

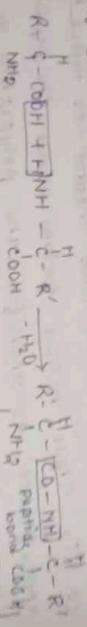
1. Peptide bond and peptide linkage

The following types of bonds play an important role in the formation of proteins

1. Peptide bond and peptide linkage:

The peptide bonds help in the formation of primary structure of protein. A single peptide bond is formed when two amino acids are joined.

In a reaction, the carboxyl group (-COOH) of one amino acid reacts with the amino group (-NH<sub>2</sub>) of another amino acid to form a peptide bond. The bond between the two amino groups is called peptide bond and the compound formed by the condensation of amino acid is known as a dipeptide.



2. Disulfide bond

Disulfide bond is also characteristic of the primary structure of proteins. It is a covalent bond and is generally established between two cysteine residues.

both cysteine has two amino and two nucleous. The disulphide bond may also be established in other sulphur containing amino acids like cysteine and methionine. When the thiol groups of two cysteine molecules are normally oxidized, they form the disulphide compound, cystine and the linkage established between them is known as disulphide (S-S) linkage. The disulphide bond may be formed either within the single polypeptide chain or between two polypeptide chains (intermolecular).

Disulphide bond helps in stabilizing the folded polypeptide chain and also in joining two or more polypeptide chains together.

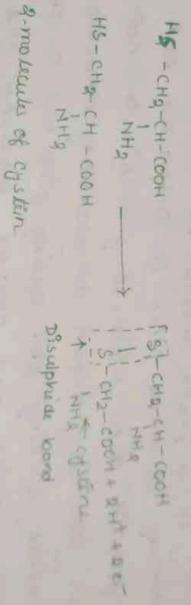


Fig 2: Formation of disulphide bond

3. Hydrogen bond: Hydrogen bonds are commonly found among the proteins. They are electrostatic in origin and help the interaction of an incompletely shielded nucleous of the H atom

1003.9 which is a portion of unit positive charge with 1.280214  
electronic system of oxygen's atom.

Hydrophobic bonds:— arise from the mutual  
hydrophobic bonds hydrogen state chains.  
Hydrophobic bonds have a no. of amino acids  
of non polar hydrogen atoms which are hydrocarbon nature  
biological systems. Thus the hydrocarbon nature  
having side chain groups in that they don't  
form hydrogen bonds with water molecules. On the  
other hand, water molecules have a strong ten-  
dency to form hydrogen bonds among them-  
selves.

#### Structure of protein

The sequential arrangement of the amino  
acids in a protein molecule is known as the  
primary structure. When in interaction both  
polypeptide takes place, it gives rise to a helical  
type structure, known as secondary structure.  
Further folding and coiling gives rise to the  
highly specific and complex tertiary and  
quaternary structure.

Primary str:— The sequential arrangement of the  
various amino acids in a protein (polypep-  
-tide chain) through the peptide bonds is

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...the primary structure, each protein molecule consists of one or more polypeptide chains. In each one amino acids are joined by peptide linkages. Hydrogen bonds exist within each polypeptide chain. The secondary structure and disulfide bonds are also present. The sites of the primary structure of proteins, the disulfide bond is generally situated between cysteine residues as in keratin and fibrous proteins.

If the protein has only one polypeptide chain, it can have only one free amino group ( $\text{C-NH}_2$  terminal) and one free carbonic (terminal) group. In the determination of primary structure of protein, it is essential to know what amino acids are at N-terminal and C-terminal ends bonds with other molecules. On the disulfide, cysteine molecules form a strong linkage as both hydrogen bonds among themselves.

#### Structure of protein?

The sequential arrangement of the amino acids in a protein molecule is known as the primary structure. Each protein.

10-02-17  
between polypeptide takes place, it gives rise to a helical type structure, known as secondary structure. Further folding and coiling gives rise to the highly specific and complex tertiary and quaternary structure.

Primary structure:

The sequential arrangement of the various amino acids in a protein (polypeptide chain) through the peptide bonds is known as the primary structure. Each protein molecule consists of one or more polypeptide chains in which the amino acids are linked by peptide linkages. Myoglobin, a protein, consists of only polypeptide chain, whereas Haemoglobin molecules consists of four polypeptide chains.

