**PAPER TITLE**

**Organic chemistry-**

**TOPIC**

**Amino Acids, Peptides, Proteins**

**OBJECTIVES**

After going through the contents of this module you should be able to,

Recognize and represent α-amino acids

Understand the importance of α-amino acids in synthesis of proteins

Appreciate the traditional nomenclature of α-amino acids

Identify the α-amino acids by their three and one letter symbols.

Classify amino acids on the basis of the nature of side chain, dietary sources and ability to synthesize proteins.

Introduction

Hello viewers, welcome to a series of e-contents on the topic amino acids, peptides, proteins and nucleic acids. These form a group of bio molecules which are interrelated. The amino acids are the building blocks of peptides and proteins whereas the nucleic acids are the ones which contain information about the proteins. The deoxyribo nucleic acid (DNA) contains the blue print of the protein in terms of the genetic code whereas ribonucleic acid i.e. RNA is the one which participates in translating the information from the DNA to the formation of protein in the cell. So in this whole biomolecules interaction, the proteins are at the core of it and that is a central theme over here.

Just take another perspective we know proteins as a dietry source because it is a very important component of our diet and are very very essential for the normal functioning of the body because proteins play enormous amount of functions in the body. There are a lot of biological functions which they perform. Now, this whole series will be built up as follows i.e. to begin with we will start our discussion on amino acids and we will spend a lot of time on understanding different aspects of amino acids. What are they? How do we represent them? Then how do we synthesize them etc.? Thereafter, we will see that how do we move from amino acids to peptides and then to proteins. We will talk about the structural and functional part of it (proteins) to some extent. Then towards the end, we will give a brief account of the structural aspect of the nucleic acids. So that is how we are going to talk about in this whole series on Amino Acids, Peptides, Proteins & Nucleic Acids.

As regards today’s session, it is going to be focused primarily on amino acids, we will start about this session by talking about amino acids in terms of – what are they, what is the structure then how do we represent them? And also we will talk about the tradition nomenclature of α-amino acids. That means on what basis have the needs being given to them. Then as regards the representation of α-amino acids go we will talk about different kind of symbols given to them. There are three letters symbol, one letter symbol and so and so forth. Then we will spend lot of time on classification of α-amino acids. We will talk about different basis of classifying of amino acids. Then see how do we classify them and what is the significance of such a classification. Towards the end we will try to sum up what we do in today’s session.

**Amino Acids**

We have just mentioned earlier that amino acids basically are the building blocks of the proteins. But that is one bit of it. But if you really ask me, the number of amino acids known run into hundreds and most of these happen to be α-amino acids. These occur either as free or in the combined form because we know that the amino acids exist as peptides, proteins, coenzymes, harmones etc. So in the wide variety of combined forms they are available in the cell.

Further out of these whole lot hundreds of amino acids, there are twenty of these are the ones which are fundamental to the sustenance of the life forms because they are the ones which are the core amino acids which we really want to focus our attention on to. In this whole series of e-contents, we will primarily focus on to these 20 α-amino acids. We will talk more about it as we proceed.

**α-Amino Acids**

Now, let us look at the general structure of α-amino acids. The α-amino acid as the name suggest has an amino and an acid group, that means it is a bi-functional molecule. The bi-function is such that this amino group happens to be attached to a carbon atom which is α- to the carboxylic group as per typical IUPAC nomenclature. . The carbon atom next to the functional group is α, still next to it is β, still next is γ. So in case of α-amino acids we have an amino substituent at the carbon atom which is α- to the carboxylic group. That is why the name α-amino acids. Further if you look at this carbon atom here, this is attached to four different groups there.

This is carboxylic acid group, this is NH2, this is just a simple hydrogen atom and this is R. R basically represents what is called as a side chain it is the R group which differentiates the 20 amino acid because for all of them this part of it will remain the same whereas this R will keep changing. By changing R we will go from one amino acid to another so basically all amino acids are differentiated on the basis of the side chain in them. We will talk more about it as we proceed a little further. Now as regards the nomenclature, how do we name them?

