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DEPARTMENT OF FOOD TECHNOLOGY

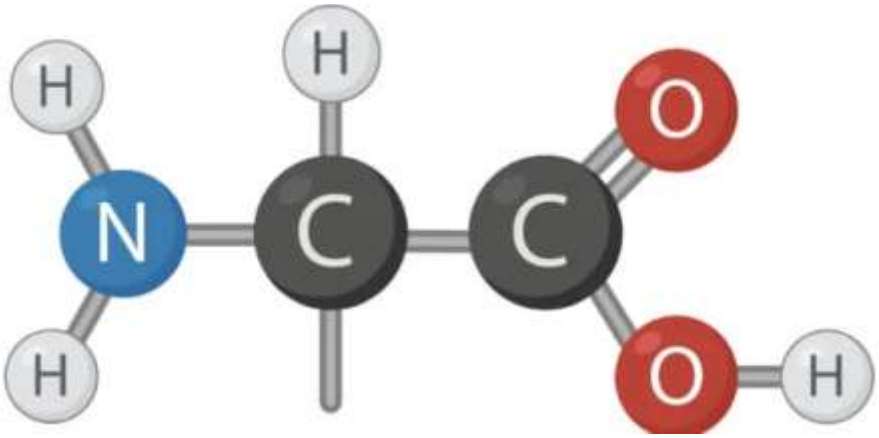
23FTT204- BIOCHEMISTRY & NUTRITION

UNIT 3- PROTEINS

TOPIC 1 & 2 - Amino Acids - Definition, Structure And Classification.

Definition

Amino acids constitute a group of neutral products clearly distinguished from other natural compounds chemically, mainly because of their ampholytic properties, and biochemically, mainly because of their role as protein constituents. An amino acid is a carboxylic acid-containing an aliphatic primary amino group in the α position to the carboxyl group and with a characteristic stereochemistry. Proteins are biosynthesized from 20 amino acids in a system involving strict genetic control. Thus, amino acids are the basic unit of proteins. More than 300 amino acids are found in nature but only 20 amino acids are standard and present in protein because they are coded by genes. Other amino acids are modified amino acids and are called non-protein amino acids. Some are residues modified after a protein has been synthesized by posttranslational modifications; others are amino acids present in living organisms but not as constituents of proteins.



Structure of Amino acids

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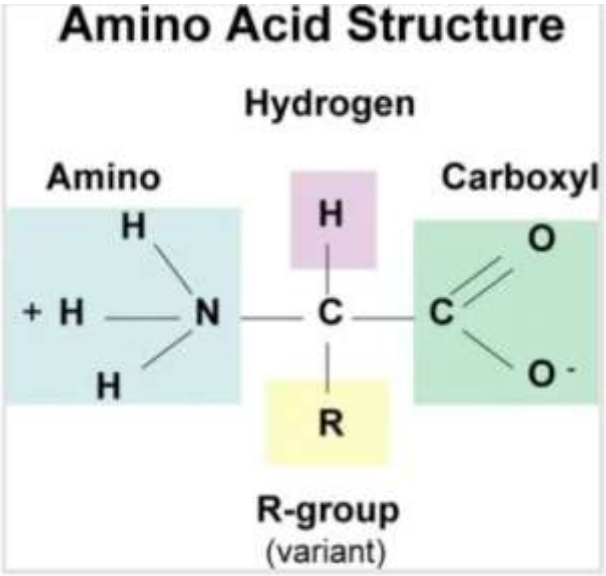
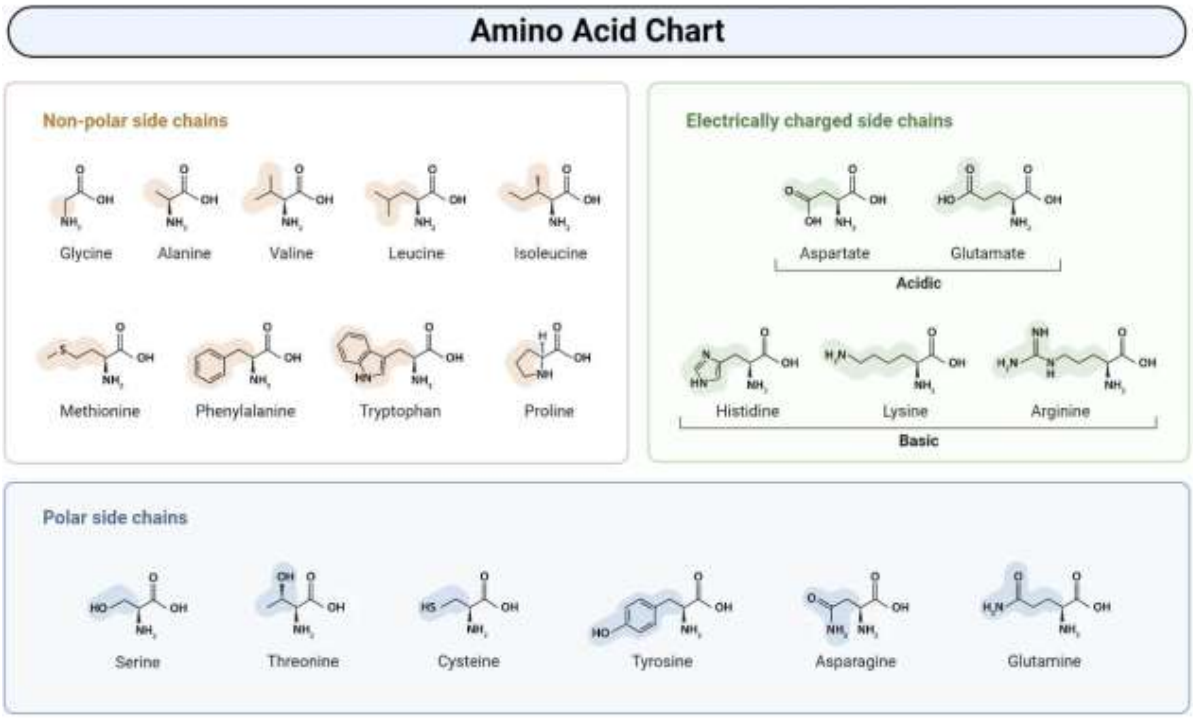
All 20 of the common amino acids are alpha-amino acids. They contain a carboxyl group, an amino group, and a side chain (R group), all attached to the α-carbon.



