Course- B.Sc. Part III Hons.

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# Protein- structure

Proteins are the largest bio molecules present in highest quantity in every organism. These are found universally in all the organisms and play multiple roles in constitution of cells and their organelles as well as cell metabolism. Enzymes, which are responsible to catalyze metabolic reactions are proteins.Different cellular transport mechanisms and electron transport during the metabolic reactions are also mediated by proteins. They act as electron carriers which may be associated with iron atoms as in case of ferredoxin, Cytochromes ($Fe^{++}/Fe^{+++}$), or may involve other elements such as copper($Cu^{++}/ Cu^{+}$). Proteins are constituted by amino acids, which are held together by peptide linkages, hence, proteins are also structurally referred to as polypeptides. Since, amino acids consist of carbon, hydrogen, nitrogen and oxygen universally so proteins also consist of all these elements. There are 20 different kinds of amino acids which participate in protein building. The -COOH group of an amino acid combines with the $–NH_2$ group of another amino acid. In joining two amino acids, a water molecule is released taking –OH from -COOH and –H from adjacent amino acid, and –CO-NH - linkage is formed which is known as peptide linkage.

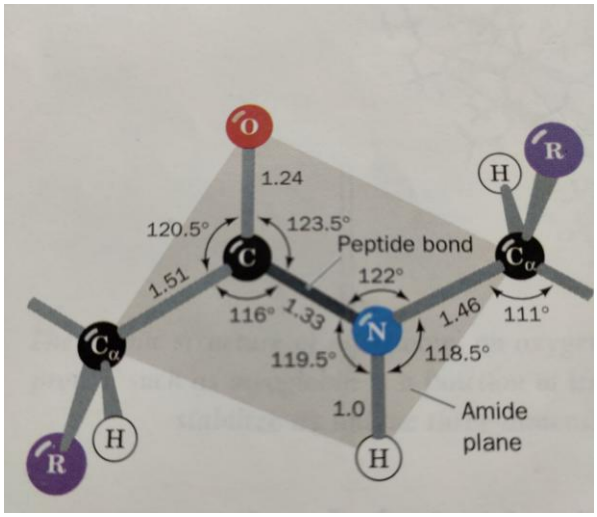


Fig. A peptide linkage formed between two amino acids.(Courtesy, Fundamentals of Biochemistry. Voet, Voet and Pratt)

Protein structure-

On the basis of levels of organization, proteins have different structures, namely primary, secondary, tertiary and quaternary. These structures are adopted by the protein molecules due to coiling in the polypeptide chain.

Primary structure - A definite sequence of amino acids held together by peptide linkage form the primary structure. This is the simplest structure of a polypeptide.

Secondary structure – Each individual polypeptide chain can adopt a helical, pleated sheet or random arrangement by formation of hydrogen bonds between the oxygen and the nitrogen atoms of the peptide linkage. This kind of three dimensional structure was described by Pauling using X-ray diffraction method and has been designated as the secondary structure of protein.

Tertiary structure – The secondary structure, such as α-helix, is folded into different specific patterns by the formation of hydrogen bonds, and disulphide bridges (formed between two SH- groups). Such a three dimensional structure is known as tertiary structure. The tertiary structures of proteins have interactions of the R- groups, salt links and *Van der Waal forces.*

Quaternary structure – This is more compact structure. When two or more polypeptide chains result into three dimensional geometry, it is referred to as quaternary structure. The polypeptides in this structure may be held together by the hydrophobic side chain interactions. Such molecules show the presence of different kinds of bonds i.e., hydrogen bonds, disulphide linkages, electrostatic interactions and *Van der Waal* interactions.