Traditional names of Amino Acids

Eventually speaking, the names of amino acids have been given by their discoverers and primarily they based their names on their sources. For example the glycine, the glycine has been so name on the basis of the fact that it happens to be sweet in taste. In Greek glycos means sweet. So that is how the name was derived. Another example is tyrosine. Tyrosine picks up its name from its source, casein. Casein basically is a milk protein that is what found in cheese, so tyros again in Greek refers to cheese. So since tyrosine was found in case in which happens to be the major protein in cheese. So that is how the name was given to be tyrosine. Further tryptophan basically is the one which derives its name from its source again i.e. trypsin which is enzyme and in Greek phainein means to appear. That means this particular of amino acid appears in the enzyme called as trypsin. Similarly we have got lysine which derives its name from tendency to participate in the catalysis part of a reaction. Primarily the lysis that is in German, lysis means breaking down, thus the name lysine and so and so forth that is how the traditional names have been given.

But now a days even IUPAC accepts these traditional name. But also for all the amino acids, we have got formal names in terms of IUPAC nomenclature. Now so there are 20 amino acids as I have mentioned earlier. The table here gives you the names of all these 20 amino acids. We don’t have to bother much about it because we will be coming across this very often. Now out of these 20 amino acids, Cysteine is the one which is unique. I just want to make a brief mention here about it because this has a role to play in structure of proteins.

The uniqueness here is basically that this is the only one amino acid in which the side chain contains a sulfhydryl group i.e. -SH group and this -SH group as such gives a very unique property to this amino acid cysteine i.e. this can undergo the reaction of this kind where in presence of a mild oxidising agents, so two molecules of cysteine can undergo a covalent linkage. That means these two –SH group here (-SH group here and –SH group here), undergo a covalent linkage and give a very significant disulphide bond. This is a very pertinent feature of this particular amino acid only. So as I just mentioned that this disulphide bond formation has a very significant role in imparting the structure to the protein because there are lot of proteins which rely heavily on the formation of disulphide bonds on their overall shape and structure. We will talk more about it, may be in future e-contents there. We will talk in details about the protein shapes.

Some of the 20 amino acids which are found in the cell take part in lot of biochemical processes and they are very common also. But they are not the ones which are genetically coded. We will talk about it a little while from now. But there are some other α-amino acids, like ornithine and citrulline which are very crucial in terms of metabolism. At some stage in bio-chemistry when we will learn about metabolic pathways, we will find that this ornithine and citrulline are very crucial molecules which basically are kind of amino acids. Ornithine is is similar to lysine because we have got one CH₂ group shorter in the side chain here. But Citrulline actually happens to be a derivative of Ornithine. Moving further the another example is Thyroxine and Thriiodothyronine. These two are very very important hormones which are found in the thyroid gland and they play a very very important role in the body there. Yet another example is that of 5-hydroxylysine which actually is found in collagen. Collagen is again a very important structural protein. So that is a kind of structure of this. This basically is small derivative that means at 5 position of lysine we have a hydroxy group there. So it is 5-hydroxy lysine. So there is some just for sake of it I mentioned few amino acids which are very common but they are not the ones the core of 20. Now how do we represent them? How do we represent α-amino acid?

There are two ways of doing it because typically the amino acids have got names which are very large. If I want to talk about peptides or proteins and if I have to write the names or the sequence of proteins and all, it becomes very tedious and cumbersome to write them. So what we do is there is some kinds of a notation have been given to them and there are two kinds of notations. The first one is the three letter symbols and the second one is one letter symbols. We will talk in little details about both of them.

**Three Letters Symbol for α-Amino Acid**

Let us start with the three letters symbol. The three letter symbol basically is derived from the trivial name of the amino acid. What we do is we pick up the first three letters of the same. That means you take the common name and take the first three letters and that they can such a fashion i.e. the first letter is taken as capital and the other two are taken to be of lowercase letters. For example, if I want to talk about glutamic acid, now glutamic acid is represented as Glu. If you write GLU like this, it is incorrect and if you write all smalls which again is incorrect. So three letters symbol basically is the first three letters of their common name and first letters of the three will be the capital one. Now when you write Glu you are representing glutamic acid. What you find is most of it is very obvious say alanine. So first three letters are Ala. So we have symbol Ala, similarly arginine, aspartic acid and so and so forth because most of them are very very straight forward or 20 and 16 are very straight forward. But the question comes up is when you talk about the asparagine, now asparagine cannot be given a symbol as Asp because Asp has been given to aspartic acid. So aspartic acid and asparagine both of them have got the first letter to be count. So in this case what has been done is it has been given special symbol as Asn, sn is picked-up from here. Similarly there is a clash between glutamic acid and glutamine. Glutamic acid has been given Glu. So glutamine cannot be given Glu. So there has been given Gln. So that is how that these two are different here. Thirdly another clash comes up is when you talk about isoleucine, in case of isoleucine, iso could not be given to this as a name here because iso actually is a prefix which is a very common prefix. So it was found to be leading to some kind of ambiguities at some stage.

