric and dimeic form is there monomer that is the unit right and dimer the double of that two of them. So, but both of them monomer and dimer are in equilibrium in bovine milk right. Bovine means those like cattles which are which are reared at home normally right.

So, that bovine milk that of course, generally bovine corresponds to cow, generally bovine acid amino of cow, but it also can be those which can be reared at home like this buffalo or some others right. So, it exist in both the both the monomeric and dimeic form and it is at in at equilibrium, it is both present equally they are at equilibrium that is monomer and dimer of the beta lactalbumin right.

So, its association depends on temperature pH, then protein, then concentration protein concentration and ionic conditions right. So, that depends on these factors that is temperature pH protein content or protein concentration and ionic conditions. The hydrophobic dimeric form linked by 1 2 3 linked by 1 2 3 disulfide bonds is approximately 36 kilo Dalton. Hydrophobic dimeric form linked by 1 to 3 right disulfide bonds is approximately thirty six kilo Dalton right.

So, normally Dalton is expressed in d also, but if you are in some of the books it is also Da and k is small kilo Dalton right. Higher concentrations of beta lactoglobulin are present in bovine milk that compare to the human milk right. So, higher concentration of beta lactoglobulin is present in bovine milk compare to that in the human milk right. So, that we are coming to the n of the class.

So, let me recapitulate that we have said there are 20 amino acids, which we earlier we said and we have given the list of the amino acids and also we have given the abbreviated terms,

abbreviated amino acids or abbreviations and the code right for example, I have one small example alanine is is abbreviated as a l a and the coding is also a right; like that between a to z 20 alphabets have been chosen and given corresponding code to the amino acids. It is not necessarily that we respect to the initial the codes are given, but it is like that those codes are given to alpha not alphabetically, but according to of course, how the bigger and bigger complex things are coming right.

A little there is there is a little I don't say correlation, but it was maintained if alpha numeric it can be not numeric, alphabetically it can be arranged in a way as close as possible right. Like leucine and isoleucine right or lysine and leucine they are not having this because both l cannot be there. So, one was l and one was k. So, like that it is all given. So, it was and then you went to the whey protein, where we have seen it is primarily alpha lactalbumin and beta lactalbumin so and then we said about that, and around 20 to 40 percent of the total protein present is in this form right.

So, today we are out of time. So, let us stop it today.

Thank you.