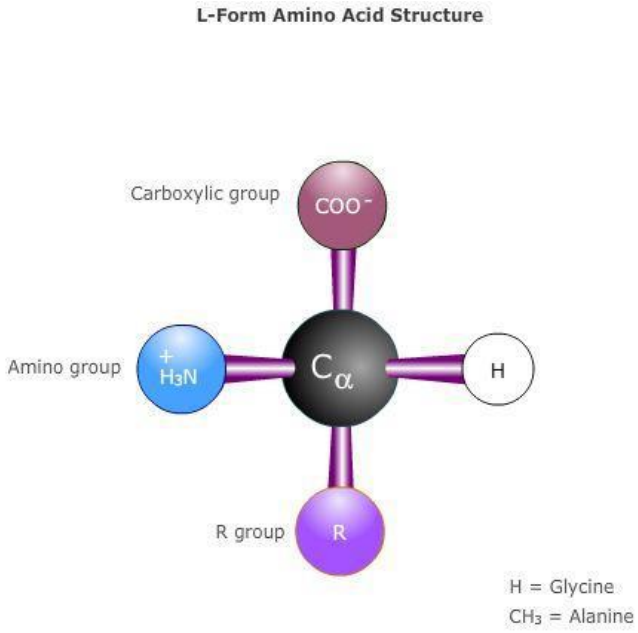
AMINO ACIDS

Introduction

An amino acid is a molecule containing both amino and carboxyl functional groups. General formula of Alpha-amino acids is H2NCHRCOOH, where R is an organic substituent. The amino and carboxylate groups are attached to the same carbon atom, which is called the $\alpha-$ carbon. Amino acids are the building blocks of proteins. Due to this central role in biochemistry, amino acids are very important in nutrition. For all animals, some amino acids are essential (an animal cannot produce them internally) and some are non-essential (the animal can produce them from other nitrogen containing compounds). About twenty amino acids are found in the human body, and about eight of these are essential and, therefore, must be included in the diet (HITFMWLKV). A diet that contains adequate amounts of amino acids (especially those that are essential) is particularly important in some situations: during early development and maturation, pregnancy, lactation, or injury (a burn, for instance). A complete protein source contains all the essential amino acids; an incomplete protein source lacks one or more of the essential amino acids.

Optical Property

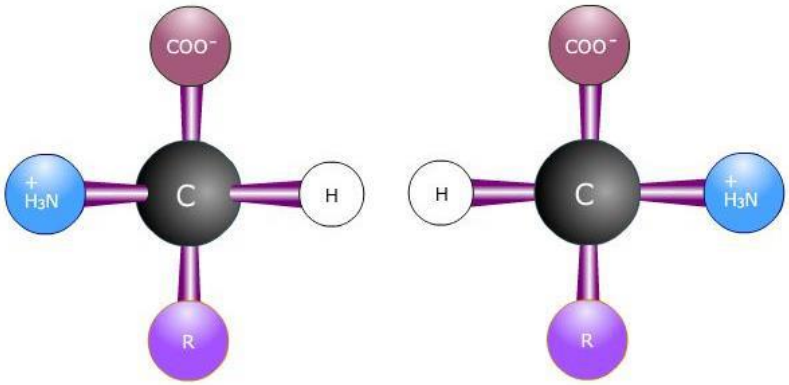
Proteins are made of twenty types of amino acids. Both one- and three-letter abbreviations for each amino acid can be used to represent the amino acids in peptides. Except glycine, all amino acids have asymmetric (chiral) carbon so they are optically active. Some amino acids are dextrorotatory and some levo rotatory depending upon the rotation of plane polarized light towards right or left direction respectively. L-amino acids represent the vast majority of amino acids found in proteins. D-amino acids are found in some proteins produced by exotic sea-dwelling organisms, components of the peptidoglycan cell walls of bacteria. The L and D convention for amino acid configuration refers not to the optical activity of the amino acid itself, but rather to the optical activity of the isomer of glyceraldehyde from which that amino acid can theoretically be synthesized (D-glyceraldehyde is dextrorotary; L-glyceraldehyde is levo rotatory).



