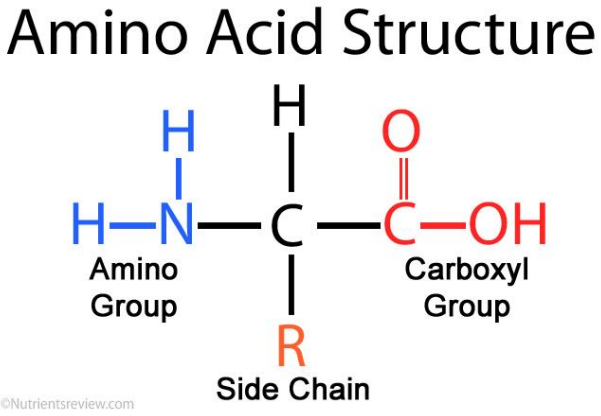
Amino acids are basically building blocks of proteins. This chapter includes the **Physio chemical properties of Amino acids**. Before going to the properties of amino acids, we should brush back the amino acids basic points. Amino acids are biological organic molecules containing both an amino group(s) and a carboxyl groups(s). An amino acid is an organic molecule with an amino group (-NH2) and a carboxyl group (-COOH).



The most frequent and of greatest interest are those amino acids forming part of proteins. Two amino acids are combined in a condensation reaction between the amino group and the carboxyl group of another amino acid, releasing one molecule of water and forming an **amide bond** is called **peptide bond**; these two amino acids form a dipeptide. If you join a third amino acid is formed one tripeptide and so on, to form a polypeptide. This reaction occurs naturally within cells, in ribosomes.

All components of the protein amino acids are L-alpha-amino acids. This means that the amino group is attached to the carbon adjacent to the carboxyl group (alpha carbon) or, in other words, both the carboxyl and the amino attached to the same carbon; also this one unite alpha carbon hydrogen and a chain (usually called side chain or radical R) of variable structure, which determines the identity and properties of each of the different amino acids. Hundreds of radicals so hundreds of different amino acids are known, but only 22 (the latter two were discovered in 1986 – selenocysteine - and 2002 – pyrrolysine -) 2 are part of proteins and have codons at specific genetic code. The human body is made up by 20 percent protein. Proteins play in almost all biological processes a key role. Amino acids are the basis of proteins.

Since much of our cells, muscles and tissues are composed of amino acids, they are part of many important functions in our body: the amino acids give the cell not only its structure, but are also responsible for transporting and storing all kind of vital nutrients. Amino acids influence the functions of organs, glands, tendons or arteries.They are essential in wound

healing and tissue repair, especially muscles, bones, skin and hair, as well as eliminating the negative impacts associated with metabolic disorders of all types.

Physio Chemical Properties of Amino acids:

1. Solubility:

Most of the amino acids are usually soluble in water, and insoluble in organic solvents.

2. Melting Point:

Amino acids are generally melts at higher temperature of ten above 200^0C.

3. Taste:

Amino acids may be sweet (Gly, Ala & Val), tasteless (Leu) or Bitter (Arg & Ile).

4. Optical Properties:

All amino acids possess optical isomers due to the presence of asymmetric α-carbon atoms except in the case of glycine.

5. Zwitter ion and Isoelectric point:

The name zwitter is derived from the German word which means "hybrid". Zwitter ion (or) dipolar ion is a hybrid molecule containing positive & negatively ionic groups. Basically the proton shifts from carboxyl group to amino group of the self molecule at normal pH cellular levels.

6. Titration Curve of Glycince:

Glycine is optically inactive, simplest amino acid because which have no asymmetric carbon atom. Acid-Base titration involves the gradual addition (or) removal of protons. It has three different stages when the Glycine undergoes acid-base titration.