The covalent bonds and disulphide (-S-S-) bonds are again characteristic of primary structure of proteins. The disulphide bond is generally established between cystein residues, as in insulin and ribonucleases.

If the protein has only one polypeptide chain, it can have only one free  $\alpha$ -amino group ( $-NH_2$  terminal) and one free carbon

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10.02 (C-terminal) group. In the determination of primary structure of protein, it is essential to know what amino acids are at N-terminal and C-terminal ends.

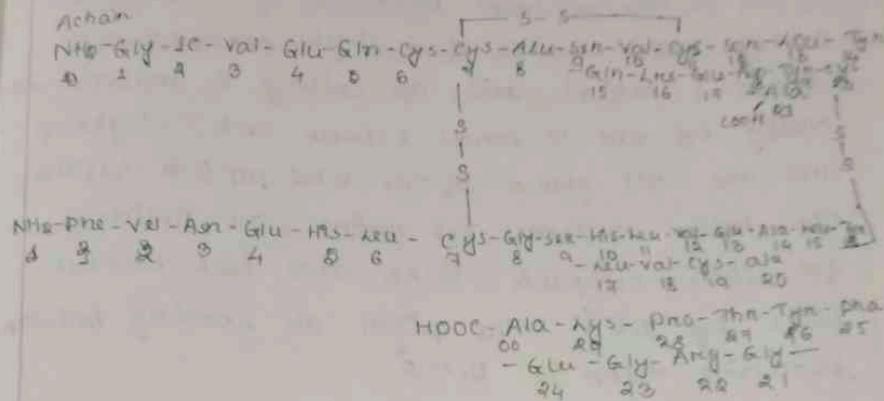


Fig- Sequence of amino acids in the cattle insulin molecule

Secondary structure

When the long polypeptide chains in a protein undergo folding, they form the secondary structure or helical structure or helical structure. The secondary structure is determined by H-bonding between the components of the peptide chain itself. The H bonds can occur either within one polypeptide chain or between different polypeptide chains of the protein molecule. Thus,

the secondary structure of proteins is represented by the helical structure of proteins :-  
 The  $\alpha$ -helix proposed by Pauling and Corey (1951) consists of a single strand twisted about a helical axis. The coiling is maintained chiefly by the H-bonds between each  $\gamma$ -C=O group and the -NH group of the 4th peptide residue. The helix contains 3.6 amino acid residues for each complete turn and each residue rises by 1.5 Å. The pitch or spacing between successive turns is 5.4 Å.

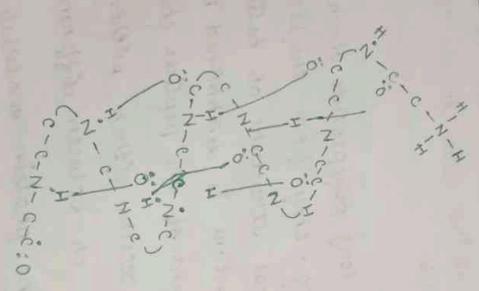


Fig:  $\alpha$ -helix model of protein coiling showing inter-chain bonding which gives stability to the molecule

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$\beta$ -structure - The  $\beta$ -structure is represented by parallel zig-zag polypeptide chains which form a pleated sheet like structure. The hydrogen bonds are formed between NH and C=O groups on the neighbouring chains which stabilize and  $\beta$  structure of proteins. The side chain attached to the amino acid residues lies above and below the hydrogen bonded sheets.

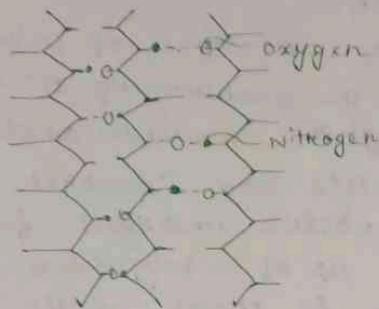
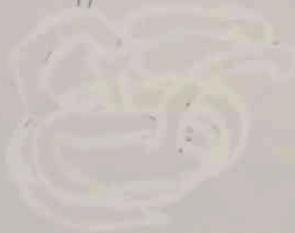


Fig -  $\beta$ -structure of proteins

Tertiary structures - Very few protein molecules exist as a simple  $\alpha$ -helix. Further degrees of folding or coiling of polypeptide chains in  $\alpha$ -helix give a complex three dimensional structure, which often contains helical and non helical regions.

