➢ PROTEINS

Characteristics

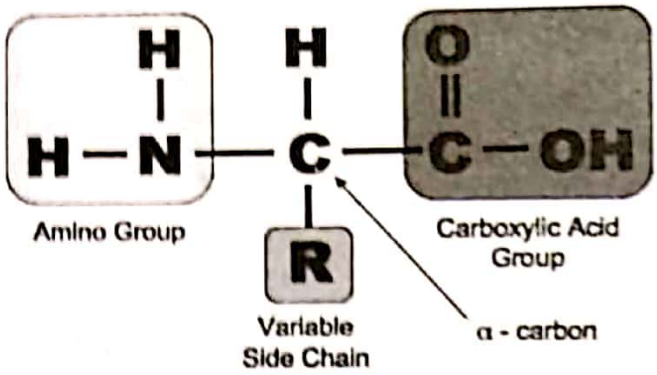
i. Proteins are the most abundant organic compounds of the cell.

ii. Proteins contain carbon, hydrogen, oxygen, nitrogen, and sulphur.

iii. Proteins are macromolecules composed of units (Monomers known as amino acids).

General structure of amino acid

Each amino acid has 4 different groups attached to α-carbon (C-atom next to COOH).These four groups are:

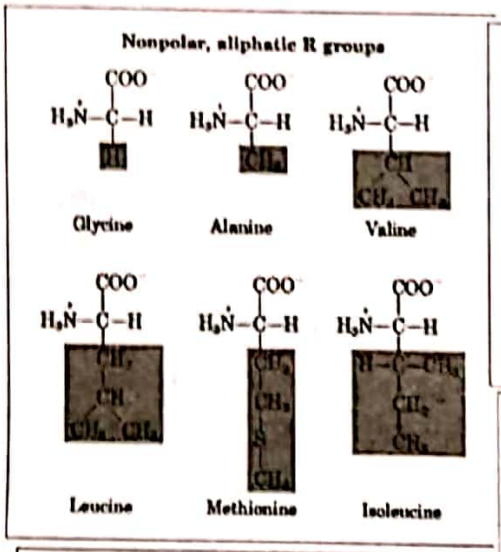


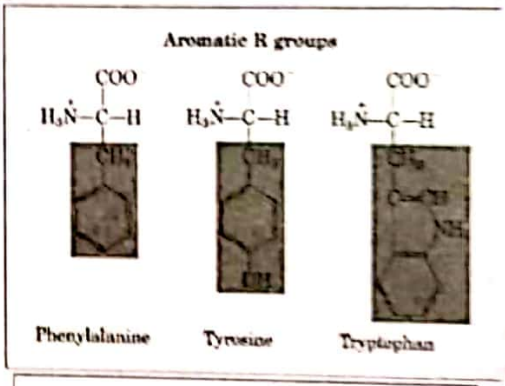
- **Standard number of amino acids**

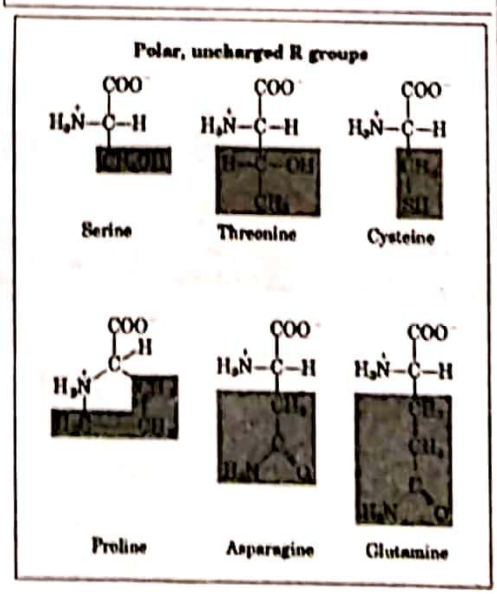
  There are about 300 amino acids occur in nature. Of these, only **twenty** different types of amino acids are involved in the formation of proteins.

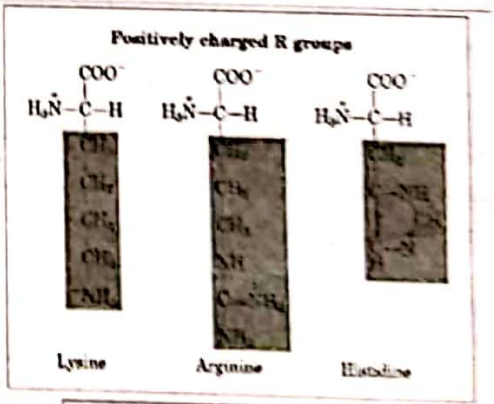
- **Variation in amino acids**

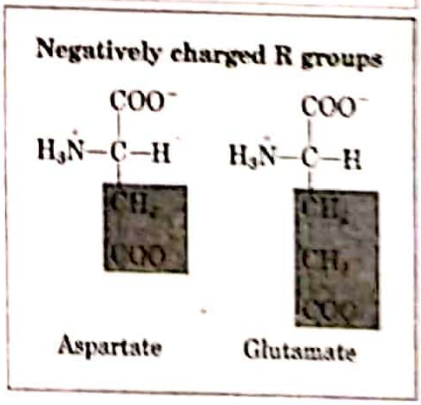
  Variation in amino acids is due to the variable group or R-group. The remaining three groups i.e. carboxyl group, amino group and hydrogen group remain constant.