Chemical Properties of Amino acids:

Chemical reactions of amino acids due to carboxyl and amino groups:

1) Due to Carboxyl group:

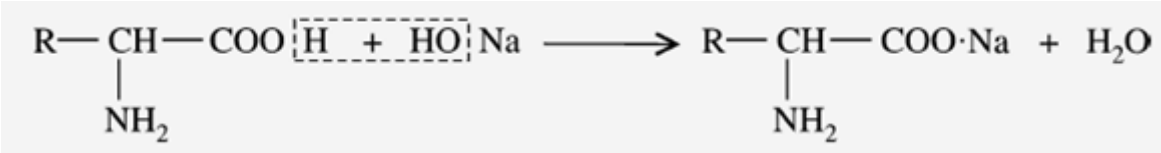
a. Decarboxylation:

The amino acids will undergo alpha decarboxylation to form the corresponding "amines". Thus important amines are produced from amino acids.

- ✓ **Histidine** → Histamine + CO_2
- ✓ **Tyrosine** →Tyramine + CO_2
- ✓ **Tryptophan** →Tryptamine + CO_2
- ✓ **Lysine** →Cadaverine + CO_2
- ✓ **Glutamic acid** → Gamma Amino Butyric Acid (GABA) + CO_2

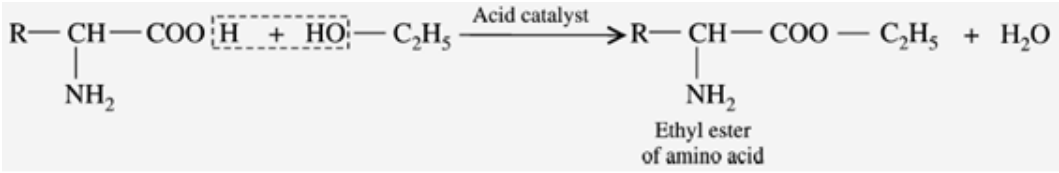
b. Reaction with Alkalies (Salt formation):

The carboxyl group of amino acids can release a H^+ ion with the formation of Carboxylate (COO^-) ions. These may be neutralized by cations like Na^+ and Ca^{+2} to form Salts. Thus amino acids react with alkalies to form "Salts".



c. Reaction with Alcohols (Esterification) :

When the amino acid is reacted with alcohol and forms "Ester". The esters are volatile in contrast to the form amino acids.



d. Reaction with Amines:

Amino acid reacts with Amines to form "Amides".

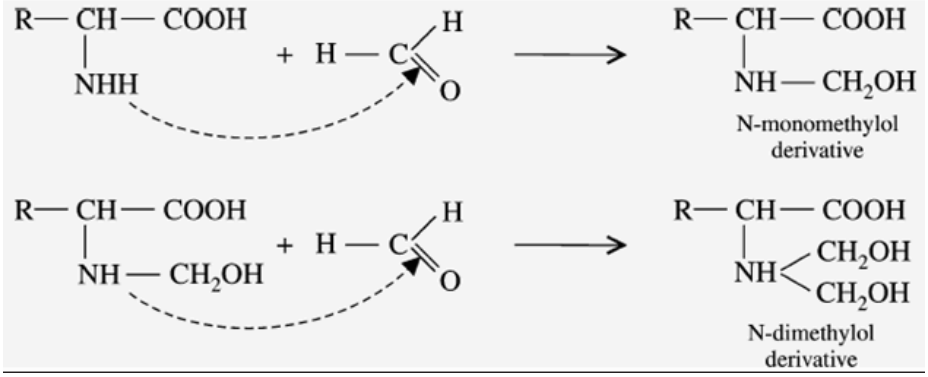
2. Due to Amino group:

a) Reaction with Mineral acids (Salt formation)

When the amino acids are treated with mineral acids (like HCl), it forms "Acid Salts".

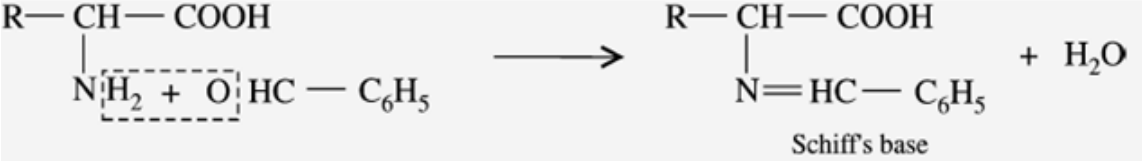
b) Reaction with Formaldehyde:

When the amino acid reacts with two molecules of Formaldehyde it forms "N-dimethylol derivative" (Hydroxy-methyl derivative). This reaction is done in two steps. These derivatives are insoluble in water and resistant to attack by microorganisms.



