Dairy and Food Process & Products Technology
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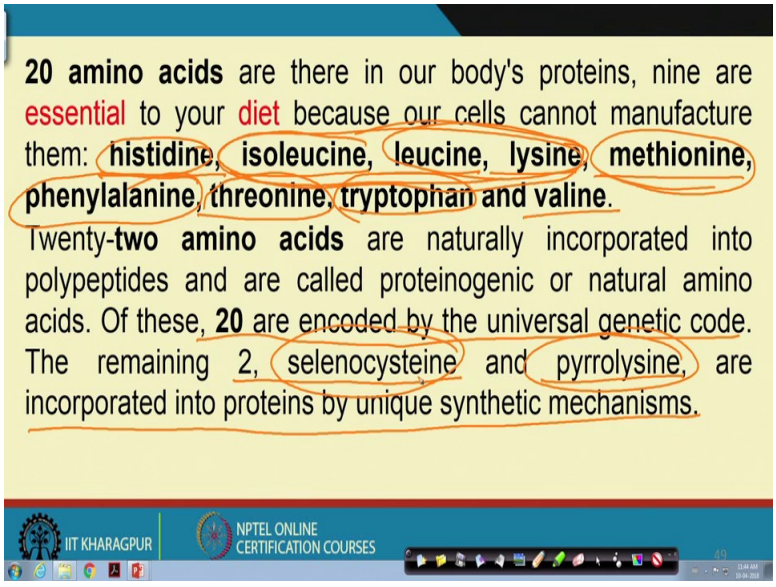
Lecture - 28
Amino Acids (Contd.)

So, we finished in the last class with the Amino Acids beginning. Today, we shall should complete it and brush up or recapitulation, is that we started with peptide and the difference between peptide and protein, difference between amino acid and protein and difference between nucleic acid and amino acid right. And then we landed up to that there are 20 amino acids which our body systems require, out of which 11 can be synthesized by the body; but 9 are not synthesized by the body and this 9 are called essential amino acids right. So, if you look back a little.

So, in this class of Dairy and Food Process Products Technology; lecture number 28, continuation of the Amino Acids.



So, in that, if we see we finished up that 20 amino acids are there in our body system and these out of which some are essential and are required to be supplemented in our diet right. So, those and nowadays, you know that advertisement has come to that level, whether you are filled and not people do not bother because that amino acid may or may not be there who is going to check. We do not have that kind of checking strong checking infrastructure also. So, they do publicize that yes this product contain so many essential

amino acids; that is the growth of your baby from 5 inch to 10 inch. It will be 5 feet to 10 feet blah blah blah blah right. So, these are not known.

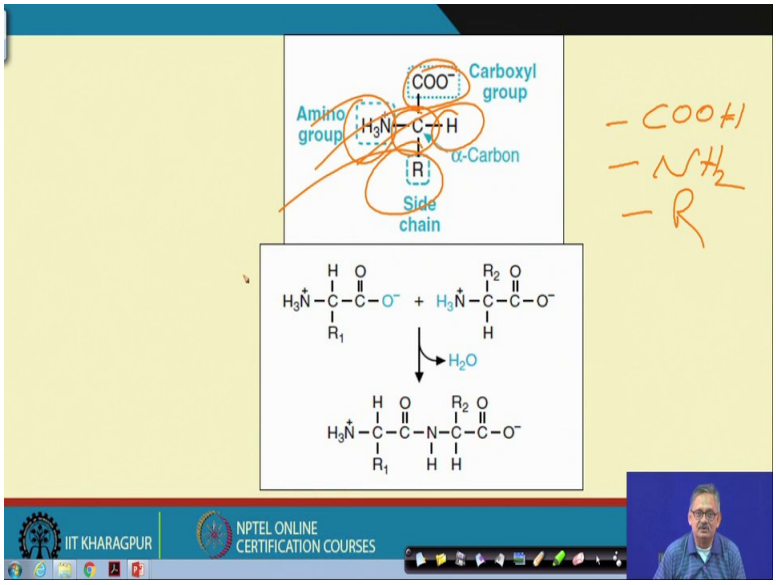
But it is true that those amino acids which are being said are not synthesized by the body to be supplemented through the diet and that is why it is called essential amino acid and the name of them we said histidine, name of them we said histidine, remember it isoleucine, leucine, lysine, methionine. So, two L, leucine and lysine, two L's right or other leucine, lysine and isoleucine, this three are easy to remember right and like methane, so methionine like that you can we can remember; phenyl, so like that phenylalaline right; threonine is a little different; tryptophan, this you come across many times in your in your medicines also and valine.

