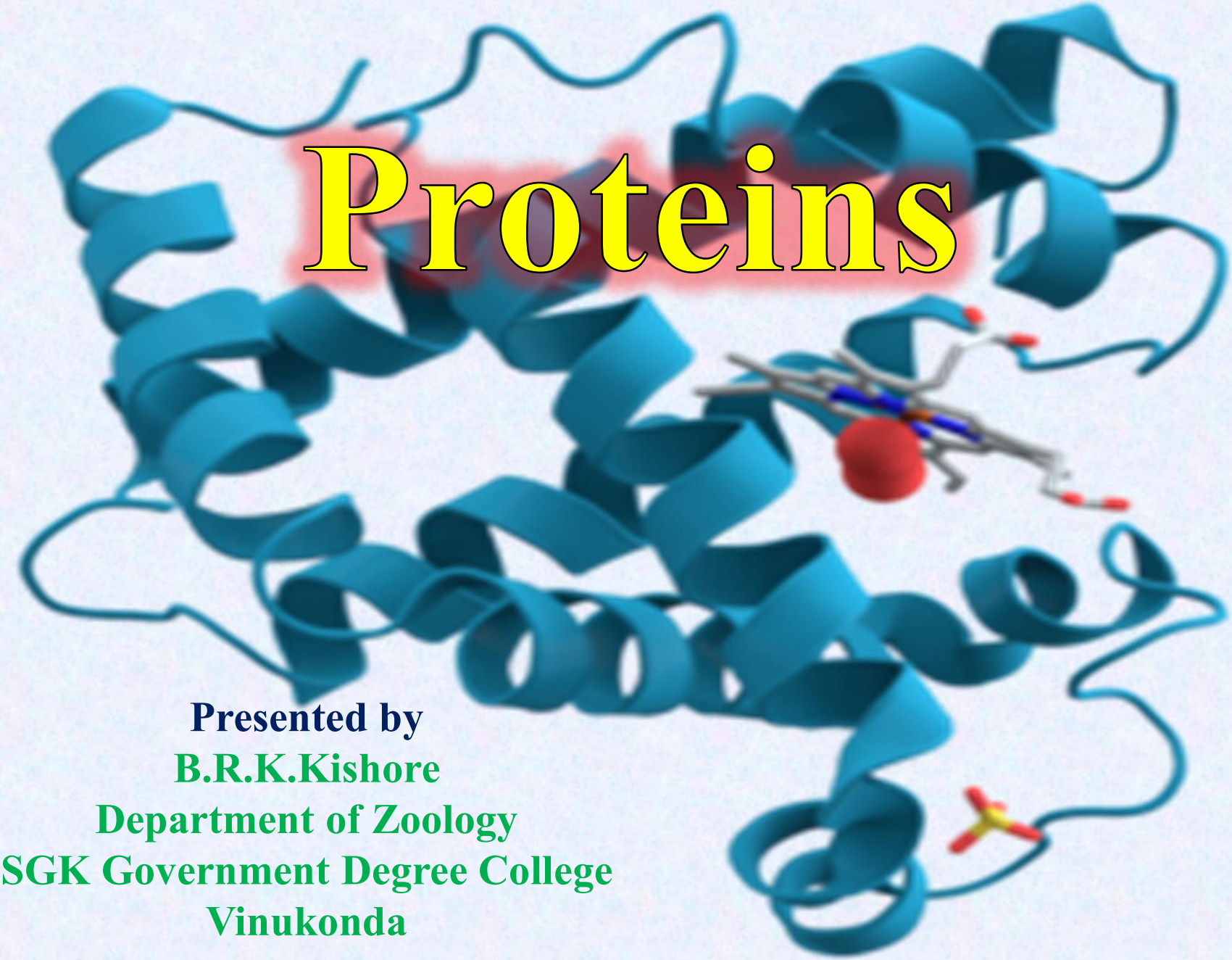
Proteins



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Proteins

- Proteins are the most abundant biological macromolecules, occurring in all cells and all parts of cells.
- Amino acids are the building blocks of proteins.
- Proteins were first **described by** the *Dutch chemist* **Gerardus Johannes Mulder** and **named by** the *Swedish chemist* **Jones Jacob Berzelius** in **1838**.
- The term " **Protein**" is derived from the ***Greek word*** " ***Proteios***" and the meaning is "**Primary in the lead**", or "**Standing in front**",

