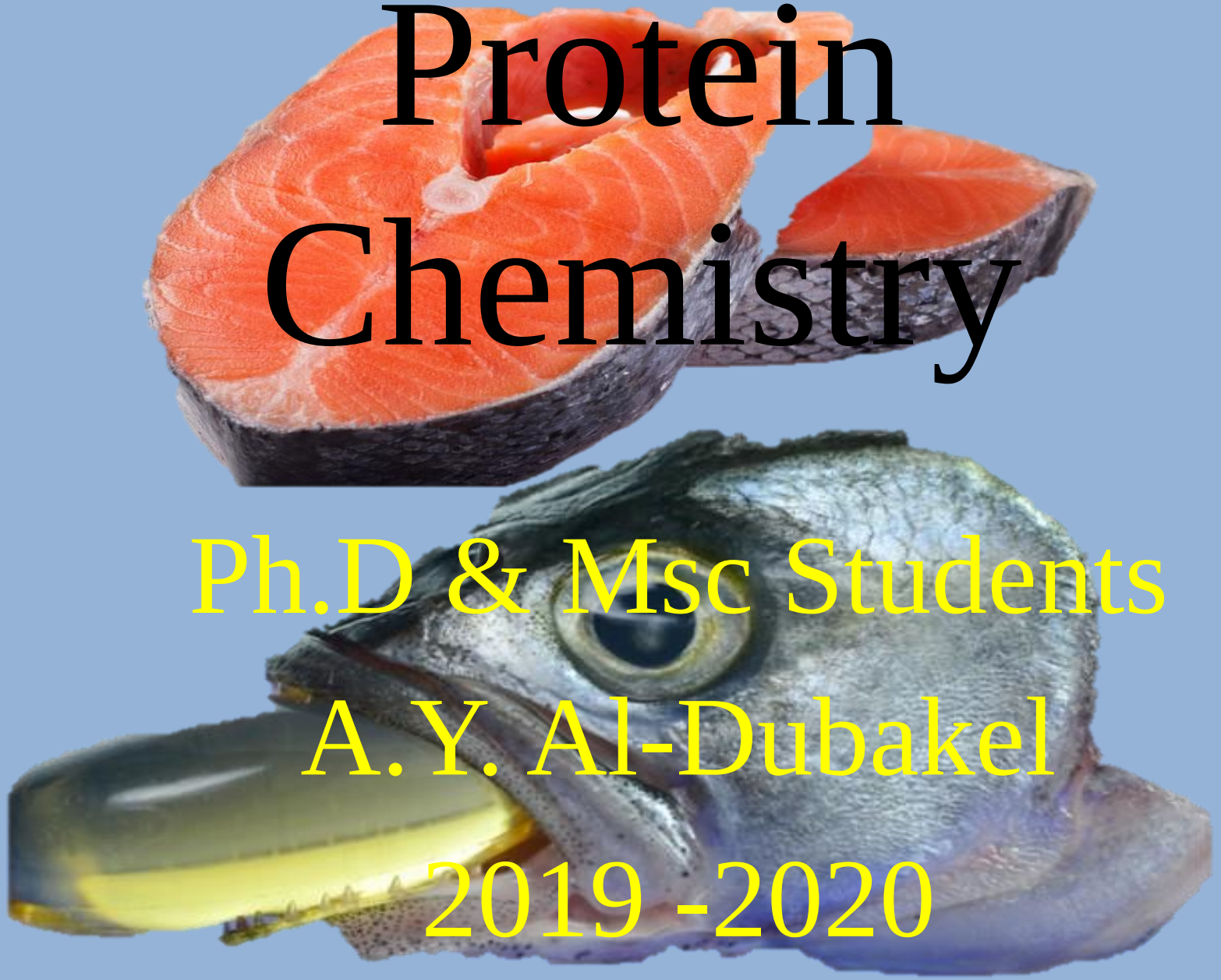
Protein Chemistry



Ph.D & Msc Students

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