So it has been given special symbol. You start with ‘I’ which is given as capital and then the first two letters of leucine part of it has been taken as So Ile is the symbol for this and rest of them are straight forward and then this comes tryptophan. Now for tyrosine the symbol happens to be ‘Tyr’ which is very obvious (the first three letters). But for tryptophan, the symbol could have been ‘Try’. So there was very likelihood of confusion between Tyr and ‘Try’. So it has been thought at to give it as a special symbol of ‘Trp’, so tryptophan. So it sounds that way. So you don’t make mistake between tyrosine and tryptophan. So there are four symbols which they are not the first three letters as a defining it to be. So that is how we have defined the three letters symbol. So that is how we represent these amino acids because we don’t write the full names always.

One Letter Symbol for α-Amino Acid

One letter symbol are used because if I use three letters symbol, even that also becomes quite cumbersome because if you look at some peptides and proteins, it may run into say few hundreds of amino acids. So if you write the names of hundreds of them, even three letters are going to consume lot of space and time. So what has been thought of is we give one letter symbol to that. So in one letter symbol each α-amino acid has been given one letter symbol as the name suggests. So this letter symbol happens to be the first letter of the common name. So here again the same issue will come and that they will be more than one amino acid starting with the same alphabet. So from this point of view 11amino acids the symbol happens to be the first letter and it happens to be the capital letter. But for the rest nine of them distinct symbol has been assigned so that there is no ambiguity of any kind.

Let us look at the symbols. But before that we observe that the three letter symbols are quite straight forward, but one letter symbols are somewhat less obvious because for nine of them we have to give special symbols there and they are not the ones which are coming from the roots of the name here. Let us look at the symbols. So we will find that for eleven of them these blue ones here symbols are very straight forward. But the red ones here are the ones which have been given specially for them say for arginine can’t be given A because A has been to alanine. So arginine it has been given a symbol as R whereas the sounds arginine so that has been given a symbol as R. That is one we are looking at it. Say for aspartic acid again because there are four of them starting with A. So we could not give A to four of them.

So these three have been given the special symbols there. Aspartic acid has been given D and as paragine has been given N and so and so forth. Glutamic acid has been given E, glutamine has been given Q because G has been given to glycine and so and so forth. Say phenylalanine so as a name sounds fenylalanine, so F has been given to this. So that is some kind of a way of looking at it but these set of one letter symbols are accepted then used globally. So there is no ambiguity on that. So if I want to write a peptide or a protein, I can use these symbols to write a sequence of that. We will be talking about at a little later stage. So that is how do we represent amino acids. Now so what you done so far is we have just seen what are amino acids, what is the structure and how do we represent them? I will talk about the nomenclature little later.

**Classification of** α-**Amino Acids on: Genetic Basis**

Now let us move on to the classification. How do we classify of amino acids? There are 20 amino acids. We know that they have got very diverse kind of structure and all and we find that there is no unique way of classifying α-amino acids. They are wide variety of them. There are different basis.

1. First basis is the genetic basis. We will talk a little while from now.

2. The second is the nature of side chain and

3. Third one happens to be the dietary source.

Now let us start with the classification of α-amino acids on genetic basis. On genetic basis, there are basically two classes. The first one happens to be coded or primary protein amino acids. As the name suggests coded, what it means is so these are the ones, the amino acid for which there is a genetic code is available there and secondly these are the ones which are incorporated one by one in the protein as per the instructions contained in the ‘gene’ for their particular protein over there. That means I mentioned earlier that larger number of amino acids are there. We have talked about 20 amino acids then their some other amino acid and then their many more of them.

