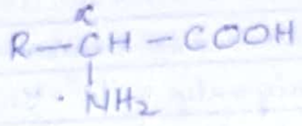
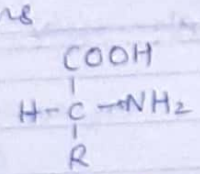
AMINO ACIDS

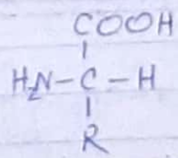
Any Consideration of the chemistry of Protein must begins with concise description of the monomeric units, the alpha amino acids when proteins are subjected to complete hydrolysis, amino acids are obtained. The amino acids are therefore, regarded as "building block of proteins" The general structure of amino acids are as follows.



Each amino acid is a nitrogenous compounds having both an acidic carboxyl (-COOH) and a basic amino (-NH_2) group. R is stand for the side chain that are different in each amino acids. The first carbon is the part of carboxyl group. The second carbon to which is attached the amino group is called the α-carbon. The α-carbon of most amino acids is joined by the covalent bonds to 4 different groups. Thus the α-carbon in all the amino acids is asymmetric except in glycine where α is symmetric. Because of asymmetry, the amino acids exist in two optically active forms. Those which are having -NH_2 group to the right side are designated as D-forms, those having -NH_2 group to the left as L-forms



D-amino acids



L-amino acid

Amino acids found in the protein is belong to L-Series (L-amino acids).

Regarding their physical Characteristic, amino acids are colourless crystalline substances. The crystal form may vary from slender needles (tyrosin) to thick hexagonal plates (cystine).

They may be either tasteless (tyrosine), sweet (glycine and alanine) and bitter (arginine). They have high melting point and often result in decomposition.

CLASSIFICATION :-

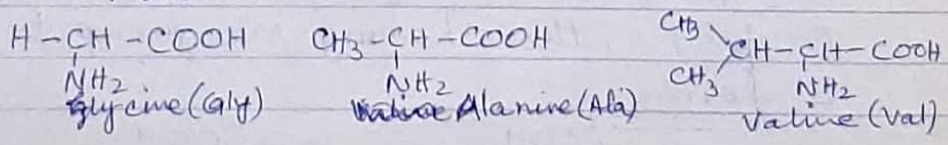
Although there are about 200 amino acids in nature but only 20 amino acids (L-isomers) are found in protein. The almost universal use of these 20 amino acids for the synthesis of various protein molecules is "one of nature's enigmatic rule". These have therefore rightly been called as the "magic 20"

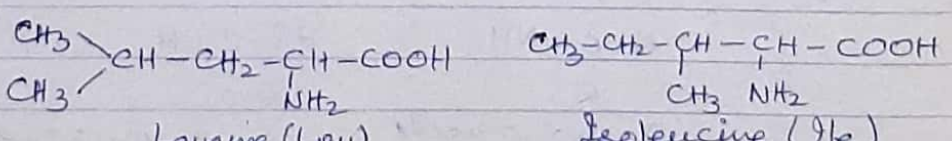
Three system of amino acid are adopted to classify them.

(A) On the basis of the Composition of the side chain or R-group :-

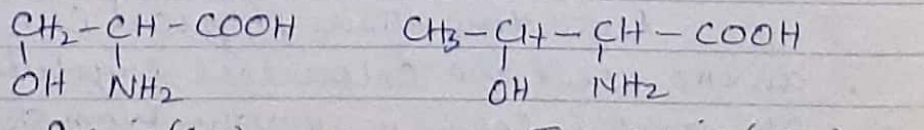
All the 20 amino acids posses a side chain which is the only variable feature in their molecules. Based on composition of side chain, the twenty amino acids may be grouped into following 8 categories (Fairly and Kilgour 1966):

(i) Simple amino acids – These have no functional group in their side chain eg. glycine, alanine, valine, leucine, Isoleucine.

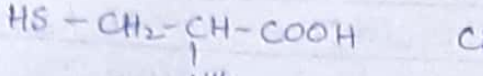




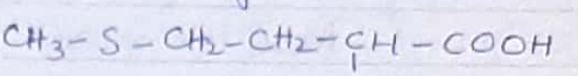
(ii) Hydroxy amino acids → Having hydroxyl group in their side chain, eg. Serine and threonine



(iii) Sulpher-Containing amino acids :- These posses a sulpher atom in the side chain eg. Cystein and methioni

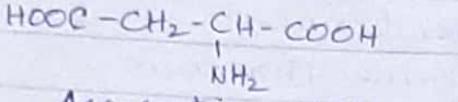


Cystein (Cys)

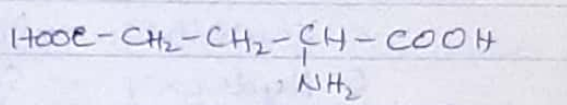


Meithrionine (Met)

(iv) Acidic amino acid :- These have a Carboxyl group in sidech eg., asparatic acid and glutamic acid.