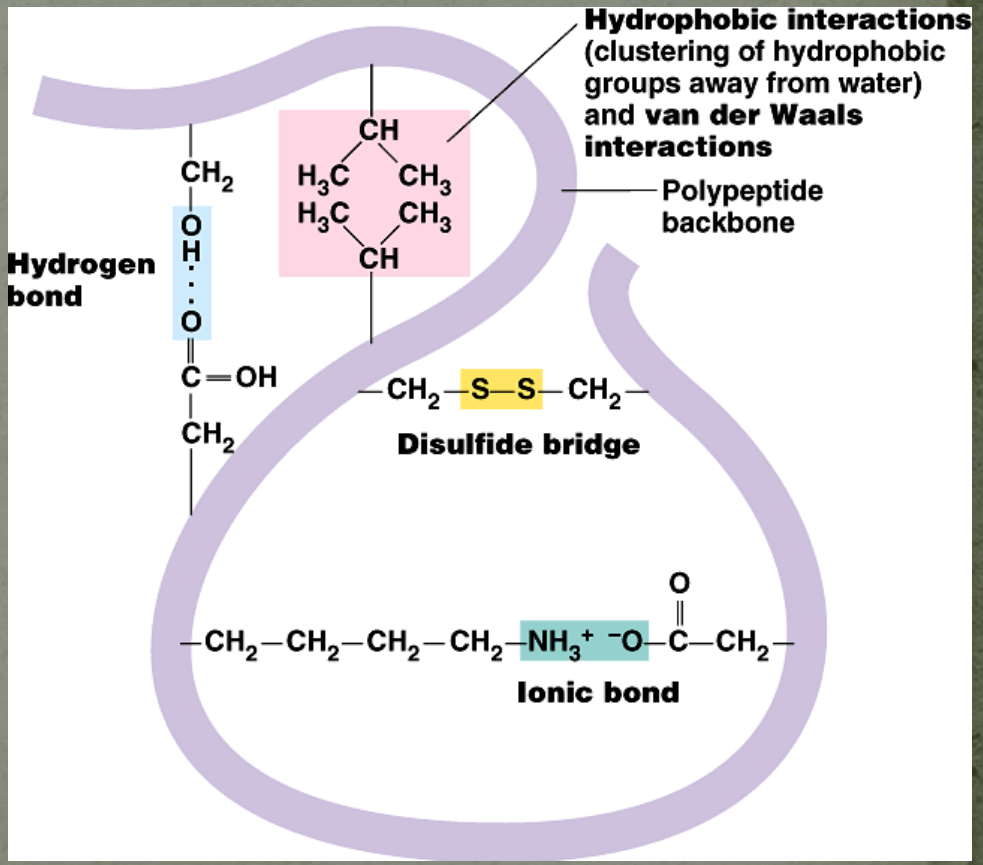
Tertiary (3°) Structure

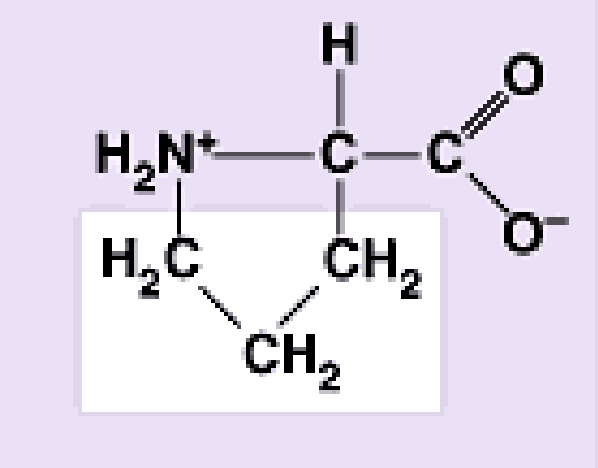
Types of interaction:

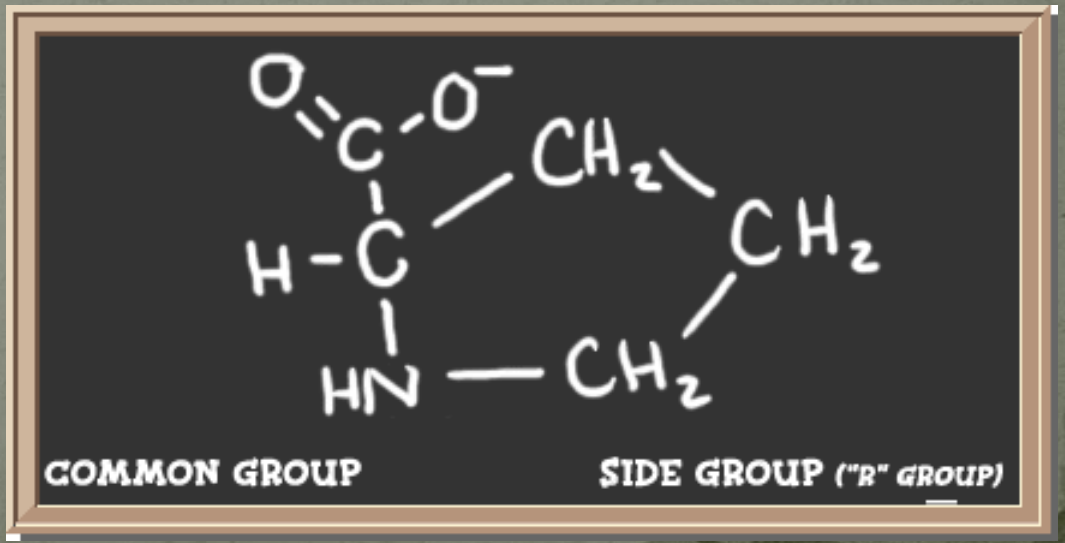
- **Hydrogen** bonds
- **Ionic** bonds
- **Hydrophobic** interactions
  - often in interior of protein
- **Covalent** bonds
  - **Disulfide bridge**: formed between the sulfhydryl groups (SH) of cysteine amino acids



Tertiary (3°) Structure: Proline kink

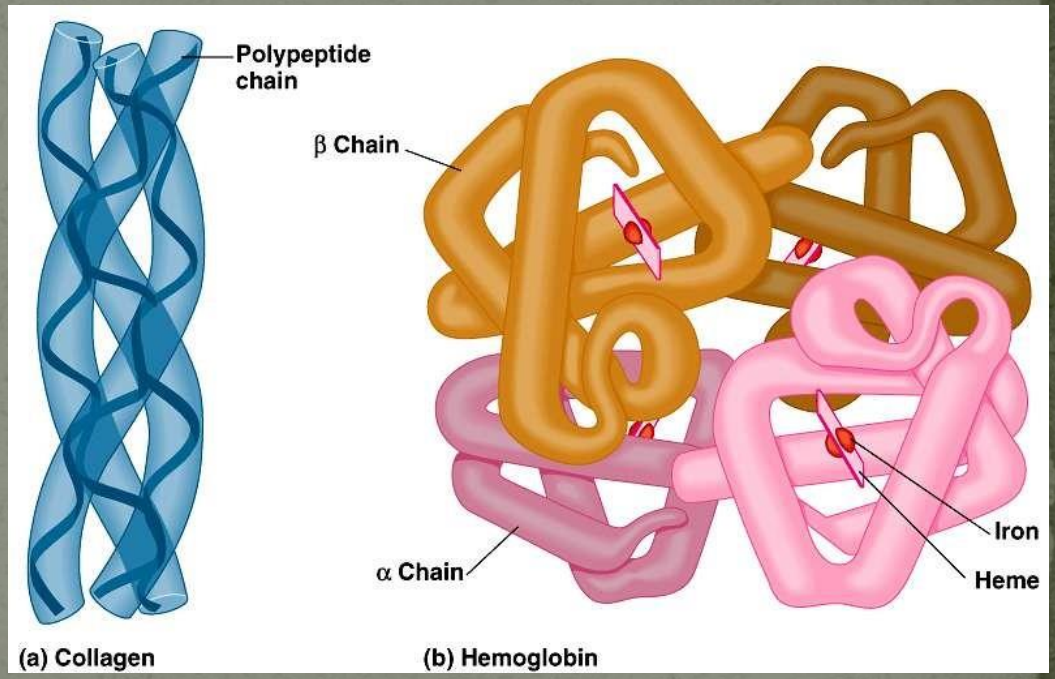
- Proline is the only amino acid in which the R group is attached to the amino group
- Forms a natural kink in the polypeptide
- Helps to shape tertiary structure