There are 20 amino acids which are coded because they are the ones which have got genetic code. So from the DNA, they will be translated to form the proteins. So they will be incorporated on the ribosomesfor protein synthesis. So they are also called as proteinogenic amino acids. That means they are the ones which will be forming proteins. The second class here happens to be as obvious which are non-coded or non-proteinogenic amino acids. So these amino acids are present in the cell but are incapable of participating in the protein synthesis in ribosomes. So coded amino acids are the only ones which will be become part of proteins when they are being formed in the ribosomes.

The 20 coded amino acids are the ones which I just mentioned earlier, so the same list holds true here also. Nowadays recently in past few years, two more α-amino acids by the name selenocysteine and pyrrolysine have been found to be existing in certain proteins and these also are found to have genetic codes. That means they also are in a way similar to coded amino acids and their codes happens to be UGA and UAG. But these are the amino acids which do not get incorporated into the proteins in the usual way as those 20 coded amino acids. So they are the new discovery which has been found recently. Selenocysteine basically is found in number of enzymes, for example glutothioneperoxidase whereas pyrrolysine is found to be present in certain microbes that produce methane. So this is just for the sake of information i.e. though we talk about 20 amino acids. But we know that now there are 2 more added to the

**Classification of α-Amino Acids on: Side Chain basis**

Now let us move to the next basis of classification i.e. the nature of side chain. So on the basis of the nature of side chain, there are three different classes or we can say three groups are there.

1. The first happens to be non-polar or apolar amino acids.

2. Second happens to be neutral or uncharged polar amino acids and

3. The third one happens to be charged polar amino acids. Let us look at each one of them.

**1) Non-Polar or Apolar Amino Acids**

Now non polar or apolar α-amino acids, it’s very obvious. That means the side chain happens to be non-polar. That means primarily they will be aliphatic side chain there. So look at glycine is one exception because in side chain they have got only hydrogen atom because glycine is exception in more than one place. We will talk about it as we move further. At here so glycine is one amino acid for which the side chain happens to be this hydrogen atom. So it is non-polar. Alanine has got a CH₃ group, say valine has got isopropyl and so and so forth. So glycine, alanine, valine, leucine, isoleucine or proline all of these belong to non-polar because they are aliphatic side chain there.

Proline also has last this group here because it doesn’t have polarity in the side chain there. Proline also has got one more kind of uniqueness to itself because this is only one amino acid which is not an amino acid in the true sense of it. Because in this case what happens is if you look at generally we have got NH₂ here. This is my carbon atom here, this is CH-α, this is my COH and this is my side chain here. Say this is alanine here. So this is my common thread in all amino acids there, that means NH₂, CH-α and COOH group.

So in this case what happens is in case of proline the amino group here is linked with the side chain because otherwise this amino CH and COOH helps to be there. But this amino group is a part of the side chain as well. Now this actually becomes a imino group. So if you really ask me one should call proline as imino acid rather than α-amino acid but it is collectively used in the same way as of the amino acid that. Another there are four more amino acids which belong to this class, they happen to be methionine, cysteine, phenylalanine and tryptophan. So this is SH group here but still is non-polar. So the prime thing here is that they are non-polar. It has a very significant implication in terms of structure because

these side chains which are non-polar or aliphatic in nature they will be hydrophobic. So when the protein structure comes into picture how does it protein fold, what kind of shape does it require? So these interactions will become very pertinent over there. All amino acids have a role to play in terms of their determination of the structure of proteins. We will talk more about it as we move further.

**2) Neutral Or Uncharged Polar Amino Acids**

The second class is neutral or uncharged polar. That means as the name suggest the side chain is neutral. There is no charge separation but still is small amount of polarity in that. So there is some kind of a polarity come into picture. For example, say tyrosine it has got. So this is my CH₂ a benzene ring here then this OH. It is a basically phenol part of there. So this is phenolic group, OH. Threonine – this is my OH again. Serine also – there is OH and so and so forth. So we find that these side chains are not charged but they have got some kind of a small polarity because of the functionalities available for side chain there.

