**Proteins: Definition, Importance and Classification**

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**In this article we will discuss about:- 1. Definition of Proteins 2. Biological Importance of Proteins 3. Classification 4. Protein Hydrolyzing Enzymes 5. Important Tests 6. Estimation.**

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**1. Definition of Proteins:**

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Proteins may be defined as the high molecular weight mixed polymers of α-amino acids joined together with peptide linkage (-CO-N H-). Proteins are the chief constituents of all liv­ing matter. They contain carbon, hydrogen, nitro­gen and sulphur and some contain phosphorus also.

**2. Biological Importance of Proteins:**

i. Proteins are the essence of life processes.

ii. They are the fundamental constituents of all protoplasm and are involved in the struc­ture of the living cell and in its function.

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iii. Enzymes are made up of proteins.

iv. Many of the hormones are proteins.

v. The cement substances and the reticulum which bind or hold the cells as tissues or organs are made up partly of proteins.

vi. They execute their activities in the trans­port of oxygen and carbon dioxide by hemoglobin and special enzymes in the red cells.

vii. They function in the homostatic control of the volume of the circulating blood and that of the interstitial fluids through the plasma proteins.

viii. They are involved in blood clotting through thrombin, fibrinogen and other protein factors.

ix. They act as the defence against infections by means of protein antibodies.

x. They perform hereditary transmission by nucleoproteins of the cell nucleus.

**3. Classification of Proteins:**

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**I. Simple proteins**

**(i) Albumins:**

Soluble in water, coagulable by heat and 1 precipitated at high salt concentrations.

Examples – Serum albumin, egg albumin, lactalbumin (Milk), leucosin (wheat), legumelin (soyabeans).

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**(ii) Globulins:**

Insoluble in water, soluble in dilute salt 1 solutions and precipitated by half 1 saturated salt solutions.

Examples – Serum globulin, vitellin (egg yolk), tuberin (potato), myosinogen (muscle), legumin (peas).

**(iii) Glutelins:**

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Insoluble in water but soluble in dilute 1 acids and alkalis. Mostly found in plants.

Examples – Glutenin (wheat), oryzenin (rice).

(iv) Prolamines: Insoluble in water and absolute alcohol 1 but soluble in 70 to 80 per cent alcohol.

Examples – Gliadin (wheat), zein (maize).

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**(v) Protamines:**

Basic proteins of low molecular weight. 1 Soluble in water, dilute acids and alkalis, j Not coagulable by heat.

Examples – Salmine (salmon sperm).

**(vi) Histones:**

Soluble in water and insoluble in very I dilute ammonium hydroxide.

Examples – Globin of hemoglobin and thymus histones.

**(vii) Scleroproteins:**

Insoluble in water, dilute acids and alkalis.

Examples – Keratin (hair, horn, nail, hoof and feathers), collagen (bone, skin), elastin (ligament).

**II. Conjugated Proteins**

**(i) Nucleoproteins:**

Composed of simple basic proteins (pro­tamines or histones) with nucleic acids, I found in nuclei. Soluble in water.

Examples – Nucleoprotamines and nucleohistones.

**(ii) Lipoproteins:**

Combination of proteins with lipids, such ‘ as fatty acids, cholesterol and 1 phospholipids etc.

Examples – Lipoproteins of egg-yolk, milk and cell membranes, lipoproteins of blood.

**(iii) Glycoproteins:**

Combination of proteins with carbohydrate (mucopolysaccharides).

Examples – Mucin (saliva), ovomucoid (egg white), osseomucoid (bone), tendomucoid (tendon).

**(iv) Phosphoproteins:**

Contain phosphorus radical as a | prosthetic group.

Examples – Caseinogen (milk), ovovitellin (egg yolk).

**(v) Metalloproteins:**

Contain metal ions as their prosthetic | groups. The metal ions generally are Fe, I Co. Mg, Mn, Zn, Cu etc.

Examples – Siderophilin (Fe), ceruloplasmin (Cu).

**(vi) Chromoproteins:**

Contain porphyrin (with a metal ion) as | their prosthetic groups.

Examples – Haemoglobin , myoglobin, catalase, peroxidase, cytochromes.

**(vii) Flavoproteins:**

Contain riboflavin as their prosthetic 1 groups.

Examples – Flavoproteins of liver and kidney.

