PROTEINS

Proteins, fundamental macromolecules, are composed of one or more polypeptides—chains or polymers of amino acids linked by peptide bonds. Although the terms "polypeptide" and "protein" are often used interchangeably, a single polypeptide must consist of a minimum of 50 amino acids to be designated as a protein. Given that there are 20 types of amino acids, proteins are heteropolymers, distinguishing them from homopolymers, which comprise only one type of repeating monomer.

Structure of Proteins:

Biologists delineate the structure of proteins at four hierarchical levels: primary, secondary, tertiary, and quaternary.

- **Primary Structure:** The sequence in which amino acids align in a protein's polypeptide chain constitutes its primary structure. Provides positional information, identifying the first (N-terminal) and last (C-terminal) amino acids.

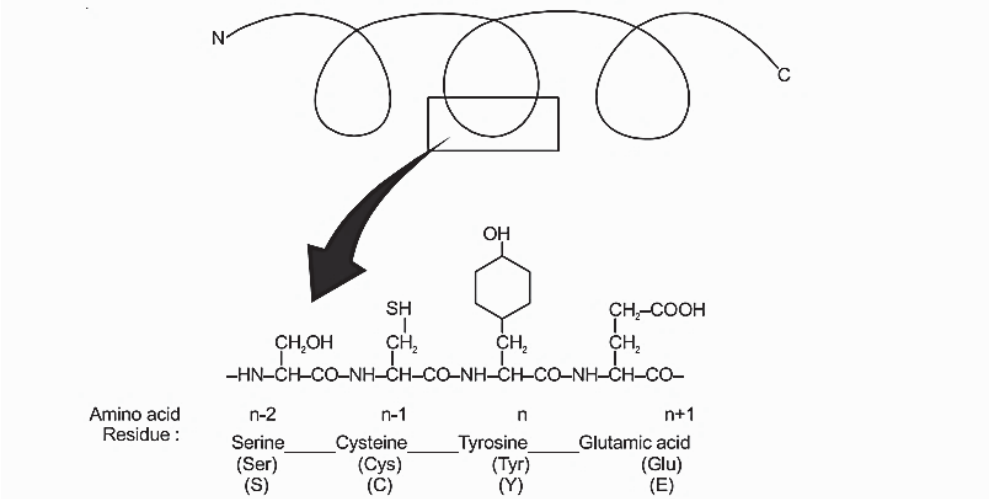


Fig. : Primary structure of a portion of a hypothetical protein. N and C refer to the two termini of every protein. Single letter codes and three letter abbreviations for amino acids are also indicated

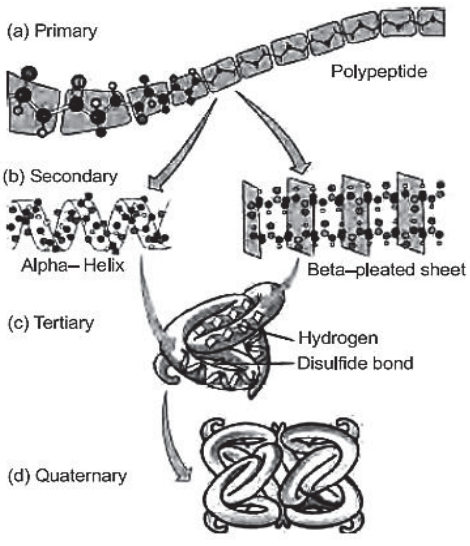


Fig. : Structure of a protein

- **Secondary Structure:** Protein threads exhibit folds in the form of helices or β-pleated sheets. α-Helix involves intramolecular hydrogen bonds every fourth amino acid, resulting in a helical shape (e.g., keratin in hair). β-Pleated sheet arises from intermolecular hydrogen bonds between two or more polypeptide chains (e.g., fibroin in silk).

Fig. : Cartoon showing : Secondary structure (α-helix) of protein

- **Tertiary Structure:** The protein chain folds upon itself, resembling a hollow woolen ball, creating the tertiary structure. Essential for various biological activities, such as forming active sites in enzymes (e.g., myoglobin in muscle cells).

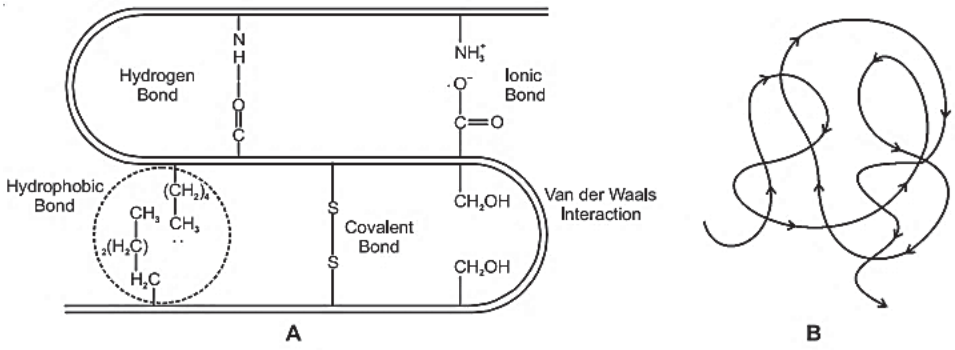
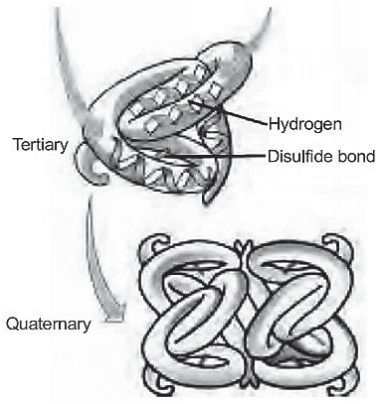


Fig. : A. Various types of bonds formed during coiling of polypeptide,
B. Cartoon showing tertiary structure of protein



- **Quaternary Structure:** Occurs when a protein comprises more than one subunit (individual polypeptide chains) with each having its own primary, secondary, or tertiary structure. The arrangement of these subunits gives rise to the quaternary structure (e.g., hemoglobin with four helical polypeptide chains).

Functions of Proteins:

Proteins play diverse roles in living organisms, encompassing essential functions:

- **Enzymes:** Almost all enzymes consist solely of proteins or in conjunction with non-protein cofactors, catalyzing chemical reactions vital in living systems. Example: Trypsin (present in pancreatic juice).
- **Defence Proteins:** Immunoglobulins or antibodies, proteinaceous in nature, combat infectious agents and are produced by B-lymphocytes.
- **Hormones:** Certain hormones, like insulin, are proteins regulating sugar metabolism, secreted by pancreatic B-cells.
- **Receptors:** Proteins present on cell membranes' external surface, binding to specific information molecules such as hormones. Also found in sensory organs like the nose and tongue for detecting smell and taste.
- **Transport Proteins:** Carrier proteins in cell membranes facilitate the transport of specific materials into cells (e.g., GLUT-4 for glucose transport). Hemoglobin, a carrier protein in red blood cells, transports oxygen from lungs to various body parts.
- **Collagen:** As the primary protein in connective tissue, collagen imparts tensile strength and constitutes a major component of cartilage, ligaments, tendons, bone, and teeth. Remarkably abundant, collagen stands as one of the longest fibrous structural proteins in the animal kingdom.