➢ Variation in structures and functions of proteins

Variation in structures and functions of proteins is due to the variation in:

i. Types of acids
ii. Number of amino acids
iii. Sequence of amino acids
iv. Number of polypeptide chains

For Example:

➢ Insulin contains **51** amino acids. These amino acids are arranged in **two** polypeptide chains.
Polypeptide chain No. 1 = 30
Polypeptide chain No. 2 = 21

➢ Haemoglobin contains **574** amino acids. These amino acids are arranged in **Four** polypeptide chains.

➢ Peptide bond

Definition: Peptide bond is formed in between an amino group of one amino acid and carboxyl group of another amino acid. Peptide bond formation is a condensation or dehydration reaction.

➢ Types of Peptide chain

1. **Dipeptide chain:** A chain containing three amino acids and two peptide bonds in known as dipeptide chain e.g. aa_1----aa_2----aa_3
2. **Tripeptide chain**: A chain containing four amino acids and three peptide bonds is called tripeptide chain e.g. aa_1---aa_2---aa_3---aa_4
3. **Polypeptide chain**: A chain containing many amino acids and many peptide bonds is known as polypeptide chain
   e.g. aa_1---aa_2---aa_3---aa_4---aa_5.....aa_n

➢ Number of polypeptide chains

Most protein molecules are composed of one, two, four and many polypeptide chains. e.g.
Myoglobin is composed of **one** polypeptide chain.
Insulin is composed of **two** polypeptide chains.

- Haemoglobin is oxygen carrying protein in the Red blood cells. It contains 574 amino acids. These amino acids are arranged in **FOUR** polypeptide chains.
- α Polpeptide chain..... 141 amino acids
- α Polpeptide chain..... 141 amino acids
- β Polpeptide chain ..... 146 amino acids
- β Polpeptide chain ..... 146 amino acids

➢ Specificity of Number and sequence of amino acids in a protein molecule is necessary for normal function of proteins

If an amino acid is not occupying its specific position in a protein molecule it will fail to perform its normal function.

For Example:

If **one of 574 amino acids** in Haemoglobin molecule is not present in its specific position then hemoglobin changes its normal globular shape and becomes sickle shaped. As a result disc shaped red blood cells also become sickle shaped.

- Sickle cell anemia is a blood disorder that affects Haemoglobin. In sickle cell anemia, **Glutamic acid** (amino acid) in haemoglobin is replaced by **valine** (amino acid).

Such type of haemoglobin cannot perform its normal function and the person with sickle cell haemoglobin dies.

➢ Size of Proteins

The size of protein molecule depends on the

i. Number of total amino acids

ii. Kinds of amino acids present in that protein molecule.

➢ Shape of Proteins

On the basis of shape, proteins are classified into two groups:

1. Fibrous proteins
2. Globular proteins

1. Fibrous proteins

i. Fibrous proteins are composed of two or more polypeptide.

ii. Fibrous proteins are linearly arranged in the form of fibers sheath.

iii. Fibrous proteins are insoluble in water.

Fibrous proteins are further two types:

a. Keratin proteins

These proteins are found in hair, nail, fur, claws hooves. Outer skin, and muscle cell (Myosin proteins).

b. Collagen proteins

It is the most abundant protein in higher vertebrates. It forms one-third ($^1/_3$) of all body proteins. Collagen proteins are found in Skin, Ligaments (connect bone with bone), Tendon (connect bone with muscle), Bones, Cornea of eyes.

2. Globular proteins

i. Globular proteins, as the name indicates are globular or spherical in shape. Due to folding of polypeptide chains.

ii. Globular proteins are soluble in water. For example: Haemoglobin, egg albumin (egg white), antibodies, enzymes, hormone (insulin), cell membrane proteins.

➢ Levels of structural organization of proteins

There are four levels of structural organization of proteins.

1. Primary Structure

Primary structure of protein was first determined by singer (1951) in Insulin protein. In primary structure, the amino acids are arranged in a linear sequence joined by peptide bonds.

2. Secondary Structure

When a polypeptide chain of amino acids are spirally coiled, it forms secondary structure e.g. keratin protein.

Stabilizing forces: The forces which give stability to the coiled structure of proteins are: Hydrogen bonds, Ionic bonds, Vander wall forces.

3. **Tertiary Structure**

When a polypeptide chain folds and refold upon itself, it forms a three dimensional structure known as e.g. Myoglobin.