3) Charged Polar Amino Acids

The third group is charged polar. That means now the side chain has a charge and of course this is a second charge, it will be polar. The example happens to be histidine, arginine, lysine, aspartic acid and glutamic acid (five of them). Lysine is the one. This is the typical backbone here. The side chain there - CH₂, CH₂, CH₂ & CH₂ (four of them). Then there is NH₂. So this is the one which is causing because NH₂ is going to pick up the proton become -NH3+ they will be charged and hence will be polar.

So this basically is an example of basic amino acid. Glutamic acid you see, in the side chain you got a CH₂ and a COOH. So this is an additional group because besides this NH₂, CH, COOH we have got a COOH group in the side chain also. So this is a carboxylic group will make the molecule again polar. This is the one way looking at the amino acid. Probably one classification could be acidic and basic amino acids. So these two are examples of acidic amino acids. Lysine and ornithine they happen to be examples of basic amino acids. That means this histidine is a basic amino acid, so it is arginine because the side chain happens to be basic in nature. So that is the way we classify amino acids.

**Classification of α–amino acids on: Dietary Sources basis**

Let us now move on to yet another way of classifying that is on the basis of the dietary sources. Let us look at what do we mean by this. We know that amino acids are synthesizing the body. All organisms, plants and animals they all synthesized amino acids. But there are certain higher animals like human beings. So they are not able to synthesize all the amino acids. Our body needs all the amino acids for variety of functions because we need lot of enzymes, we need lot of proteins and so many of them are required. But our body can synthesize some of the amino acids required for that. But others are not being made in the body. So we need to have some dietary source for that and on that basis we can classify amino acids into three groups. They happen to be:

1. Essential α-amino acids,

2. Semi-essential α-amino acids and

3. Non-essential α-amino acids.

Let us look at each one of them.

**Essential α-amino acids**

The essential amino acids as the name suggest, cannot be synthesized for the body. They must be provided by the dietary source. That means they are essential to be present in the dietary sources. The food we take must have these amino acids. If we are taking food which is devoid of these α-amino acids, we will be having lot of implications in terms of health and all. Now the essential α-amino acids, they differ from species to species. For human beings they have the certain groups. For other animals, they may be different set of amino acids that will be essential. So their food will need those amino acids. For human beings, there are eight α-amino acids which belong to this category. They happen to be leucine, isoleucine, valine, lysine, methionine, phenylalanine, threonine and tryptophan. So there are eight of them. You must have heart about lysine rich bread. Now lot of breads come which are reach in lysine because it has been added from outside. So that means if consume that bread we are taking lysine which is required by the body to prepare proteins …

**Semi-essential amino acids**

Now the second class is semi-essential amino acids. What does it mean?

These amino acids, they are the ones which can be synthesized in the body but they are synthesized at a rate which is not sufficient. That means we need certain amount of amino acids and certain rate is required, they are not formed at that rate. So it is advisable that these are available in the diet. They are not essential to be present in the diet but if they are there, they will definitely contribute to the wellbeing of the organism and the two amino acids belong to this category are arginine and histidine. Some of the authors even club these two amino acids along with the essential amino acids then accordingly there are 10 amino acids which are essential. But you must distinguish between the eight which I mentioned earlier and these two which are being synthesized in the body but at a rate lower than what is required.

Now these need not necessarily be present in the diet, but if they are there, they definitely are advisable or desirable.

Before I move to third category, let me make a mention of two very important amino acids – **cysteine and tyrosine**. They are very ambiguous in terms of the classification as we are talking about because these can be synthesized in the body. There is no problem on that. But they consume, that means **cysteine** to be made that **uses methionine** but **tyrosine uses phenylalanine**. That means we need phenylalanine to prepare tyrosine and these two amino acids - methionine and phenylalanine happen to be essential amino acids. So the body can make cysteine and tyrosine but it uses two important essential amino acids for the purpose. So it is better that these are present in the food as these will deplete, otherwise the two essential amino acids. Suppose they are present in the diet, it always good. Otherwise what happens is they will consume these two amino acids which are essential. They are not being made in the body. That means we will have to provide from outside. So if they are there, that is really great.