So, histidine, this also you come across with your your with your medicines and other. So, similar names, so there is no other go other than remembering it right; histidine, isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan and valine right. So, all these are essential amino acids and we said there are 20 amino acids which body systems do required, but now another two have come up. So, it is 22 right.

This two another which have come up are selenocysteine and pyrrolysine, selenocysteine and pyrrolysine. This 20 are encoded by the universal genetic code. So, those 20 are coded by the universal genetic code but the other two like selenocysteine and pyrrolysine are incorporated into proteins by unique synthetic mechanisms right. So, these 2, that is selenocysteine and pyrrolysine, this two are not coded in by the universal genetic coding system right.

So, these two are also there. So, we then come to know that two more are also there that is selenocysteine and pyrrolysine right; these two are not coded by the coding system that is universal genetic coding system. They have given the code for individual 20 amino acids, out of which 9 are essential and 11 body system can make it right.

Now, let us look into how these amino acid look like right; how this amino acid look like.

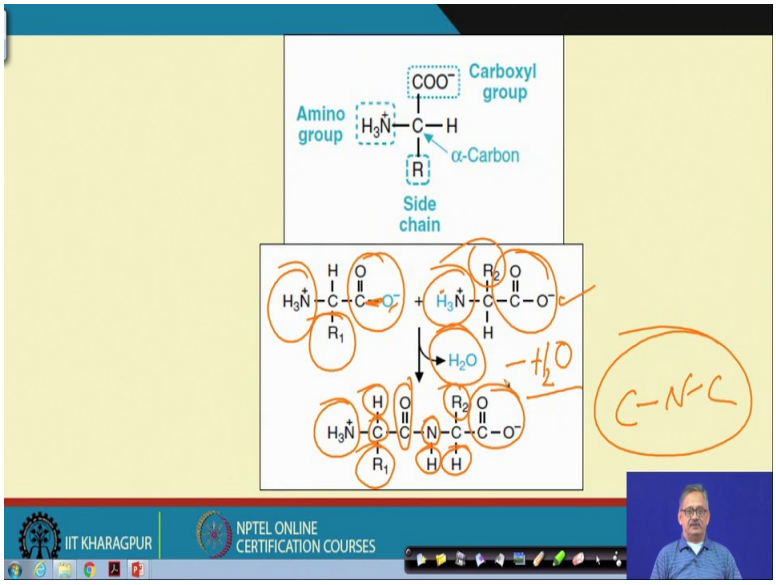


It looks like this that it has one carboxylic acid group, one amino group and one side chain group which we are referring to be R and one at the central alpha carbon atom, this is called alpha carbon, central alpha carbon. I said the other day other class also and one hydrogen group, hydrogen is also there right. So, all these put together forms the structure of the amino acid right.

All these put together makes the structure of the amino acid, repeat one carboxylic acid group C O O, H acid group is C O O H. Let me write in a better way C O O H. This is the carboxylic acid group, then amino group normally we call it amino group as N H 2 right and alkyl or side chain group is R right.

Now, here this amino acid group is shown as NH 3 plus because one H from there has come to here at forming NH 3 plus when that H has lived, so let and that is why it is minus. So, one plus and one minus is there in the amino acid basic structure. There is the side chain that is R and central alpha carbon C and one hydrogen, this is the structure of the amino acid right.

Now, let us look into that how they are forming right; how they are forming that one amino acid is reacting with the another amino acid like this. So, we have C O O minus we have.