Exceptions are:

- Glycine, which does not have a side chain. Its α-carbon contains two hydrogens. Proline, in which the nitrogen is part of a ring.
- Thus, each amino acid has an amine group at one end and an acid group at the other, and a distinctive side chain. The backbone is the same for all amino acids while the side chain differs from one amino acid to the next.
- All of the 20 amino acids except glycine are of the L-configuration, as for all but one amino acid the α-carbon is an asymmetric carbon. Because glycine does not contain an asymmetric carbon atom, it is not optically active and, thus, is neither D nor L.

Classification of amino acids on the basis of R-group



1. Nonpolar, Aliphatic amino acids: The R groups in this class of amino acids are nonpolar and hydrophobic. Glycine, Alanine, Valine, leucine, Isoleucine, Methionine, Proline.

2. Aromatic amino acids: Phenylalanine, tyrosine, and tryptophan, with their aromatic side chains, are relatively nonpolar (hydrophobic). All can participate in hydrophobic interactions.

3. Polar, Uncharged amino acids: The R groups of these amino acids are more soluble in water, or more hydrophilic, than those of the nonpolar amino acids, because they contain functional groups that form hydrogen bonds with water. This class of amino acids includes serine, threonine, cysteine, asparagine, and glutamine.

4. Acidic amino acids: Amino acids in which R-group is acidic or negatively charged. Glutamic acid and Aspartic acid

5. Basic amino acids: Amino acids in which R-group is basic or positively charged. Lysine, Arginine, Histidine

Classification of amino acids on the basis of nutrition

Essential amino acids (Nine)

Nine amino acids cannot be synthesized in the body and, therefore, must be presentin the diet in order for protein synthesis to occur.These essential amino acids are histidine, isoleucine, leucine, lysine, methionine,phenylalanine, threonine, tryptophan, and valine.

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Non-essential amino acids (Eleven)

These amino acids can be synthesized in the body itself and hence do not necessarily need to be acquired through diet. These non-essential amino acids are Arginine, glutamine, tyrosine, cysteine, glycine, proline, serine, ornithine, alanine, asparagine, and aspartate

Classification of amino acids on the basis of the metabolic fate

1. Glucogenic amino acids: These amino acids serve as precursors of gluconeogenesis for glucose formation. Glycine, alanine, serine, aspartic acid, asparagine, glutamic acid, glutamine, proline, valine, methionine, cysteine, histidine, and arginine.

2. Ketogenic amino acids: These amino acids break down to form ketone bodies. Leucine and Lysine.

3. Both glucogenic and ketogenic amino acids: These amino acids break down to form precursors for both ketone bodies and glucose. Isoleucine, Phenylalanine, Tryptophan, and tyrosine.