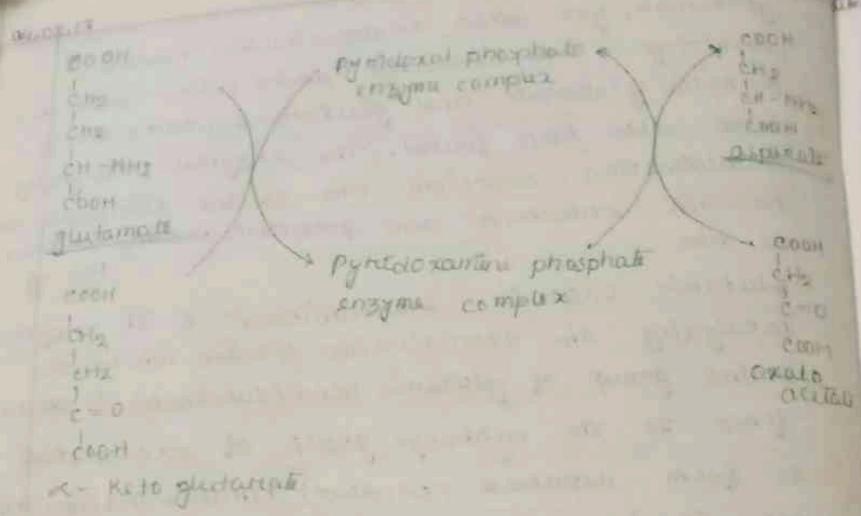




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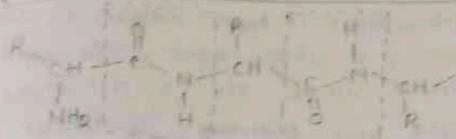


Secondary structure—  
 The degree of polymerization of a protein unit. The quaternary structure is exhibited by haemoglobin molecules which was determined by Parutz and Coworker (1960). They showed that this protein undergoes further organization being made up of 4-polypeptide chains. The quaternary structure is known as the quaternary structure. The chains undergo secondary folding of the structures consisting of  $\alpha$ -chain and other two of  $\beta$  chain.



Peptide Bond

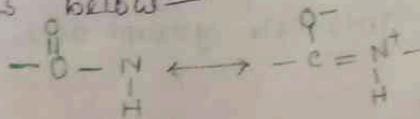
Proteins are the linear sequence of amino acids and the bonds by which the amino acids are linked together are called peptide bonds. The peptide bond is a chemical, covalent bond formed between the  $\alpha$ -amino group of one amino acid and the  $\alpha$ -carboxyl group of another. Each area within the dotted box in the following diagram includes four atoms of the peptide bond:



A compound composed of two amino acids linked together by one peptide bond is called a dipeptide. Of three amino acids, a tripeptide, and so on long, unbranched chains of amino acids can be linked with (together) by peptide bonds to form oligopeptides (upto 25 amino acid residues). Conventionally peptide chains are written down with the free  $\alpha$ -amino group on the left and a free  $\alpha$ -carboxyl group on the right and a hyphen between the amino acids to indicate the peptide bonds. For ex, the tripeptide  $^+\text{H}_3\text{N}$ -serine-leucine-phenylamine- $\text{COO}^-$  would be written simply as ser-leu-phe or S-L-P.

The peptide bond between carbon and nitrogen exhibits partial double bond character due to the closeness of the carbonyl carbon-oxygen double bond allowing the resonance structure

as below—



1. Simple proteins - They are compounds that on hydrolysis, yield only amino acids. On the basis of solubility properties simple proteins are further divided into six groups as below

are classified into two major groups - single proteins and conjugated proteins. depending on solubility properties and on known chemical and physical differences, proteins

### Classification of Proteins

of the carbonyl group, rather than on the same side (cis) side (trans) of the double bond to the oxygen amino groups nearly always on the opposite to be different angles. The hydrogen of the peptide bond, permitting adjacent peptide units  $C-N$  bonds, i.e. the bonds either side of the rotation can take place about the  $C-N$  and thus relatively rigid and planar, although free rotation which is made up of the  $CO-NH$  atoms is shorter than normal  $C-N$  single bonds. The peptide bonds, because of this, the  $C-N$  bond length is also