**Non-Essential Amino Acids**

Third class is basically non-essential amino acids. That means this is listed about 8 + 2 + another 2. So they are 12. So the eight of them happen to be belonging to this category, they are called as non-essential amino acids. What does it mean is that these can be synthesized in the body and need not necessarily be

present in the diet because it doesn’t mean they should not be there. If they are there, fine. But when I say they are non-essential amino acid, it doesn’t mean that these are not required in the body. Our body needs all twenty amino acids. All are important. The only thing is when you talk about classification of this kind essentially they are referring to the dietary sources. That means they are not essential in terms of they are being present in the diet. Otherwise they are essential for the wellbeing of the body.

**Summary**

Let us now sum up what we done today. We started by putting the topic i.e. amino acids in perspective, that means where do they falling our whole scheme of things. Thereafter, we saw what are amino acids, what is the importance and then how do we named them. We talked about the nomenclature of α-amino acids in terms of the traditional way we are doing it wherein we said that they are named on the basis of their sources and some other physical properties. Thereafter, we took up the representation of amino acids. In the context of representation, we talked about two ways of representing them. One is in terms of three letters symbol or three letters code and one letter symbol and we saw that how do we represent them and what are the rules of representing them in this kind of symbol and all.

Thereafter, we had a detail account of the classification α-amino acids on different basis. We started with the classification base of genetic basis. On that basis, we said they are coded and non-coded amino acids. Thereafter we talked about classification on the basis of the nature of side chain where we have talked about the amino acids side chain to be say a polar or non-polar and then uncharged polar and then polar and so and so forth. Then we did highlight this fact that they have significant in terms of the overall structure the proteins going to adopt at a later stage.

Thereafter, towards the end we took up the classification of α-amino acids in terms of their dietary source and in that context we defined three different classes’ i.e. essential amino acids which are essential to be present in the dietary source. Then there are semi essential, they desirable to be there and non-essential need not be there in the diet but we conclude by saying that all α-amino acids are essential for the body. It is just that only in the context of they are being present or not present in the dietary source, we put them to different

classes there. Now in the next session we will talk about the stereo chemical aspect of structure of amino acid and also we will talk about certain physical properties of the amino acids and what kind of role they play in terms of the protein structure and function.

 **F.A.Qs.**

**Q1. What are biomolecules?**

Ans. Living systems are made up of various complex molecules like carbohydrates, proteins, nucleic acids, lipids, etc. These molecules interact with each other and constitute the molecular logic of life processes and are called biomolecules.

**Q2. What are amino acids?**

Ans. These are important biomolecules composed of amine (-NH2) and carboxylic acid (-COOH) functional groups, along with a side-chain specific to each amino acid

**Q3. What are α-amino acids?**

Ans. Biomolecules, in which an amino group and a carboxyl group both are attached to the same carbon (C) atom, termed the α-carbon are called α-Amino Acids. The remaining two bonds of the α-carbon atom are generally satisfied by a hydrogen (H) atom and the *R* group.

**Q4. What is R group in an α-Amino Acids?**

Ans. The R group in an α-Amino Acid represents the side chain it represents a H atom in glycine or any other aromatic , hetrocyclic ring or simple aliphatic chain as in alanine. The R group differentiates the 20 amino acid because for all of them three groups on the α carbon remain same and only the fourth group R keeps changing.

**Q5. What are coded amino acids? How many coded aminoacids are present in the living system?**

Ans. The amino acid for which there is a genetic code available on the DNA are incorporated one by one to form the protein as per the instructions contained in the ‘gene’ for the particular protein. There are 20 amino acids which are coded they are the ones which have got genetic code. So from the DNA, they will be translated to form the proteins.

**Q6. What is the classification of amino acids on the genetic basis?**

Ans. The coded amino acids which take part in protein synthesis are also called as proteinogenic amino acids. That means they are the ones which will be forming proteins. The second class here happens to be as obvious which are non-coded or non-proteinogenic amino acids. So these amino acids are present in the cell but are incapable of participating in the protein synthesis in ribosomes.

**Q7. Why proline should be called as the imino acid?**

Ans. The amino acid proline has NH group rather than NH2 attached to the α carbon atom as both the NH and the α carbon become a part of the five member ring. Now this actually becomes a imino group. So one should call proline as imino acid rather than α-amino acid but it is collectively used in the same way as of the amino acid that.