Stabilizing forces: Hydrogen bonds, Ionic bonds, Vander Waal forces

4. **Quaternary structure:**

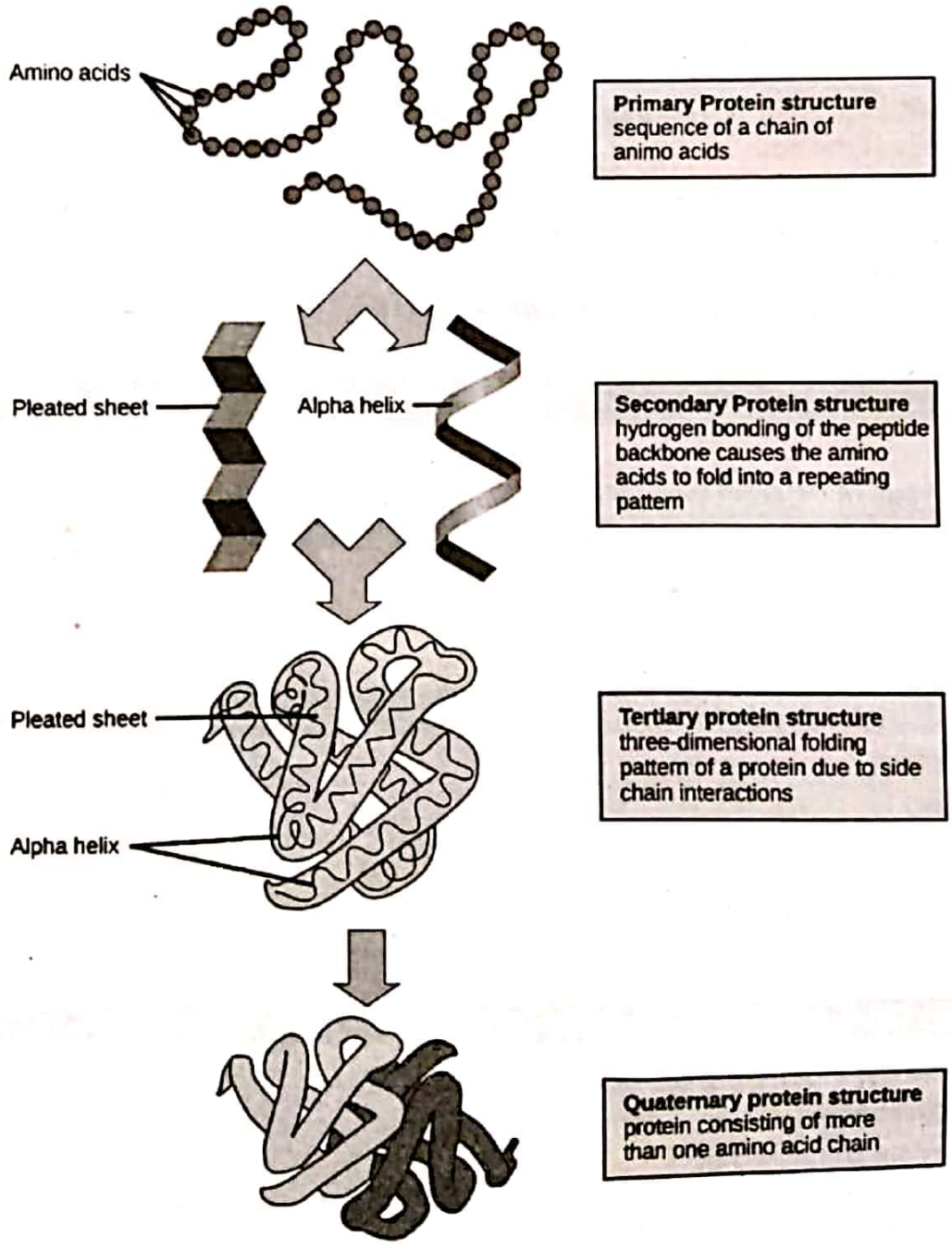
When two or more polypeptide chains are associated or aggregated with each other it form large sized molecule, it is known as quaternary structure.

e.g. Haemoglobin

- Haemoglobin has 574 amino acids
- These amino acids are arranged in four polypeptide chains.

Stabilizing forces:

Hydrogen bonds, Ionic bonds, Vander Waal forces



Function of proteins

Proteins perform the most important functions in living organisms.

Following are the function of proteins:

1. **Structural building material**

   Proteins are the structural building materials of living organisms e.g. cell membrane is composed of lipoprotein molecules.

2. **Speed vital chemical reactions:**

   All enzymes are proteins in nature. They speed up biochemical reactions. Some hormones e.g. insulin are proteins which regulate Sugar level in the blood.

3. **Role in digestion**

   The digestive enzymes e.g. pepsin, trypsin has role in digestive processes.

4. **Role in movement**

   Actins and myosins proteins has a role in contraction and relaxation of muscles and hence in movement.

5. **As oxygen carries**

   Haemoglobin is protein in red blood cells. It carries oxygenated blood from alveoli of lungs to different cells of the body.

6. **Formation of various structures**

   In animals, proteins form various structures e.g. skin, nails, hairs, claws and hooves etc.

7. **Source of energy**

   In plants, proteins are stored in most seeds for the future need of the embryos e.g. Bean, Pulses and Pea etc.