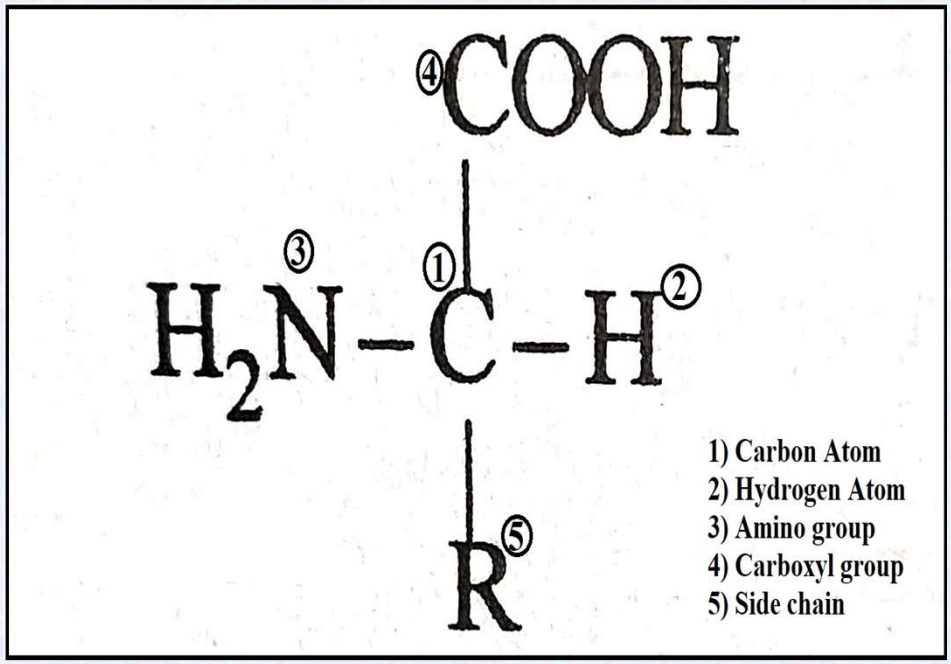
Amino Acids

- Amino acids are organic compounds that contain both amino and carboxylic acid functional groups.
- French chemists Louis-Nicolas Vauquelin and Pierre Jean Robiquet isolated a compound from asparagus that was subsequently named **Asparagine**, the first amino acid to be discovered in 1806.
- They are the building blocks of proteins
- There are 200 amino acids in nature but only 20 functional amino acids are participated in protein synthesis.

Amino Acids

- In Proteins, the amino acids are linked together by poly peptide bonds.
- The amino acid structure contain

1. Carbon atom (C)
2. Hydrogen atom (H)
3. Amino group (NH_2)
4. Carboxyl group (COOH)
5. Side chain (R)



Amino Acids

Properties:

- They are in the form of **crystals**.
- They are **colour less**
- They are readily soluble in water, slightly in Alcohol and not soluble in Ether
- They have high melting points i.e. above 200°C
- They act as zwitterions (have both negative and positive charge at polar regions)
- They react with both alkalies and acids to form salts

Structure of protein

- **Most proteins consist of linear polymers built from series of up to 20 different L-α- amino acids.**
- **All proteinogenic amino acids possess common structural features, including an α-carbon in which an amino group, and a carboxyl group.**
- **The amino acids in a polypeptide chain are linked by peptide bonds.**

Classification of Proteins

Proteins are classified in to different groups based on the following aspects

1) **Solubility and composition**
2) **Function**
3) **Structure**

Classification on Solubility and composition

According to this classification, proteins are divided into three main groups, such as

1) ***Simple Proteins***
2) ***Conjugated Proteins***
3) ***Derived Proteins Proteins***

Simple Proteins

Properties:

- **Soluble in water**
- **Yields Amino acids when hydrolysed**
- **Coagulated by heat**

Classification of Simple Proteins

These proteins are further classified based on their solubility in different solvents as well as their heat coagulability.

1. Albumins
2. Globulins
3. **Prolamins**
4. **Glutelins**
5. **Histones**
6. **Protamines**
7. **Albuminoids**

Albumins

- Albumins are readily **soluble in water**, **dilute acids and alkali's.**
- **Coagulated by heat**.
- Seed proteins contain albumin in lasser quantities.
- Albumins may be precipitated out from solution using high salt concentration, a process called **'salting out'.**

Globulins

- Globulins are **insoluble** or **sparingly soluble** in **water**, but their **solubility is greatly increased by the addition of neutral salts** such as sodium chloride.
- These proteins are **coagulated by heat**
- **They are deficient in Methionine**
- Serum globulin, fibrinogen, myosin of muscle and globulins of pulses are examples.

Prolamins

- Prolamins are insoluble in water but soluble in 70-80% aqueous alcohol
- Upon hydrolysis they yield much **Proline** and **Amide nitrogen**, hence the name prolamin.
- They are **deficient in lysine**.
- Gliadin of wheat and zein of corn are examples of prolamins.

Glutelins

- Glutelins are insoluble in water and absolute alcohol but soluble in dilute alkalies and acids.
- They are plant proteins e.g., Glutenin of wheat.

Histones

- Histones are **small and stable** basic proteins
- They contain fairly **large amounts** of **basic amino acid, Histidine.**
- They are soluble in water, but insoluble in ammonium hydroxide.
- They are **not readily coagulated by heat.**
- They occur in **globulin** of haemoglobin and nucleoproteins

Protamines

- Protamines are the **simplest** of the proteins.
- They are soluble in water and are not coagulated by heat.
- They are basic in nature due to the presence of large quantities of **Arginine.**
- Protamines are found in association with nucleic acid in the sperm cells of certain fish.
- Tyrosine and tryptophan are usually absent in Protamines.