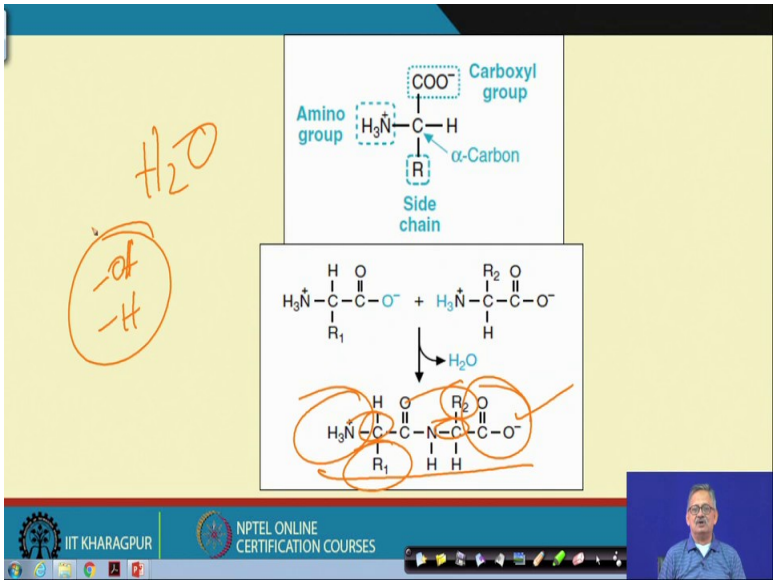


N H 3 plus with one side chain as R 1, R 1 can be anything and another amino acid with C O O minus right, a one amino group plus and another side chain alkyl group R 2 that can be anything right. So, when these two are reacting right that is by elimination of one water molecule.

So, minus H 2 O, one elimination of one water molecule is happening and then what is forming you see, N H 3 plus N H 3 plus remains H, H remains; this central carbon, central carbon remains; this R 1, R 1 remains here. We had C O O minus that C O O minus as net right and here we are joining with whom right.

This C right, this C is now because this C is now adding with one N, this N, one N and this has become N H, one H 2 and this O as left and all remaining this alkyl group as R 2, this hydrogen remained as H and this carboxylic acid whatever was there remains. So, it is the peptide bond that is C N C right.

So, this is the peptide bond between C N C where between two carbon, there is a nitrogen right between two carbon, there is a nitrogen and you see all others remaining same no change in them, only who are from one carboxylic acid, one oxygen and from one ammonia amino group or N H 3 plus, one H 2 has left. So, it has become remaining N H and that has become C O right. So, this is how the new form two amino acid groups when they are reacting or at they are joining right they form this kind of amino acid.



This is also an amino acid because we have one at carboxylic group, we have one amino group and we have central carbon. So, in this case two central carbons right and we have Rs or side chain groups that is whether it is aliphatic, aromatic, alkyl groups that we will dictate what kind of amino acid it is right.

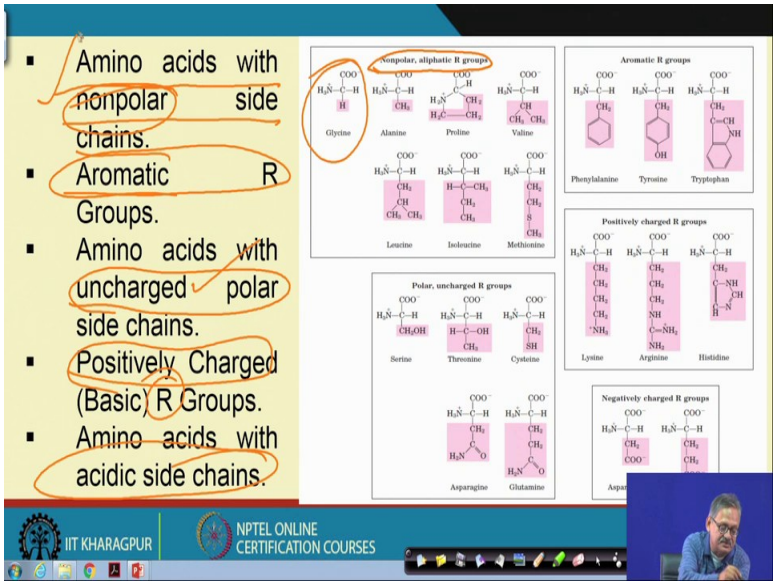
So, keep in mind that we have to keep in mind that in any amino acid, the basic units are one carboxylic acid group one amino, amino group right and one hydrogen one central carbon at the centre and this is surrounded by you know one side hydrogen and another side alkyl group or side chain group. Depending on the side chain or R, your naming of the amino acids or structures of different amino acids can be different.

Now how they are, how they are joining, how they are they are two amino acids, how they are reacting, when they are reacting then hydrogen from two hydrogen from one amino group and one oxygen from a carboxylic acid group, they are joining together. Normally the joining happens with one hydrogen and one O H which is which we have seen for elimination of, for elimination of water right.

