

Properties of Protein

- **Solubility:** forms colloidal solution instead of true solutions in water – large size of protein
- **Molecular Weight:** depends on number of amino acid
- **Shape:** there is wide variety in shape – globular(insulin), oval(albumin), fibrous or elongated (fibrinogen)
- **Acidic and basic:** depends on ratio of (lysine + arginine) : (Glut + Asp). Ratios greater than 1 is basic and vice-versa

Properties of Protein : Charge

- Protein are isoelectric
- Nature of amino acids determines the pH of a protein
- Acidic amino acid (Asp, Glu) and basic amino acid (His, lys, Arg) – determines the charge on protein
- At isoelectric pH, the protein exist **as Zwitter-ions** and **dipolar ions**
 - Electrically neutral
 - Minimum solubility
 - Maximum precipitability
 - Least buffering capacity

Classification

- Proteins are classified on the basis of
 - **Chemical nature and solubility**
 - Simple
 - Conjugates
 - Derived
 - **Function**
 - Structural
 - Enzyme or catalytic
 - Transport
 - Hormonal
 - Contractile
 - Storage
 - Genetic
 - Defense
 - Receptor
 - **Nutritional Importance**
 - Complete
 - Partially incomplete
 - Incomplete

Chemical nature and solubility : Simple

- They are composed of only amino acid residues
- They are again classified as
 - **Globular Protein** : spherical or oval in shape, soluble in water or other solvent and digestible
 - **Globulin**: soluble in neutral and salt solution. Ex: serum globulin
 - **Albumin**: soluble in water and dilute salt solutions and coagulated by heat. Ex: serum albumin, ova albumin, lactalbumin

Chemical nature and solubility :

Simple

- **Globular Protein (Cont)...**
 - **Glutelins** : soluble in dilute acids, alkalies and mostly found in plants. Ex: Glutelin (wheat), oryzenin (rice)
 - **Prolamines**: soluble in alcohol. Ex: gliadin(wheat), zein (maize)
 - **Histones**: strongly basic proteins, soluble in water and dilute acids but insoluble in dilute ammonium hydroxide. Ex: thymus histone

Chemical nature and solubility :

Simple

- **Fibrous Protein:** fiber like in shape, insoluble in water and resistant to digestion. It again of 3 types
 - **Collagen:** connective tissue protein lacking tryptophan. On heating with boiling water or acids it turns to soluble **gelatin**
 - **Elastin:** elastic tissues such as tendons and arteries
 - **Keratin:** present in the exoskeleton structures. Ex: hair, nails, horns

Chemical nature and solubility :

Conjugate Protein

- Beside amino acid, it contains a non-protein moiety known as **prosthetic group** or **conjugating group**. Its again of 6 types
 - **Nucleoprotein**: nucleic acid (DNA or RNA)
 - **Glycoprotein**: prosthetic group is carbohydrate which is less than 4 % and when it exceeds 4% its called **mucoprotein**. **Ex**: mucin (saliva), ovomucid (egg white)
 - **Lipoprotein**: found in the conjugation with lipids. **Ex**: serum lipoprotein, membrane lipoprotein

Chemical nature and solubility :

Conjugate Protein

- **Phosphoprotein:** phosphoric acid as conjugate. Ex: casein(milk), vitelline (egg yolk)
- **Chromoprotein:** prosthetic group is colored in nature. Ex: Hemoglobins, cytochromes
- **Metalloprotein:** it contains metal ions such as Fe, Co, Zn, Cu, Mg,

Chemical nature and solubility :

Derived Protein

- Denatured or degraded product of simple or conjugated protein
- Its of 2 types
 - **Primary derived protein:** denatured or cogulated or first hydrolyzed product of proteins. They are
 - **Cogulated proteins:** denatured protein produced by agents such as heat, acids, alkalies
 - **Proteans:** earliest product of protein hydrolysis by enzymes, dilute acids, alkalies etc. Insoluble in water
 - **Metaprotein:** second stage of protein hydrolysis obtained by treatment with slightly stronger acids and alkalies
 - **Secondary derived protein:** progressive hydrolytic product of protein hydrolysis. Ex: proteoses, peptones, polypeptides and peptides

Denaturation

- The phenomenon of disorganization of **native protein structure**
- It results in the loss of secondary, tertiary and quaternary structure of proteins.
- It involves the change of physical, chemical and biological properties
- **Agents of Denaturation**
 - **Physical agents:** Heat, UV radiation, X-rays and violent shaking (centrifuge)
 - **Chemical Agents:** Acids, alkalies, organic solvents (ether, alcohol), salts of heavy metals, urea, salicylate

Denaturation

- Primary structures remains intact i.e peptide linkage are not broken
- Loses its biological activity
- Insoluble in solvent which was previously soluble
- Viscosity increases while its surface tension decreases
- Its more easily digestible
- Its usually **irreversible**, but careful denaturation (**renaturation**) is reversible. Ex: Hemoglobin is renatured on removal of salicylates

Denaturation

- **Coagulation**

- Irreversible denaturation of protein to semi-solid viscous precipitate
- Albumins and globulins – coagulable proteins

- **Flocculation**

- Protein precipitation at isoelectric pH.
- Precipitate is known as flocculum
- Casein – milk protein, prepared by adjusting isoelectric pH by dilute acetic acid
- Its reversible, but on heating it turns to be irreversible

References

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