General structure of amino acid

Optical property

Non - Superimposable mirror image



Non superimposable Mirror images of Amino Acids

Zwitterions

At a certain pH known as the isoelectric point, the number of protonated ammonium groups having positive charge and deprotonated carboxylate groups having negative charge are equal, resulting in a net neutral charge. These ions are known as a zwitterion. Thus zwitterion act as base (proton acceptor) as well as acid (proton donor).

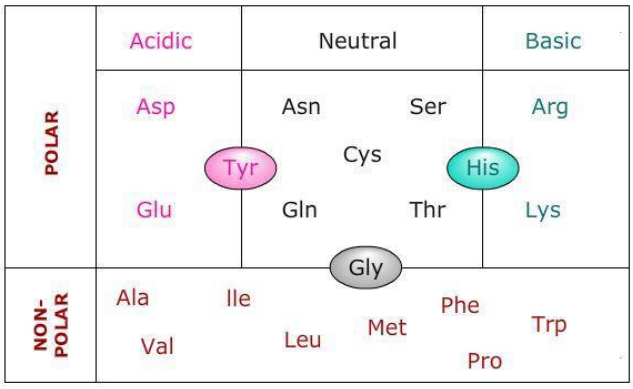
$$\mathrm{pI} = \frac{1}{2}(\mathrm{p}K_1 + \mathrm{p}K_2) = \frac{1}{2}(2.34 + 9.60) = 5.97$$

For glycine, which has no ionizable group in its side chain, the isoelectric point is simply the arithmetic mean of the two pKa values. Thus, glycine has a net negative charge at any pH above its pI and will thus move toward the positive electrode (the anode) when placed in an electric field. At any pH below its pI, glycine has a net positive charge and will move toward the negative electrode (the cathode).

Classification of Amino acids

Amino acids are classified as basic, acidic, aromatic, aliphatic, or sulfur - containing based on the properties of their R groups.

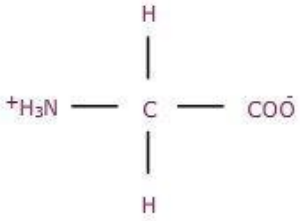
Classification of Amino Acids by Polarity



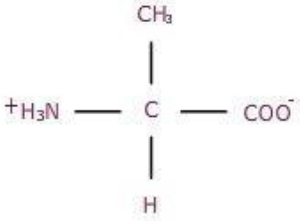
Polar or non-polar, it is the bases of the amino acid properties

Amino acids with aliphatic side chains

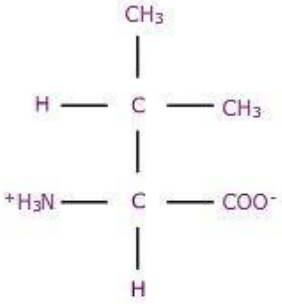
Aliphatic Side Chains



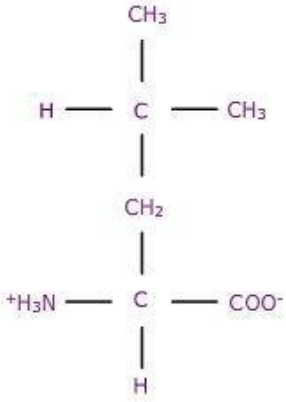
Glycine (Gly,G)



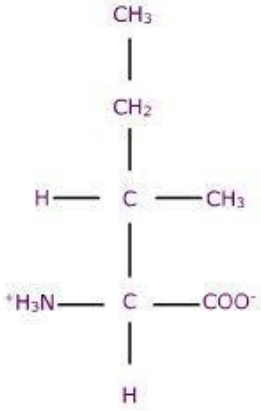
Alanine (Ala,A)



Valine (Val, V)



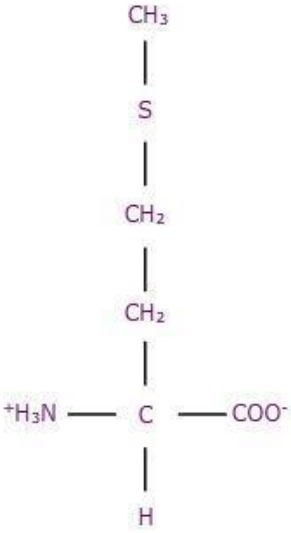
Leucine (Leu,L)