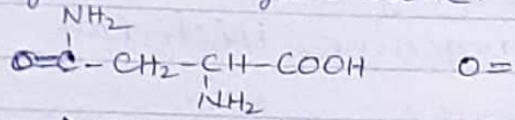


Asparatic acid (Asp)

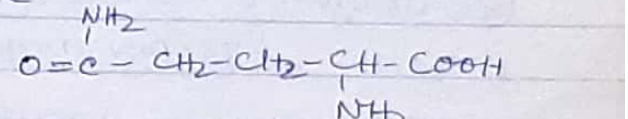


Glutamic acid (Glu).

(v) Amino acid amides :- These are derivative of acidic amino acids in which one of the carboxylic group has been transformed into an amide group (-CO.NH$_2$) e.g Aspa ragine and glutamine.

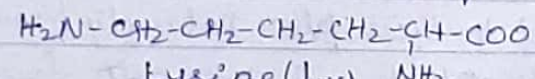


Asparagine (Asn)

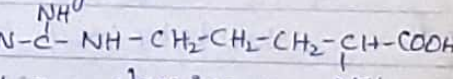


Glutamine (Gln)

(vi) Basic amino acids :- These posses an amino group in the side chain eg lysine and arginine.

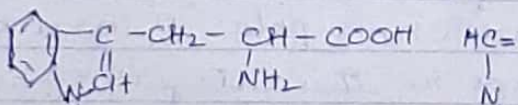


Lysine (Lys)

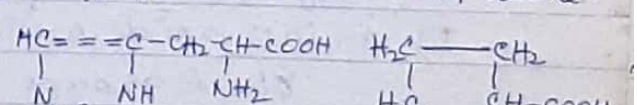


Arginine (Arg)

(vii) Hetrocyclic amino acids :- These amino acids have in their side chain a ring which posses at least one atom other than the carbon eg tryptophan, histidine, proline.



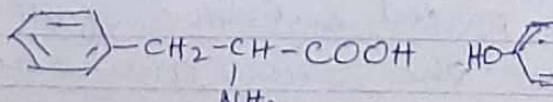
Tryptophan (Trp)



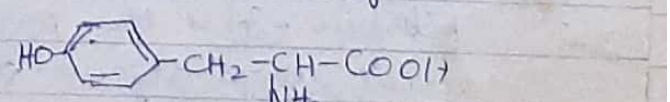
Histidine (His)

Proline (Pro)

(viii) Aromatic amino acids :- These have a benzene ring in their side chain eg. Phenyl alanine and tyrosine.



Phenylalanine (phe)



Tyrosine (Tyr)

(B) On the basis of the number of amino and carboxylic groups:-

McCilvery and Goldstein (1979) have classified various amino acids as follows:-

(i) Monoaminomonocarboxylic amino acids

1. Unsubstituted – Glycine, Alanine, Valine, Leucine, Isoleucine
2. Hetrocyclic – Prolin
3. Aromatic – Phenylalanine, Tyrosine, Tryptophan
4. Thioether – Meithionene
5. Hydroxy – Serine, Threonine
6. Mercapto – cystein
7. Carboxamide – Asparagine, Glutamine.

(ii) Monoaminodicarboxylic amino acids

Asparagena Asparatic acid, Glutamic acid.

(iii) Diaminomonocarboxylic amino acids:

Lysine, argenine, Histidine.

(C) On the basis of the polarity of the Side chain or R-group:-

The side chain or R-groups of amino acids vary widely with respect to their phase polarity from totally non-polar or hydrophobic R group to highly polar or hydrophilic R-groups. This classification of amino acids emphasizes the possible functional roles with they perform in protein. This system have following 4 categories

I). Amino acids with non-polar R-groups.-

The R groups in this category of aminoacids are hydrocarbon in nature and thus hydrophobic. This group includes following amino acids.

(1) Alanine (α-aminopropionate):-

It was first obtained in 1888 from silk fibroin - It is the parent substance of all amino acids except glycine. The various amino acids may be derived from alanine by replacement of one or two H-atoms of the methyl group present on α-carbon atom.

② Valine (α-aminoisovalerate): It is branched chain amino acids and can be derived from alanine by introduction of two methyl groups in place of two H-atoms of the methyl group present on α-Carbon atom

③ Leucine (α-amineisocaproate) :- It was first isolated from cheese in 1819 by Proust. It is also branch chain amino acids and is next higher homologue of valine.

④ Isoleucine (α-amino β-methyl valerate) It is an isomer of leucine and is also a branched chain amino acid. It has two asymmetric carbon atom and thus occurs in four stero isomeric forms

⑤ Proline (2-Pyrrolidine carboxylate) It is present in almost all protein. It is a cycliged derivative of glutamic acid. Its α-amino group is not free but is substituted by a portion of its R group to yield a cyclic structure.

⑥ ~~Phyn~~ Phenylalanine (α-amino-β-Phenyl propanate). It is benzenoid amino acid. It can not be formed in the animal because of its aromatic ring.

⑦ Tryptophan (α-amino-β-3-Indolepro pionate). It is the most complex amino acid found in protein on acid hydrolysis it completely destroyed.

⑧ Methionine (α-amino-β-methylmercapto butyrate). It is the only common amino acid which possess and ether linkage. Methionine is also important as a donor of active methyl group.