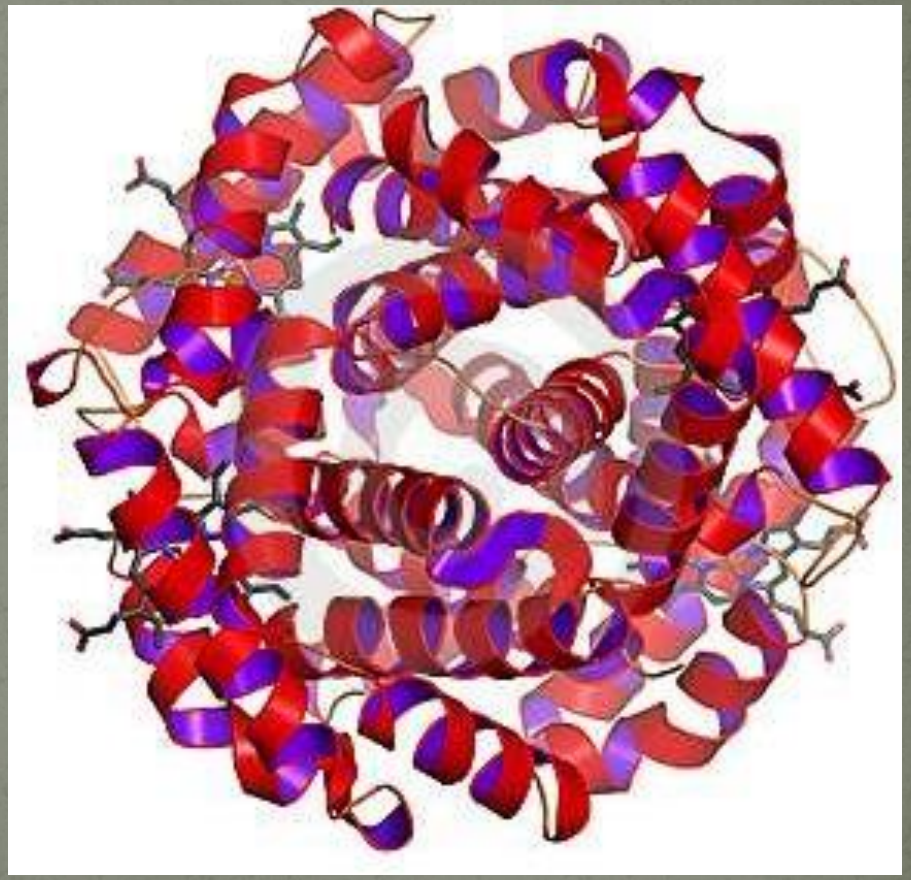
Quaternary (4°) Structure

- aggregation of two or more polypeptide subunits
- forms 2 types of proteins: globular and fibrous
- not found in all proteins