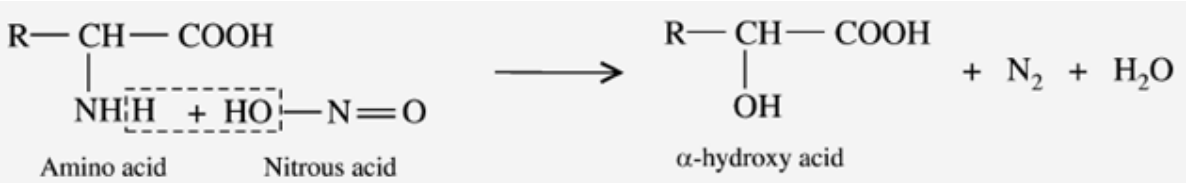
c) Reaction with Benzaldehyde:

When the amino acid reacts with Benzaldehyde, it gives "Schiff's base".



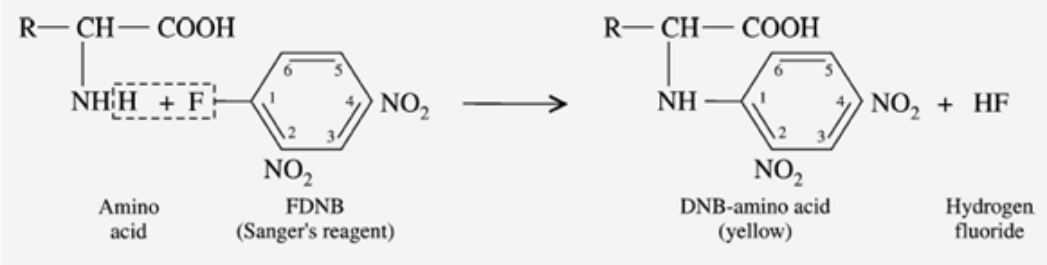
d) Reaction with Nitrous acid (Van slyke reaction):

When the amino acids react with Nitrous acid (HNO2) to liberate N2 gas and to produce the corresponding "α-hydroxyl acid". The imino acids Proline and Hydroxyproline do not respond to this reaction.



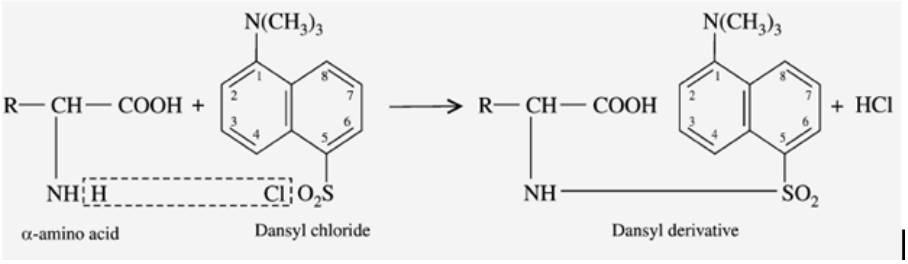
e) Reaction with Sanger's reagent:

"1-flouro-2,4-dinitrobenzene" is called Sanger's reagent (FDNB). In mildly alkaline solution, sanger's reagent reacts with α-amino acid to produce Yellow colored derivative, DNB-amino acid.



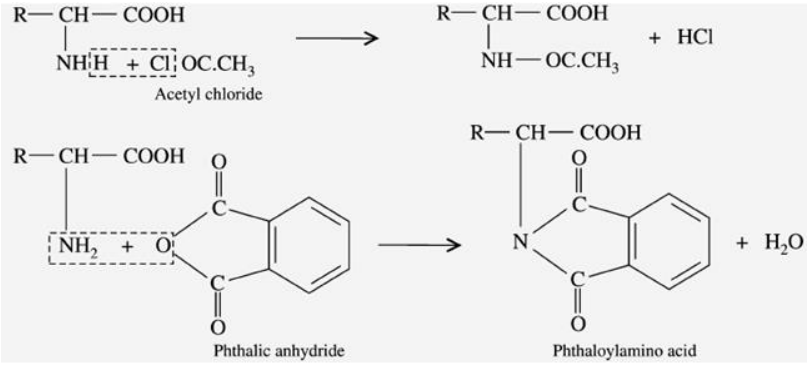
f) Reaction with DANSYl Chloride:

DANSYl chloride means “Dimethyl Amino Naptha Sulphonyl Chloride”. When the amino acid reacts with DANSYl chloride reagent, it gives a “Flourescent DANSYl derivative”.



g) Reaction with acylating agents (Acylation):

When the amino acids react with “Acid chloride” and acid anhydride (Pthalic anhydride) in alkaline medium it gives “pthaloyl amino acid”.

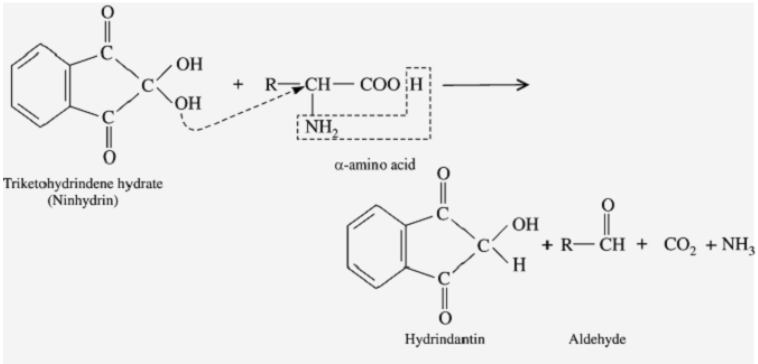


c) Due to amino & carboxyl group:

Ninhydrin reaction:

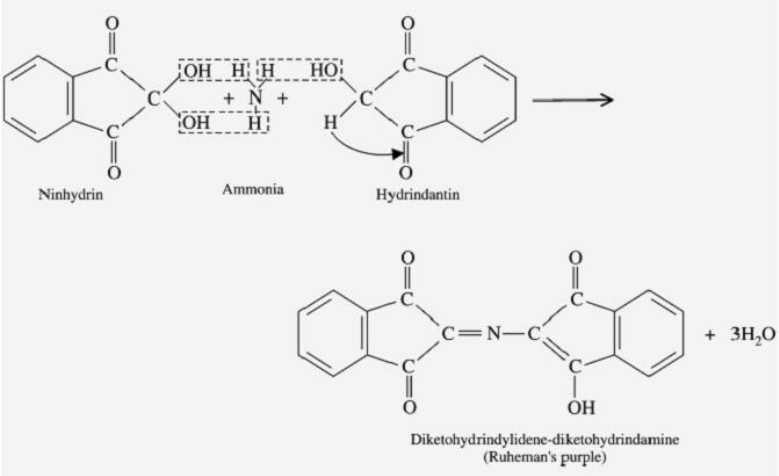
Step1:

Ninhydrin (=indane 1,2,3-trione hydrate) is a powerful oxidizing agent and causes oxidative decarboxylation of α-amino acids producing CO_2, NH_3 and an aldehyde with one less carbon atom than the parent amino acid.



Step2:

The reduced ninhydrin then reacts with the liberated NH3 and a mole of ninhydrin, forming Blue-colored Rhumann's complex.



This reaction is very sensitive reaction and it is used for amino acid and imino acid identification.

When Amino acids (or) Imino acid reacts with Ninhydrin molecule it gives Color. When it gives **Purple color (Rhumann's Complex)** –the Unknown sample is Amino acids (Which have primary amine $–NH_2$) or it is gives Yellow color – the Unknown sample is Imino acid (**-NH-**).

Reaction with Edmann's degradation:

Edmann's reagent is **"phenylisothiocyanate"**. When amino acids react with Edmann's reagent it gives "*phenyl thiohydantoic acid*" finally it turns into cyclized form "*Phenyl thiohydantoin*" (Edmann's derivative).