For elimination of water, we see one O H from one and one H from another forming H 2 O and this is getting eliminated in most of the reactions we have to have but here to make you understand, it is we are showing that this hydrogen is coming from this amino group or ammonia N H 3 plus, that is why it is shown plus and one from oxygen from the other carboxylic acid group. So, that is eliminating water H 2 O and forming a amide

bond or called C N C this bond is being formed right and of course the new one will be named according to what are you have R 1, what R 2 you have right.

So, now let us look into that, what these R s are made for right.



So, this is what we are now planning to say that amino acids, amino acids do have non polar side chain. They are classified normally very difficult to classify, very difficult to classify but on the basis of this, we can make them separate that amino acids those which have non-polar side chain then aromatic R group, that side chain is aromatic side chain group, amino acids with uncharged polar side chains, uncharged polar side chains or positively charged or basic R groups and amino acid with, amino acid with acidic side chains right amino acid.

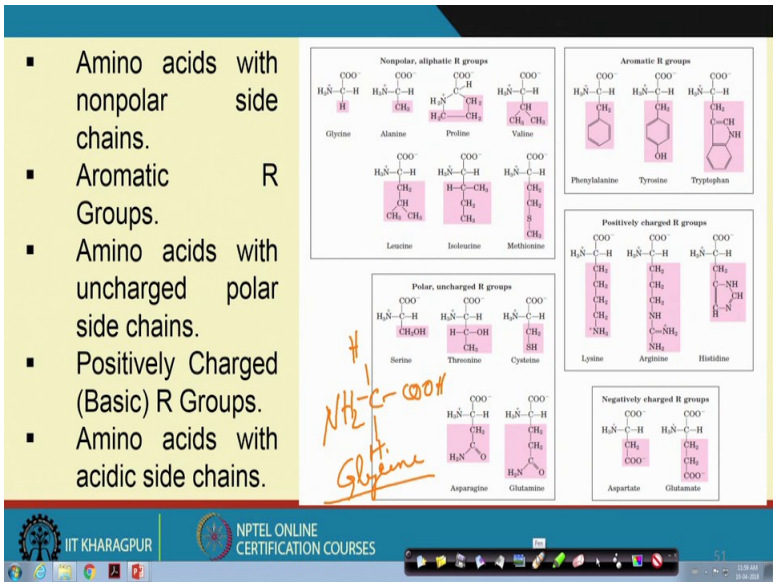
This five if we look at that the entire amino acid family they can be divided or they can be classified in on the basis of this information that, what is the information that amino acids can be classified or divided based on non polar side chain group, based on aromatic side chain group, based on uncharged polar side chain group of, based on positively charged basic side chain group or based on acidic side chain group right. So, these five can make the distinctions between one amino acid with the other right.

So, if we look at though from this, from this, from this slide, the letters are very small but you see the first one is glycine right. The simplest one is the glycine which comes under the family of non polar aliphatic R that is this one non polar aliphatic R, let me remove so that, I will clean the board, so that again we can find it out. So, this is that non polar

side chain group or aliphatic R group, in that this is the glycine that is the simplest, that is it has one carboxylic acid group, one amino group or that one central carbon, one hydrogen and the R group is replaced by H because we said that to be a non polar side chain right.

So, glycine is the simplest amino acid. So, if you are said, ask that what is the simplest amino acid; so, the answer is glycine. Then if it again asked why and how, then you have to say that a by definition amino acid do contain one carboxylic acid group and one amino group bonded with two a central carbon atom or central alpha carbon atom and one hydrogen bond or hydrogen group is also there and one side chain R is also there.

Now, if the side chain R is replaced by one hydrogen group then that is called the simplest one thus glycine right. So, it is formula will be then N H 2 C C O O H C H or N H 2 C H 2 C O O H, that is the simplest amino acid as glycine.