**Q8. What are essential amino acids? How many amino acids are essential?**

Ans. The essential amino acids as the name suggest, cannot be synthesized by the body. They must be provided by the dietary source. That means they are essential to be present in the dietary sources. The food we take must have these amino acids. If the food we take is devoid of these α-amino acids, we will have lot of complications in terms of health. The essential α-amino acids, differ from species to species. For human beings they have the certain groups. For other animals, they may be different set of amino acids that will be essential.

Essential amino acids for human beings are: Valine and Leucine

 **Glossary**

**α- Amino acids:** These are biomolecules in which an amino and a carboxyl group both are attached to the same carbon (C) atom, termed the α-carbon. The remaining two bonds of the α-carbon atom are generally satisfied by a hydrogen (H) atom and the *R* group.

**Amino acids**: These are important biomolecules composed of amine (-NH₂) and carboxylic acid (-COOH) functional groups, along with a side-chain specific to each amino acid.

**Biochemistry:** The pursuit of knowledge of what goes on chemically within a living system falls in the domain of biochemistry

**Biomolecules:** Living systems are made up of various complex molecules like carbohydrates, proteins, nucleic acids, lipids, etc. These molecules interact with each other and constitute the molecular logic of life processes and are called biomolecules.

**Charged Polar Amino Acids:** The side chain has a charge due to presence of an extra acidic or basic group. The examples are histidine, arginine, lysine, aspartic acid and glutamic acid.

**Essential Amino Acids:** Those Amino Acids which cannot be synthesised by our body and are essential components of our diet. The essential amino acids are Histidine, Isoleucine, Leucine, Lysine, Methionine, Phenylalanine, Threonine, Tryptophan, and Valine.

**Lysis:** Lysis means breaking down.

**Non-Proteinogenic Amino Acids:** These amino acids are non-coded these are present in the cell but are incapable of participating in the protein synthesis.

**Nonessential Amino Acids:** Those Amino Acids which can be synthesised by our body and are essential components of our diet Alanine, Asparagine, Aspartic Acid, Glutamic Acid.

**Non-Polar or Apolar Amino Acids:** These have a non-polar side chain which is primarily aliphatic in nature. For example glycine, alanine, valine, leucine, isoleucine or proline are non-polar because they have aliphatic side chains.

**Neutral or Uncharged Polar Amino Acid:** There is no charge separation in the side chain but a small amount of polarity is present due to difference in the electronegativity’s of the atoms present in the functional group. Usually these amino acids have an alcoholic or a phenolic group present. For example, Tyrosine, Threonine and Serine. Lysine, histidine and arginine are basic in nature and are examples of basic amino acids, these have a NH₂ group in the side chain. Glutamic acid and aspartic acid have a COOH group in the side chain so these are acidic amino acids.

**Proteinogenic Amino Acids:** These amino acids have a genetic code and participate in protein synthesis.

 **Summary**

In this e-content, we began by putting the topic i.e. amino acids in perspective, that means where do they fall in our whole unit. Thereafter, we saw what are amino acids, what is the importance and then how do we name them. We talked about the nomenclature of α-amino acids in terms of the traditional way, wherein we said that they are named on the basis of their sources and some other physical properties. Thereafter, we took up the representation of amino acids. In the context of representation, we talked about two ways of representing them. One is in terms of three letters symbol or three letters code and one letter symbol and we saw that how do we represent them and what are the rules of representing them in this kind of symbol and all.

Thereafter, we had a detail account of the classification α-amino acids on different basis. We started with the classification base of genetic basis. On that basis, we said they are coded and non-coded amino acids. Thereafter we talked about classification on the basis of the nature of side chain where we have talked about the amino acids side chain to be say a polar or non-polar and then uncharged polar and then polar.

Then we did highlight this fact that they have significant in terms of the overall structure the proteins going to adopt at a later stage. Thereafter, towards the end we took up the classification of α-amino acids in terms of their dietary source and in that context we defined three different classes’ i.e. essential amino acids which are essential to be present in the dietary source. Then there are semi essential, they desirable to be there and non-essential need not be there in the

diet but we conclude by saying that all α-amino acids are essential for the body. It is just that only in the context of they are being present or not present in the dietary source, we put them to different classes there.

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