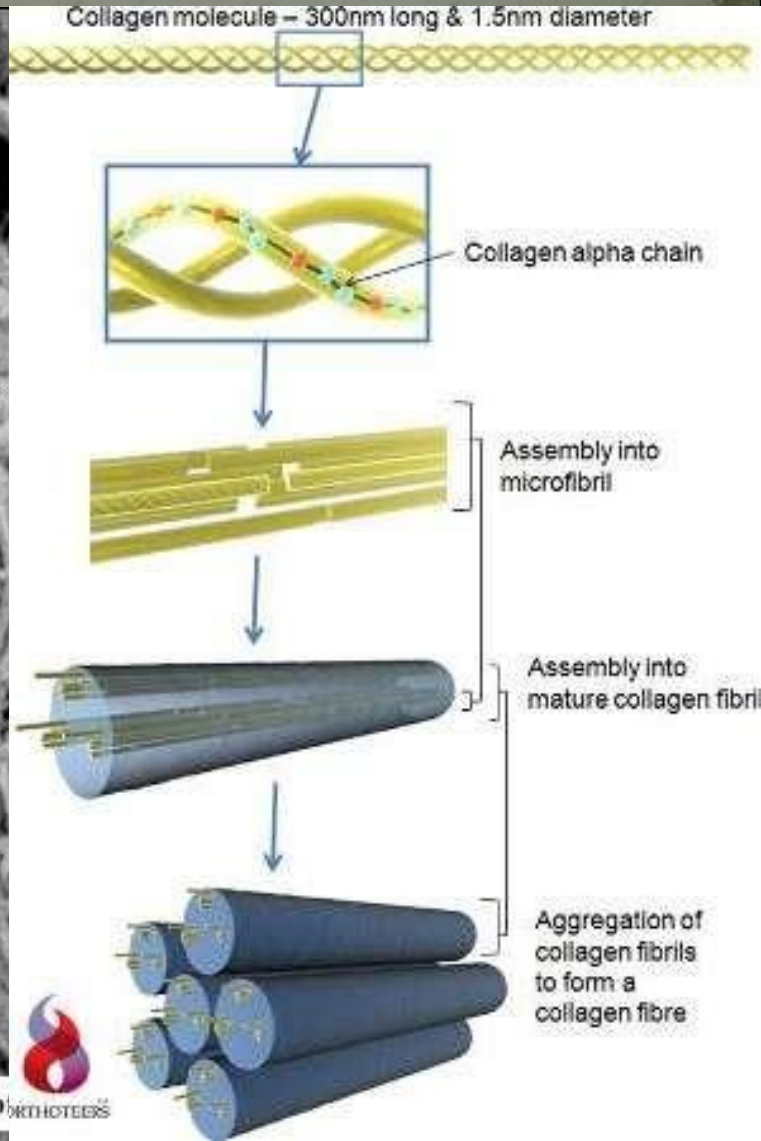
Quaternary (4°) Structure: Globular

- Water soluble
- Compact, spherical
- Example: hemoglobin



Quaternary (4°) Structure:Fibrous

- Water insoluble
- Threadlike
- Example: collagen
  - 3polypeptides supercoiled like a rope
  - provides structural strength for role in connective tissue



Denaturation of Protein

Denaturation is defined as any non-proteolytic modification in the original structure of the native proteins, giving rise to definite changes in physical, chemical, and biological properties. The native structure of protein is the net result of various attractive and repulsive forces intramolecular as well as interaction with surrounding water medium. This structure is thermodynamically stable with lowest feasible free energy at physiological conditions. Any change in the environment, such as temperature, pH, ionic strength, solvent composition etc. will force the molecule to assume a new stable structure if the change does not drastically alter the molecular. architecture.

Major changes in the secondary, tertiary and quaternary structures without cleavage of peptide bonds are called as denaturation. But in many cases, denaturation involves a loss of ordered structure. In a denatured protein the globular proteins become a random coil.

(i) Changes in protein during denaturation

Denaturation is brought about by the following: (1) Denaturing agents, such as acids, alkalis, salts, (2) Increase in temperature and (3) Extensive beating. Denatured proteins lose their ability to crystallize. There is an increase in viscosity of food.

(ii) Stages of denaturation

1st stage: Unfolding of helix of the protein molecules

R groups are exposed. leading to aggregation of the molecules, bringing about increased viscosity. This is the first change in denaturation which involves structural alteration.

2nd stage: When sufficient proteins have united, the protein molecules are no longer dispersed as a 'sol'. At this stage the protein is said to have coagulated, i.e., water is held in the capillary spaces formed by united protein molecules and the coagulated proteins form a 'gel'.

3rd stage: If the liquid separates from the coagulated protein, the protein is said to be, 'precipitated' or 'flocculated', i.e., 'curdling' takes place. These stages can be observed while cooking scrambled eggs. If it is overcooked, liquid separates out.

(iii) Effects of denaturation

Properties of denatured proteins are completely different from their native form. Denaturation of food is irreversible unless it occurs under very mild condition.

Biologically active proteins lose their biological activity. During heating enzymes are destroyed, e.g., browning does not take place in boiled potato.