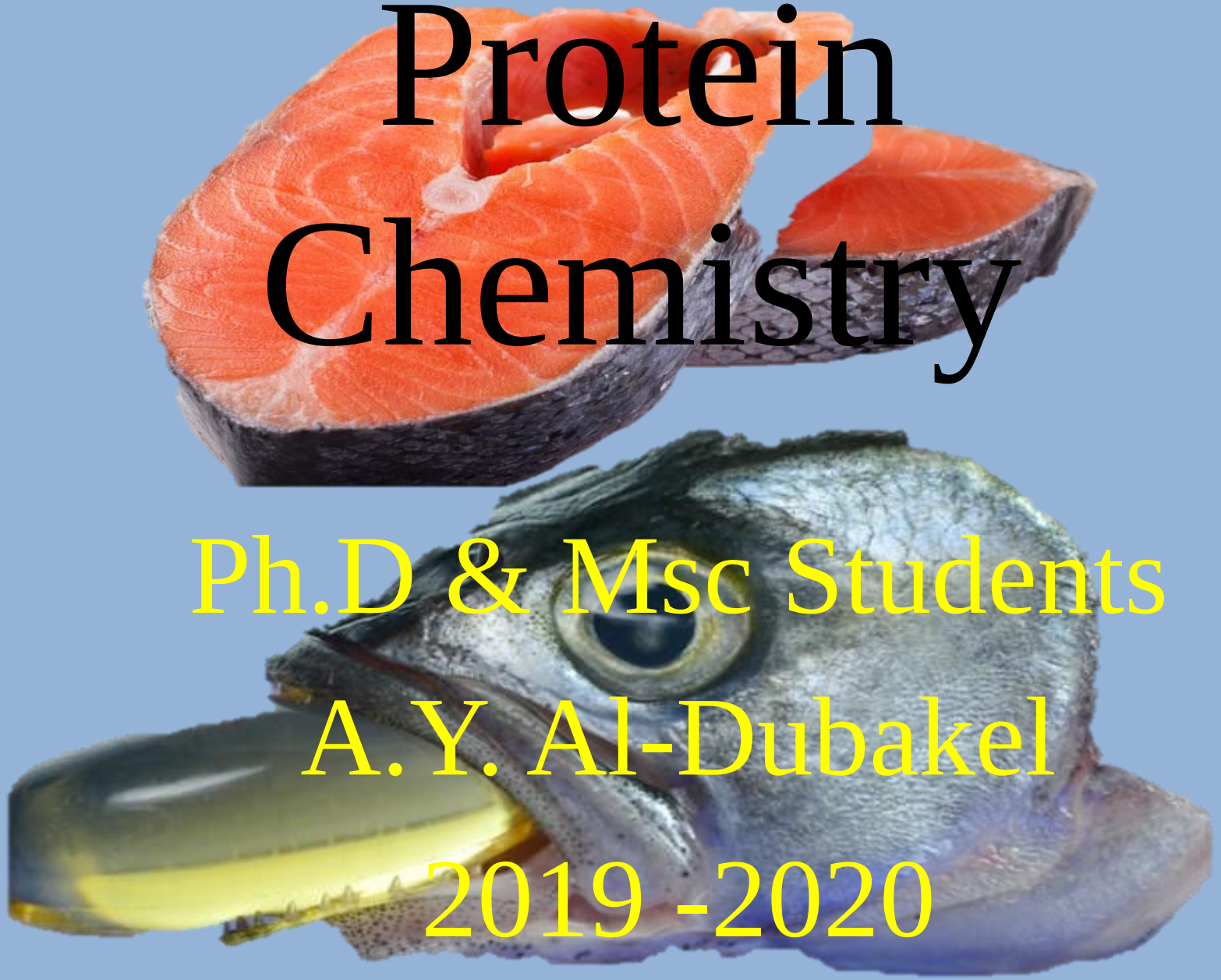
Protein Chemistry



Ph.D & Msc Students

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Food proteins lose their functional property. In some cases it is desirable. Denatured proteins are easily attacked by proteolytic enzymes, e.g., cooked meats are more easily digested than raw meats. Denaturation of trypsin inhibitors in legumes improves the digestibility and biological value of proteins present.