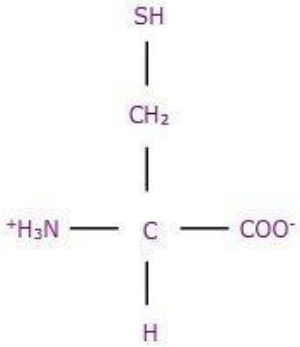
Isoleucine (Ile,I)

Amino acids side chains with sulfur atoms

Side Chains with Sulfur Atoms

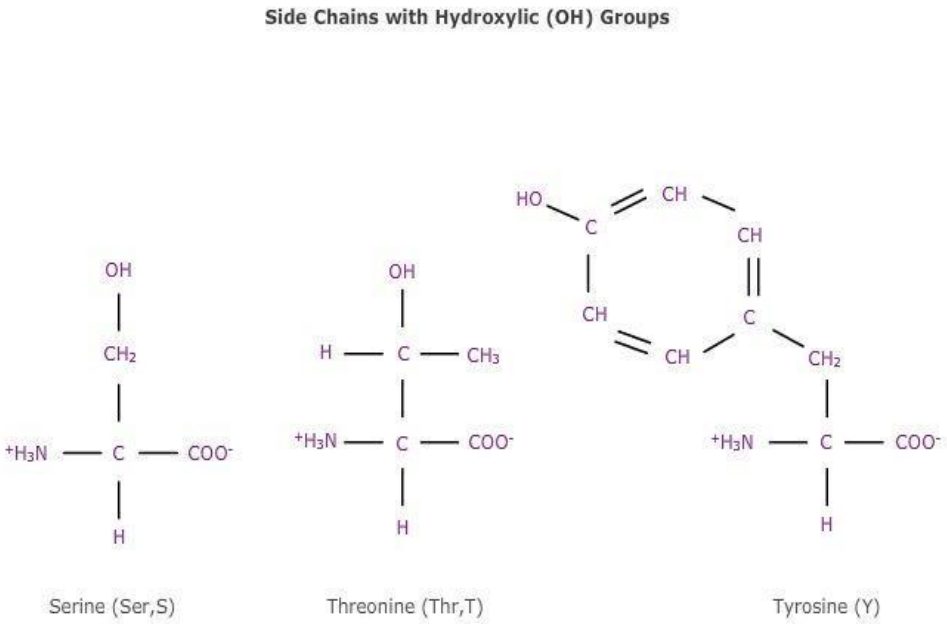


Methionine (Met,M)

