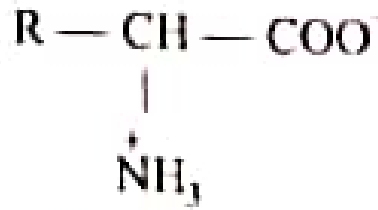
2.2 DIPOLAR NATURE OF AMINO ACIDS (ZWITTERION STRUCTURE)

It has been found that an amino acid molecule appears as a dipole, one part of it carrying positive charge and the second negative charge. The dipolar ionic structure of amino acids can be represented as:



This is also called a *Zwitterion* or *Internal salt*. There is no free amino or carboxylic group present in the molecule.

Evidence in support of dipolar nature

1. Spectroscopic studies of amino acids do not show bands characteristics of $-NH_2$ and $-COOH$ groups

2. Amino acids are insoluble in non-polar solvents and soluble in polar solvents like water. This behaviour can be expected of the polar substances.

3. Amino acids are non-volatile crystalline solids, which melt at high temperature. This is quite like ionic substances which have high melting points and unlike amines and carboxylic acids which have low melting points.

4. They have high dipole moments indicating polar nature of the molecule.

5. Dissociation constant K_a and K_b give us an idea about the acid and base strengths. Amino acids have very low values of K_a and K_b indicating that the molecule does not possess these groups in the normal forms.

2.5 ISOELECTRIC POINT

As amino acids are polar in nature, they show electrical properties. On applying electrical field to the solution of amino acids, they migrate to one or the other electrode depending upon the following factors:

(*a*) If the solution is acidic, then the equilibrium lies towards positively charged amino acid (NH_3^+ CHR – COOH). Hence, on passing an electric current through the solution of the amino acid, it moves towards the cathode.

(*b*) If the solution is alkaline, then the equilibrium is predominantly lying towards the negatively charged amino acid ($NH_2CHR - COO^-$). Hence on passing electricity, amino acid molecule which is in the form of anion, moves towards the anode.

(*c*) At a certain pH of the solution, the anionic and cationic structures will be in equal concentrations. On passing electricity we shall observe that there is no movement of the amino acid.

The pH at which a particular amino acid does not migrate under the influence of the electrical field is called isoelectric point. Every amino acid has a characteristic isoelectric point. Glycine has an isoelectric point at pH 6.1. It may be noted that amino acids have the minimum solubility at the isoelectric point. This is because at isoelectric point, there is maximum concentration of dipolar ions which are relatively less soluble.

Isoelectric points of some amino acids are given in table 2.2.

TABLE 2.2 *Isoelectric points of some α-amino acids*

Amino acid		Isoelectric point
Alanine	Neutral	6.02,
Valine		5.97
Leucine		5.98
Serine		5.70
Threonine		5.60
Aspartic acid	Acidic	2.87
Glutamic acid		3.22
Lysine	Basic	9.74
Arginine		10.70