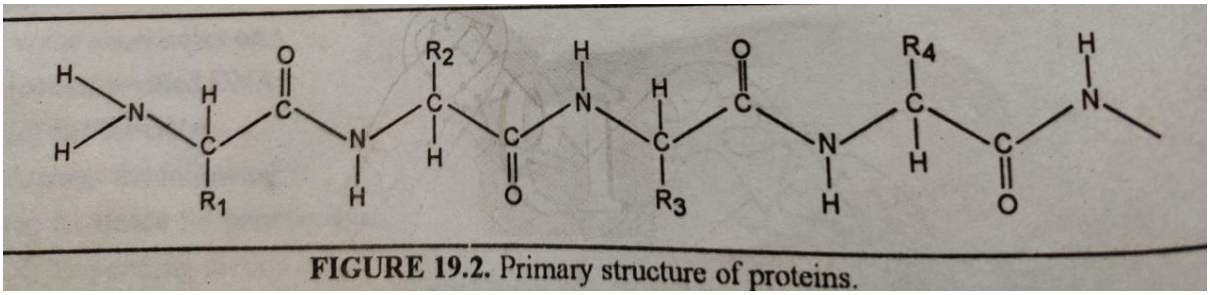


**FIGURE 19.2.** Primary structure of proteins.

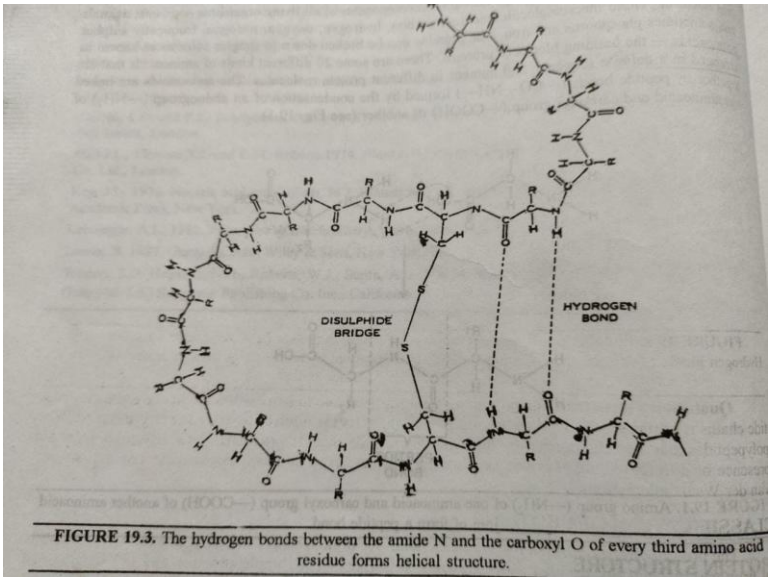


**FIGURE 19.3.** The hydrogen bonds between the amide N and the carboxyl O of every third amino acid residue forms helical structure.

Fig. Secondary structure of protein forming disulphide and hydrogen bonds.

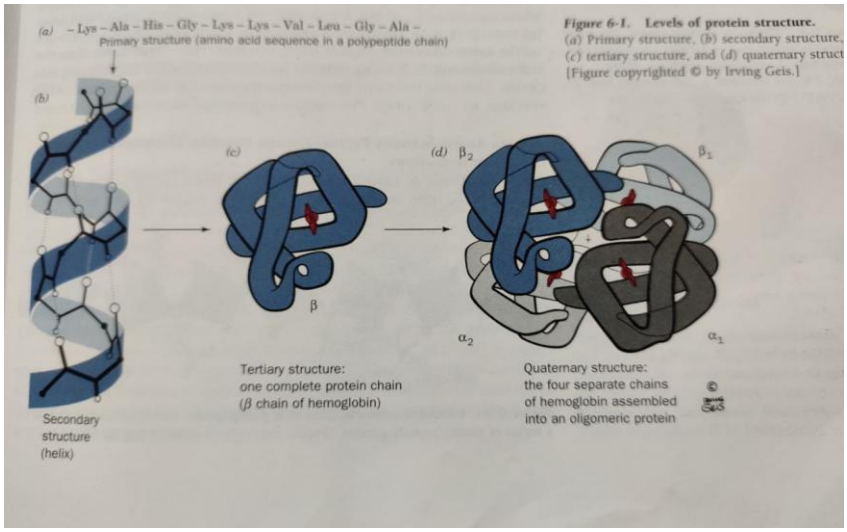


***Figure 6-1.*** **Levels of protein structure.**
(*a*) Primary structure, (*b*) secondary structure, (*c*) tertiary structure, and (*d*) quaternary struct
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