Atomic Energy Central School, Indore

Class XII Chemistry BIOMOLECULES Handout 2/3

Proteins

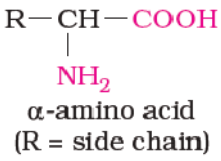
Proteins are the most abundant biomolecules of the living system. The word protein is derived from the Greek word, "**proteios**" which means primary or of prime importance.

All proteins are polymers of α-amino acids.

Sources: milk, cheese, pulses, peanuts, fish, meat, etc.
Occurrence: every part of the plant and animal body.
Function: They form the fundamental basis of structure and functions of life. They are also required for growth and maintenance of body.

Amino acids: Amino acids contain amino ($-NH_2$) and carboxyl (–COOH) functional groups. As the $-NH_2$ group is present on the α- carbon atom, these amino acids are called α-amino acids. Proteins on hydrolysis give only α-amino acids. There are 20 amino acids. Some are essential (not synthesized in the body) and others are non essential(synthesized in the body).

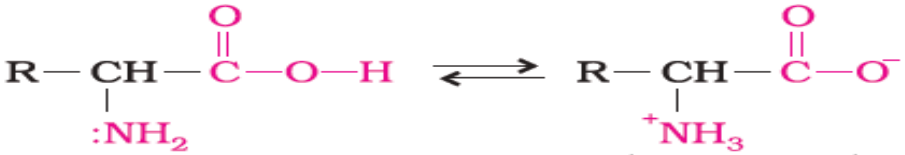
Essential Amino Acids		Non-essential Amino Acids	
Valine	Leucine	Glycine	Alanine
Isoleucine	Arginine	Glutamic acid	Aspartic acid
Lysine	Threonine	Glutamine	Asparagine
Methionine	Phenylalanine	Serine	Cysteine
Tryptophan	Histidine	Tyrosine	Proline



α-amino acid
(R = side chain)

Amino acids are classified as acidic, basic or neutral depending upon the relative number of amino and carboxyl groups in their molecule.
Neutral amino acid = Equal number of amino and carboxyl groups
Acidic amino acid = more carboxyl groups as compared to amino groups
Basic amino acid = more number of amino groups than carboxyl groups

Nature of amino acids:
1 colourless, crystalline solids
2 water-soluble, high melting solids
3 behave like salts. This behaviour is due to the presence of both acidic (carboxyl group) and basic (amino group) groups in the same molecule. In aqueous solution, the carboxyl group can lose a proton and amino group can accept a proton, giving rise to a dipolar ion known as ***zwitter ion***. This is neutral but contains both positive and negative charges.



(Zwitter ion)

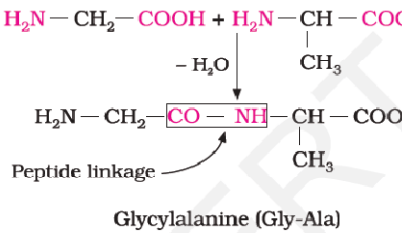
Except glycine, all other naturally occurring α-amino acids are optically active, since the α-carbon atom is asymmetric. These exist both in 'D' and 'L' forms. Most naturally occurring amino acids have L-configuration.

The melting points and solubility in water of amino acids are generally higher than that of the corresponding halo acids. Explain.

The amino acids exists as zwitter ions. Due to this polar salt like character they have strong electrostatic attractions. So, their melting points and solubility in water is higher than corresponding halo acids.

Structure of Proteins

Proteins are the polymers of α -amino acids and they are connected to each other by **peptide bond** or **peptide linkage**.
(an amide formed between –COOH group and $–NH_2$ group results In the elimination of a water molecule and formation of a peptide bond –CO–NH–).



When 2 amino acids combine, a dipeptide is formed.
Ex. Glycylalanine (Gly-Ala)
When 3 amino acids combine, a tripeptide is formed.
Ex. Glycylalanylvaline (Gly-Ala-Val)
When many amino acids combine, a polypeptide is formed. Ex. Insulin (51 amino acids)

Proteins are divided into two types		
S No.	Fibrous Protein	Globular Protein
1	When the polypeptide chains run parallel and are held together by hydrogen and disulphide bonds, then fibre– like structure is formed.	This structure results when the chains of polypeptides coil around to give a spherical shape.
2	Such proteins are generally insoluble in water	Such proteins are generally soluble in water
3	Some common examples are keratin (present in hair, wool, silk) and myosin (present in muscles),	Insulin and albumins are the common examples of globular proteins.

Structure and shape of proteins:

(i) ***Primary structure*** *of proteins*: Each polypeptide in a protein has amino acids linked with each other in a Specific sequence of amino acids that is said to be the primary structure of that protein.

(ii) ***Secondary structure*** *of proteins***:** The secondary structure of protein refers to the shape in which a long polypeptide chain can exist. They are found to exist in two different types of structures viz. α-helix and β-pleated sheet structure.

(iii) ***Tertiary structure*** *of proteins***:** The tertiary structure of proteins represents overall folding of the polypeptide chains i.e., further folding of the secondary structure. It gives rise to two major molecular shapes viz. fibrous and globular.

(iv) ***Quaternary structure*** *of proteins***:** Some of the proteins are composed of two or more polypeptide chains referred to as sub-units. The spatial arrangement of these subunits with respect to each other is known as quaternary structure.

What is denaturation of proteins?

Denaturation of proteins: When a protein in its native form, is subjected to physical change like change in temperature or chemical change like change in pH, the hydrogen bonds are disturbed. Due to this, globules unfold and helix get uncoiled and protein loses its biological activity. This is called denaturation of protein. During denaturation 2° and 3° structures are destroyed but 1º structure remains intact.Ex. The coagulation of egg white on boiling . Another example is curdling of milk which is caused due to the formation of lactic acid by the bacteria present in milk.

Where does the water present in the egg go after boiling the egg?

When the water is boiled, the protein first undergoes denaturation and then coagulation and the water present in the egg gets adsorbed in the coagulated protein doe to hydrogen bonding.

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