Albuminoids

- These are characterized by great stability and insolubility in water and salt solutions.
- These are called albuminoids because they are essentially similar to albumin and globulins.
- They are **highly resistant** to proteolytic enzymes.
- They are **fibrous in nature** and form most of the supporting structures of animals.
- They occur as **chief constituent of exoskeleton** structure such as hair, horn and nails.

Conjugated or compound proteins

- These are simple proteins combined with some non-protein substances known as prosthetic groups.
- The nature of the non-protein or prosthetic groups is the basis for the sub classification of conjugated proteins.

Classification of Conjugated Proteins

The Conjugated or compound proteins sub classified in to following sub classes

1. Nucleo-proteins
2. Muco-proteins
3. Chromo proteins
4. Lipoproteins
5. Metalloproteins
6. Phospho proteins

Nucleo-proteins

- Nucleoproteins are simple basic proteins (Protamines or Histones) in salt combination with nucleic acids as the prosthetic group.
- They are the important constituents of nuclei and chromatin.

Muco-proteins

- These proteins are composed of simple proteins in combination with carbohydrates like muco polysaccharides, which include hyaluronic acid and chondroitin sulphates
- On hydrolysis, muco polysaccharides yield more than 4% of amino-sugars, hexosamine and uronic acid e.g., ovomucoid from egg white.
- Soluble Mucoproteins are neither readily denatured by heat nor easily precipitated by common protein precipitants like trichloroacetic acid or picric acid.
- The term glycoprotein's is restricted to those proteins that contain small amounts of carbohydrate usually **less than 4% hexosamine.**

Chromoproteins

These are proteins containing coloured prosthetic groups e.g., haemoglobin, flavoprotein and cytochrome.

Lipoproteins

- These are proteins conjugated with lipids such as neutral fat, phospholipids and cholesterol

Metalloproteins

- These are metal-binding proteins.
- A -globulin, termed transferrin is capable of combining with iron, copper and zinc.
- This protein constitutes 3% of the total plasma protein.
- Another example is ceruloplasmin, which contains copper.

Phosphoproteins

- These are proteins containing phosphoric acid.
- Phosphoric acid is linked to the hydroxyl group of certain amino acids like serine in the protein e.g., casein of milk.

Derived proteins

- These are proteins derived by partial to complete hydrolysis from the simple or conjugated proteins by the action of acids, alkalies or enzymes.
- There are two types of derivatives, such as
    1) Primary-derived proteins
    2) Secondary-derived proteins

Primary-derived proteins

- These protein derivatives are formed by processes causing only slight changes in the protein molecule and its properties.
- There is little or no hydrolytic cleavage of peptide bonds.
- It include the following types

a) Proteans
b) Metaproteins
c) Coagulated proteins

Proteans

- Proteans are insoluble products formed by the action of water, dilute acids and enzymes.
- These are particularly formed from globulins but are insoluble in dilute salt solutions.
- Ex. myosan from myosin, fibrin from fibrinogen.

Metaproteins

- These are formed by the action of acids and alkalies upon protein.
- They are insoluble in neutral solvents

Coagulated proteins

- Coagulated proteins are **insoluble products formed by** the **action of heat or alcohol on natural proteins.**
- Ex. cooked meat and cooked albumin.

Secondary-derived proteins

- These proteins are **formed in** the progressive **hydrolytic cleavage** of the peptide bonds of protein molecule.
- They are roughly grouped into proteoses, peptones and peptides according to average molecular weight.

Proteoses :

- Proteoses are hydrolytic products of proteins, which are soluble in water and are not coagulated by heat.

Peptones:

- Peptones are hydrolytic products, which have simpler structure than proteoses.
- They are soluble in water and are not coagulated by heat.

Secondary-derived proteins

Peptides:

- Peptides are composed of relatively few amino acids.
- They are water-soluble and not coagulated by heat.
- The complete hydrolytic decomposition of the natural protein molecule into amino acids generally progresses through successive stages as follows:

Protein -----> Protean -------Metaprotein

Proteoses ---->Peptones ----->Peptides ---- amino acids

Classification of proteins based on Structure

Based on structure, proteins are classified into four groups, such as

i. **Primary Proteins**
ii. **Secondary Proteins**
iii. **Tertiary Proteins**
iv. **Quaternary Proteins**

Primary Proteins

- Protein have many amino acids but all remain single chain with polypeptide bonds.
- The polypeptide bond is a repeating unit and peptide have below 10 amino acids are called Oligopeptide, and have above 10 then it is called polypeptide.
- The ends of the chain named **N-terminal and C-terminal ends** respectively.
- Ex. **Fibroin of silk**

Secondary Proteins

- Protein have spirally or helically arranged hundreds of amino acid chains.
- Amino acid chains are connected with hydrogen bonds.
- Ex. Keratin, Collagen

Tertiary Proteins

- Proteins are composed of many polypeptide chains which are connected by -S-S- bonds.
- The chain have the capacity to form helix, it assumes ellipsoid or other form
- Ex. Myoglobin

Quaternary Proteins

- Two or more polypeptide chains associate together and produce quaternary structure.
- Final quaternary structure was formed by the combination of primary, secondary and tertiary chains.
- Ex. Haemoglobin

Thanking You