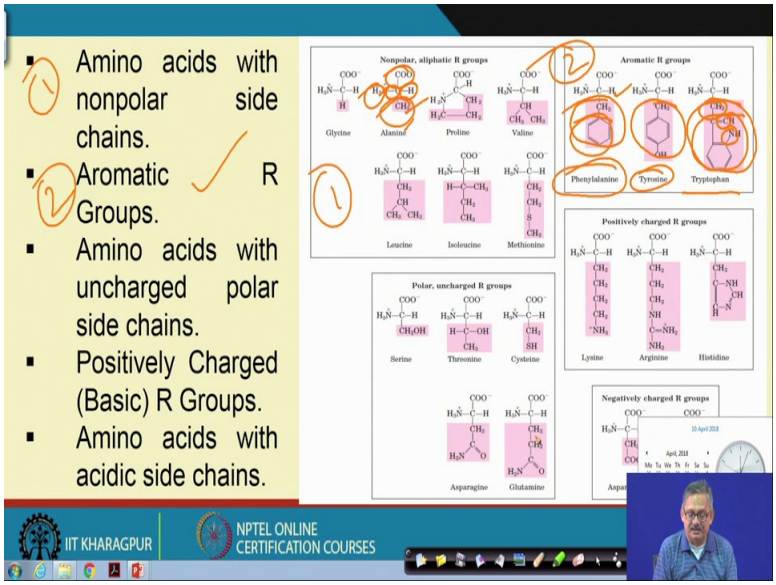
I repeat that it is N H 2 C H and H and here C O O H that is the simplest amino acid as glycine right, that is the simplest minimum size glycine ok. Then, under this group of, under this group of non-polar aliphatic R group next is the alanine. So, alanine is having one methyl group as the side chain. So, that is the alanine. Then proline proline has one methyl this C H 2 C H 2 C H 2. So, they are again inter bonded right, this is N H 2 plus this is connected to another carbon. So, and this C H 2 is connected to another.

So, our basic carboxylic acid and amino group is there but the R is a little H is also there, R is a little here also H was there, here also H was there. So, we are not deviating at all

from the definition right. Then we are coming to valine. Valine is a one carboxylic acid group, one amino acid group, one carbon central carbon and hydrogen and then this is a, this is branched chain where C H C H 3 C H 3, two carbon two, two, two alkyl group or methyl group is there with a carbon right that is the valine, C H. Then leusine, it is also a branched chain but C H 2 C H C H 3 C H 3, one N H 3 plus amino group carboxylic acid group, hydrogen is also there right.

Then leusine, it is already there. So, isoleucine, in isoleucine, it was a branch stone but here the branching is different right. Here it is C H C H 3 C H 2 C H 3 right, C H 3 C H or we can say C H 3 C H 2 C H C H 3 is this alkyl group and carboxylic acid group, amino acid group, hydrogen is also there right. Then methionine, so these 1, 2, 3, 4, 5, 6, 7 are based on non-polar aliphatic R group right.

So, in methionine, one sulphur is also there that is in the side chain, we have C H 2 C H 2 S C H 3 or this is the other way it is said C H 3 S C H 2 C H 2, that is connected to the sulphur the central carbon methyl the sorry this is that amino and carboxylic acid groups are there right, then aromatic R group, the second one, aromatic R groups, so this is the first one.



So, this is the second one right. So, second group is aromatic R group where it is phenylalanine right. So, they side chain is phenylalanine, that is this is the phenyl phenolic group with one methyl group they are right. So, it is called phenylalanine right. So, alanine was there you see one carboxylic acid, one your amino group, one hydrogen,

one central and this is methyl. So, instead of this methyl one hydrogen is replaced by this phenyl group right. So, then this becomes phenylalanine right.

Then tyrosine, tyrosine, the side chain is like this, one phenyl group with hydroxyl at one end this is parahydroxy right. This position is para, so parahydroxy this again, this alanine similar to that but in this you we are replacing with the phenol group right. So, that is tyrosine ok and this is this is of course benzene. And then tryptophan, tryptophan that side chain is like this C H 2.

So, one 6 membered with 5 member in the 5 member again, one nitrogen is there and then that is connected to this C H 3. So, basically this unit is connected to replacing one hydrogen in the alanine right. So, if that be true, then we got this one and two like that right. So, this was one and this was two right. Now, about the third and fourth, third one is that polar right side chains polar uncharged R groups.

So, what is that this is C H 2 O H, one serine right that C H 3 was in alanine. So, here it is one hydroxyl group is replacing one hydrogen. So, C H 2 O H that is serine then threonine, again one in this was replaced by the entire thing by C H 3 C H O H. That C H 3 is entirely replaced by C H 3 C H O H right. Then cysteine again, it contains one sulphur, we also saw one sulphur in methionine and one sulphur in cysteine.