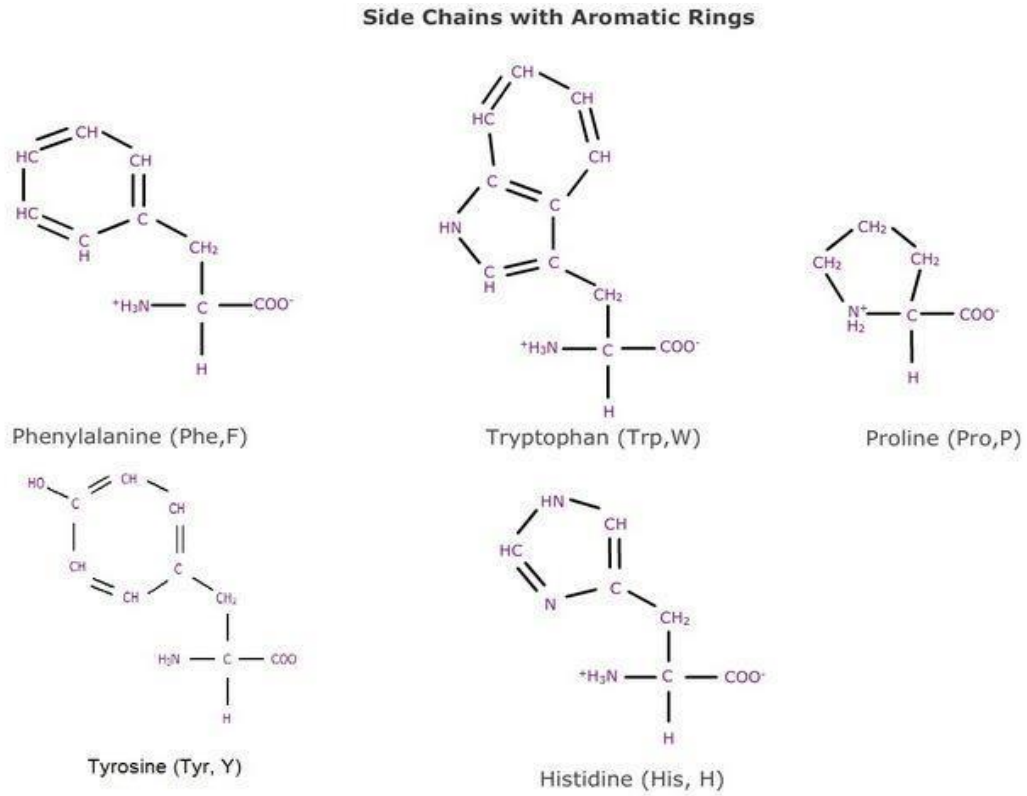


Cysteine (Cys,C)

Amino acids side chains with hydroxylic (OH) groups

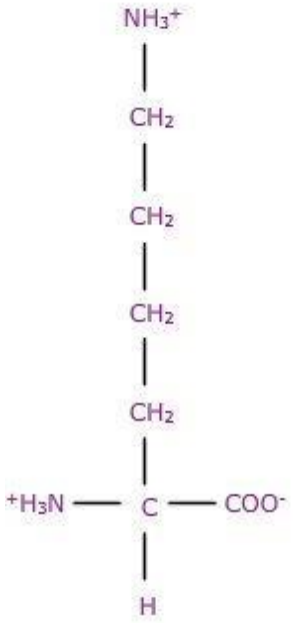


Amino acids with aromatic rings

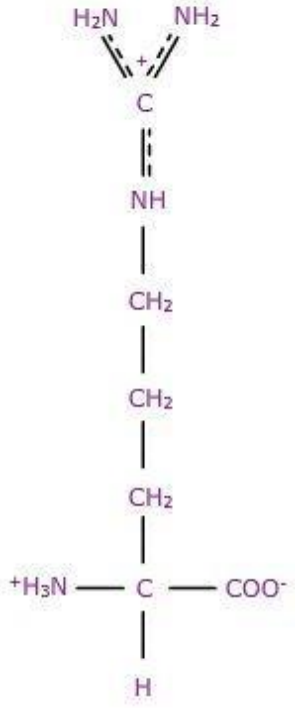


Amino acid side chain with basic group

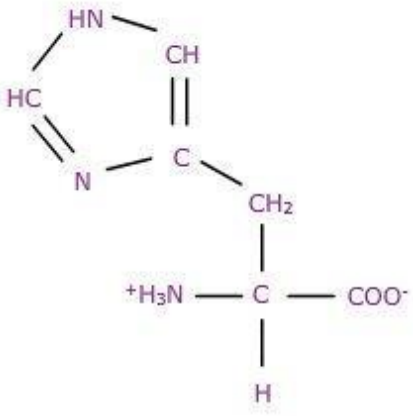
Side chain with Basic group



Lysine (Lys,K)



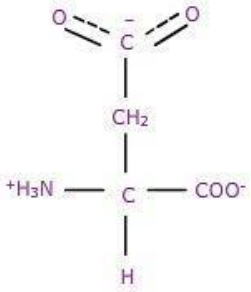
Arginine (Arg,R)



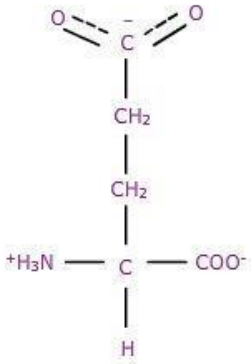
Histidine (His, H)

Amino acids side chains with acidic groups or their amides

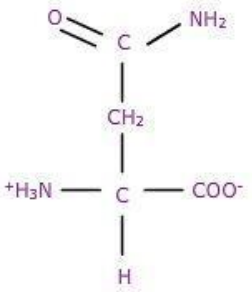
Side Chains with Acidic Groups or their Amides



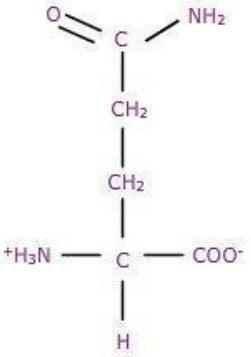
Aspartate (Asp,D)



Glutamate(Glu,E)



Asparagine (Asn,N)



Glutamine (Gln,Q)