Heat denaturation results in improved flavour and texture, e.g., cooking improves flavour in meat, and eggs give structure and improve texture cakes.
Denaturatin decrease solubility of protein. For example, cooked egg white is not solution in water.

Denaturing Agents

1. pH: Proteins are more stable against denaturation at their isoelectric pH. At neutral pH, most proteins are negatively charged and a few are positively charged. The net electrostatic repulsive energy is small and hence, most proteins are stable at neutral pH. But at extreme pH values the strong intramolecular repulsions due to high net charge results in swelling and unfolding of the protein molecule.

e.g. Caseinogen is dispersed as a sol in milk. When milk turns sour (pH 4.6 ; IEP it curdles (3rd stage in denaturation). Egg albumin is colloidally dispersed as a sol. It has a pH of 7.2-7.8. But when the pH is reduced to 4.6 (its IEP) by adding vinegar to water used for poaching eggs, the egg coagulates faster.

2. Temperature: When a protein solution is gradually heated above a critical temperature, it undergoes a sharp transition from the native to the denatured state.

e.g. When egg white is heated at 60°C the protein ovalbumin gets denatured. A temperature increases, coagulation takes place and egg white separates out as solid. If the temperature is below 100°C, e.g., poaching, then coagulation is slow and coagulated protein is soft and easily digested. If temperature is above 100°C, e.g., boiling and roasting, coagulation is fast and coagulated protein is hard and more difficult to digest.

3. Organic solvents: Organic solvents affect the solubility of protein hydrophobic and electrostatic interactions and hydrogen bonding. Some nonpolar side chains are more soluble in organic solvelts than in water, hydrophobic interactions are weakened by organic solvents.At low concentrations, some organic solvents can stabilize proteins. At high concentrations, however all organic solvents cause denaturation of proteins because of their solubilising effect on nonpolar side chain.

4. Surface denaturation: This is brought about by mechanical means, e.g., beating egg white or milk to foam. Surface denaturation of the protein takes place leading to pellicle or skin formation. This stabilizes the foam (pellicle is seen when foam has subsided). If such a foam is heated, as in egg white foam, it becomes firm due to the coagulation of ovalbumin. If pH of ovalbumin is at its IEP, then coagulation is faster. Hence, acidic sub stances (cream of tartar, lime juice, etc.) are added when whipping egg white.

5.Salts: At low concentrations, ions interact with proteins via nonspecific electrostatic interactions. When present in a high concentration salt precipitates proteins out of solution and disperses them. e.g., cured ham baked in white sauce. The high salt concentration of the ham can cause the milk in white sauce to curdle.

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6. Detergents: Detergent such as sodium dodecyl sulphate are powerful protein denaturing agents. It is due to the interaction of the detergent to the R-group disrupting the interactions involved

The supplementary value of protein

One way of improving quality of dietary protein with limiting amino acid is by adding another protein containing the missing amino acid. Some proteins are poor quality proteins as such due to limiting amino acids. But they are complementary in limiting essential amino acid composition i.e., a limiting essential amino acid in one protein is present in excess amounts in another protein and vice versa. So they supplement each other and make good quality protein in diet. This is known as supplementary value of proteins. For example wheat proteins and red gram proteins are complementary proteins and as such both are low quality proteins due to limiting amino acid.Wheat protein is limiting in lysine but good source of tryptophan whereas red gram is limiting in tryptophan but a good source of lysine. When they are mixed they make up good quality protein in diet by supplementing one another i.e., wheat protein effectively supplement pulse protein and vice versa. Therefore chapati and dal combination improves quality of protein in diet.