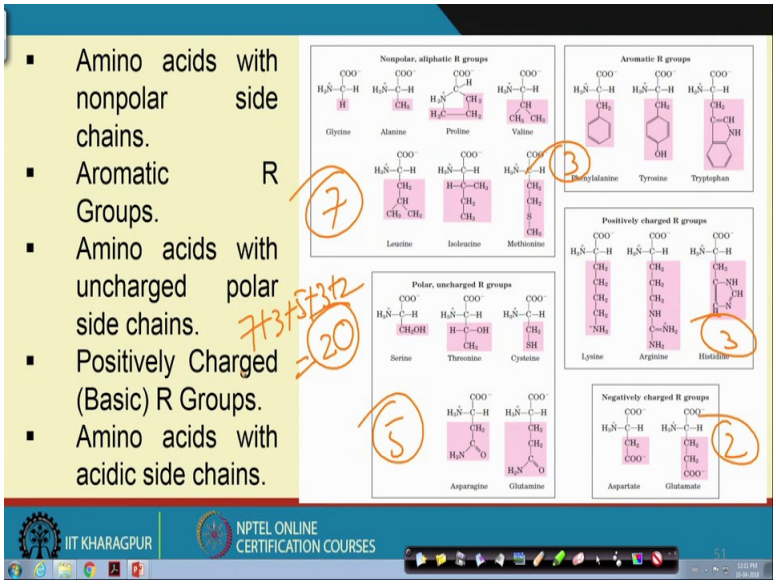
So, in that the side chain group is S H C H 2 right. Then asparagine, asparagine is that C H 3 of the alanine is replaced by this side group that is C H N H 2 C O C H 2 N H 2 C O C H 2, that is asparagine. Then glutamine, so glutamine in that glutamic acid you might have heard of course that is not this. So, glutamine this is amino acid. So, in that this side chain is replaced with this one that C H 3 is replaced with this one that is N H 2 C O C H 2 C H 2 right. This C H 3 is replaced by N H 2 C O C H 2 C H 2 is the glutamine right.

Then we come, again then we have come to 1, 2 and this is 3. We have seen this is 1, this is 2 and this is 3. Then positive charge R group positively charged R group that is the fourth differentiation or fourth group right, in that lysine is one. So, how? So, the positive charge is coming here right. You remember that we all the time said in basic unit it remains like that. So, it is also like that but the positively charged is N H 3 plus C H 2 C H 2 C H 2, this is the, this is the group which is replacing the C H 3 in the alanine right.

So, lysine is like that. Then arginine right, arginine is like this that we have a replacement of C H 2 C H 2 C H 2 N H C N H 2 plus N H 2. Normally, this is said from this end that is N H 2, C double bond N H 2 with the with the positively charged N H C H 2 C H 2 C H 2 is replacing this C H 3 of alanine right. Then histidine, histidine is a complex these were creatively simple straight chain, but this is a complex because this is having a 5 membered ring right with nitrogen.

So, this C a 5 membered ring is C H N C H N C A C with the C H 2 that is replacing this right. So, this is the positively charged R group right. So, we have come 1, 2 3 and 4. So, this 4 units, we have seen by differentiation with their R group. We have made them different or segregated them.

Now, the final unit was amino acids with acidic group. So, that is negatively charged, negatively charged R group is what acidic group C H 2 C O O minus right, this replaced that C H 3 of the alanine and this is that aspartate right. Aspartate is one there it is C H 2 C O O minus is replacing C H 3, aspartate and the glutamate right, glutamate is another where this acidic group that is C O O minus C H 2 C H 2 replacing this C H 3 was the alanine right. So, this is the negatively charged and we call it to be the fifth group as this with the negatively charged acidic group right. So, keeping all these in mind, keeping all these in mind, we will see how many then we have said here we have 3 and 7, we have here 7, here we have 3, right; here we have 5 and here we have 3 and here we have 2.



So, we have 7, we have 7 plus 3 plus 5 plus 3 plus 2 that is equals to 5, 5; 10 and 7, 3, 10; 20. So, these are the basic 20 amino acids which our body systems utilizes for forming the different proteins required by the body ok.

So, with this we conclude about the amino acid right. Next we will go to the milk protein, come back to milk again ok.

Thank you.