**III. Derived Protein**

**A. Primary derivatives**

**(i) Proteans:**

Derived in the early stage of protein hydrolysis by dilute acids, enzymes or alkalis.

Examples – Fibrin from fibrinogen.

**(ii) Metaproteins:**

Derived in the later stage of protein hydrolysis by slightly stronger acids and alkalis.

Examples – Acid and alkali metaproteins.

**(iii) Coagulated:**

They are denatured proteins formed by the action of heat. X-rays, ultraviolet rays etc.

Cooked proteins, coagulated albumins.

**B. Secondary derivatives**

**(i) Proteoses:**

Formed by the action of pepsin or trypsin. Precipitated by saturated solution of ammonium sulphate, incoagulable by heat.

Examples – Albumose from albumin, globulose from globulin.

**(ii) Peptones:** .

Further stage of cleavage than the proteoses. Soluble in water, incoagu­lable by heat and not precipitated by saturated ammonium sulphate solutions.

**(iii) Peptides:**

Compounds containing two or more amino acids. They may be di-, tri-, and porypeptides.

Examples – Glycyl-alanine, leucyl-glutamic acid.

**4. Protein Hydrolyzing Enzymes:**

**i. Pepsin:**

In Gastric Juice.

**ii. Trypsin, Chymotrypsin and Carboxypeptidases:**

In Pancreatic Juice.

**iii. Amino-peptidases, Dipeptidases and Poly-peptidases:**

In intestinal juice.

**5. Important Tests of Proteins:**

**A. Colour reactions:**

**i. Biuret test:**

To 2 ml of test solution add an equal volume of 10% NaOH and one drop of 10% CuSO4 solution. A violet col­our formation indicates the presence of peptide linkage.

**ii. Ninhydrin test:**

To 1 ml Ninhydrin solu­tion add 1 ml protein solution and heat. Formation of violet colour indicates the presence of α-amino acids.

**B. Coagulation reactions:**

**Heat coagulation:**

Take the test solution up to 2/3 of the test tube and heat the upper portion of the solution holding the lower part of the test tube. An opalescent appears which becomes deep on the addition of a few drops of 2% acetic acid. This in­dicates the presence of protein (albumin).

**C. Precipitation reaction:**

**i. Full saturation:**

Saturate 5 ml of test solu­tion in a test tube with solid ammonium sulphate. A gelatinous precipitate appears indicating the presence of albumin.

**ii. Half saturation:**

Add 3 ml saturated solu­tion of ammonium sulphate to 3 ml of test solution in a test tube and shake vigor­ously. A gelatinous precipitate forms in­dicating the presence of globulin.

**6. Estimation of Proteins:**

**Quantitative estimations of proteins of foods and other biological materials are performed by the fol­lowing methods:**

**A. Kjeldahl method:**

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i. This method consists in digesting a known weight of the material with concentrated sulphuric acid and potassium sulphate with copper sulphate, mercuric oxide or selenium dioxide as a catalyst.

ii. The amino groups of the amino acids and N present in the heterocylic rings of histi­dine, tryptophan, proline and hydroxyproline are converted into ammonia as well as carbon is oxidized to carbon dioxide.

iii. The ammonia present as sulphate is esti­mated after distillation by titration with standard acid or colorimetrically using Nessler’s reagent.

iv. The nitrogen content of the sample is cal­culated and converted into “Crude Pro­tein” content by multiplying by the fac­tor 6.25.

**Defects:**

a. The factor 6.25 is only approximate for the same proteins.

b. The nitrogen of urea, Creatinine and other N compounds (which have no nutritive value) present in animal foods, fish and milk in small amounts also forms part of the total nitrogen i.e. crude protein.

**B. Coiorimetric method:**

i. This method is entirely based on the Biu­ret reaction or Folin’s phenol reagent.

ii. This method is generally used for the esti­mation of concentration of protein of se­rum.

**C. Electrophoretic method:**

i. This method is used for the separation and estimation of protein in serum, tissues and foodstuffs.

ii. In case of tissues and foods, the proteins are extracted with suitable solvents before separating them electrophoretically.

iii. The electrophoretic separation can be per­formed using filter paper, agar gel and starch gel.

iv. The proteins, after separation, are treated with suitable dye and the intensity of the colour of the individual dye-protein com­plex bands are measured using a densito­meter.

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