

Protein

Proteins are high molecular weight macromolecules composed of amino acids linked by peptide bonds.

Properties of protein

- Macromolecule with variable shape and molecular weight
- Optically active
- Have iso-electric pH.
- Proteins are precipitated by adding of salt, heavy metal ions, organic solvents and at Pl.
- Gives color reactions with Biuret and ninhydrin reagent.

Amino acid: Amino acid is the amino group containing carboxylic acid.

Peptide bond: It is the covalent bond which formed by joining of '-COOH' group of one amino acid and '-NH₂' group of another amino acid with removal of one molecule water.

- Not broken by denaturing agents but broken by proteolytic enzyme.
- It is rigid, planer, covalent bond and shows partial double bond character.
(অনমতীয়) (পঞ্চান)

Biological Importance / function of protein

- Formation of cytoskeleton
- Promotes catalytic function by enzymes and hormone.
- Provides defense against infection by Antibody.
- Helps in muscle contraction by actin and myosin.
- Act as a vehicle for transport of hormone, drugs, vitamins etc.
- Provide mechanical support by structural element.
eg. collagen, elastin.
- Helps in coagulation by clotting factors.
- Helps in gas transport by Hb.
- Plasma protein maintain colloidal osmotic pressure.
- storage, expression & transport genetic information by nucleoprotein.
- Source of energy.

Classification of protein

A. Functional classification

(i) Structural protein → collagen, elastin

(ii) Catalytic " → pepsin, trypsin

(iii) Transport " → albumin, globulin

(iv) Hormones " → insulin, growth

- (v) Gene regulating \rightarrow Histone
- (vi) contractile protein \rightarrow actin, myosin
- (vii) protective " \rightarrow Immunglobulin
- (viii) Receptors " \rightarrow LDL receptor
- (ix) storage \rightarrow Ovotransferrin, albumin

(B) Based on size, shape & solubility

(i) Simple protein: Contains only amino acid.

These are two types -

a. Globular - Oval or spherical shape, water soluble.

e.g. albumin, globulin, protamin, histone.

b. Fibrous - Fiber like, water insoluble, chief component of tendon, ligament, cartilage, hair, nail etc.

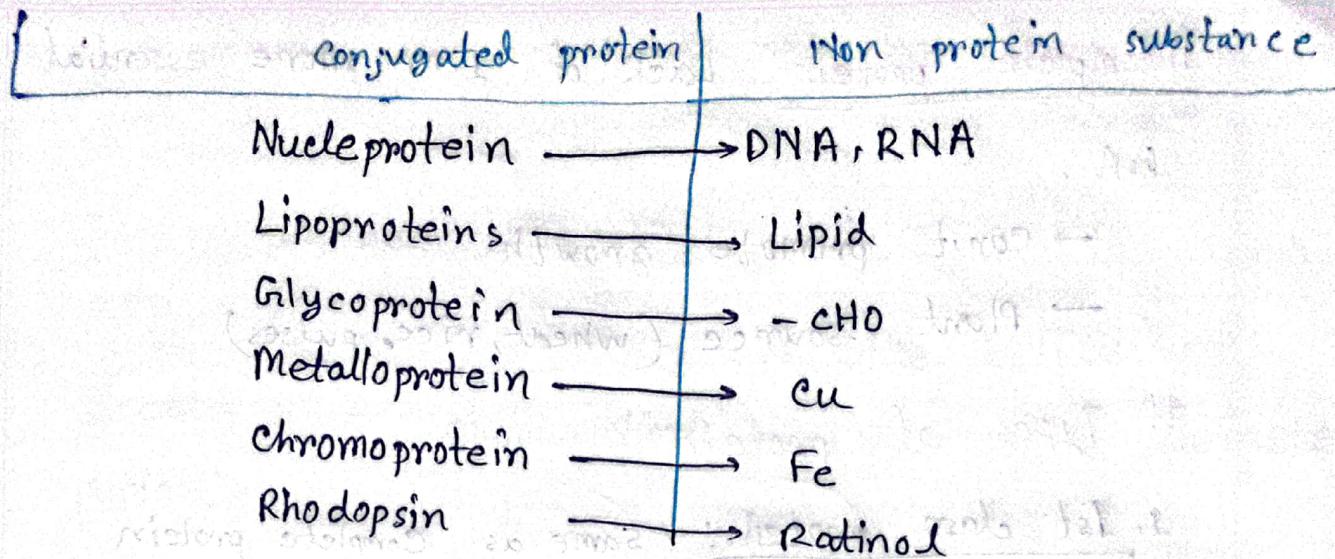
e.g. Collagen \rightarrow Connective tissue.

Elastin \rightarrow Elastic "

Keratin \rightarrow hair, nail.

(ii) Conjugated protein: composed of simple protein along with non-protein prosthetic substance.

(Eg.)



(iii) Derived protein: Degraded on denatured product of simple or conjugate protein.

a. Primary DP → slight change in protein molecule, no change in peptide bond.

e.g: Proteam, metaprotein

b. Secondary DP → Partially degraded protein produced by progressive hydrolytic cleavage of peptide bond.

e.g: Protease, peptone, polypeptide

c. Nutritional classification

(i) Complete protein: high biological value.

- contain 10 essential AA,
- can promote growth
- animal protein

Incomplete protein: Lack of 1 or more essential amino acids.

AA.

- can't promote growth
- Plant source (wheat, rice, pulses)

Types of protein

1. 1st class protein: same as complete protein

→ Biologically complete

→ Animal origin

2. Second class protein: same as incomplete

→ Biologically incomplete

→ Plant source

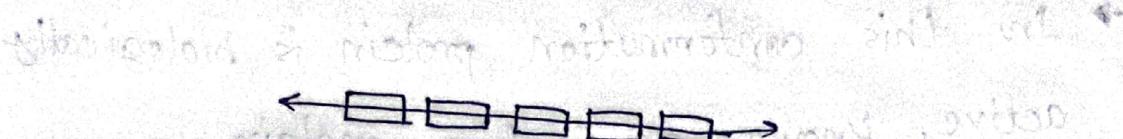
Structure of protein

1. Primary structure: It is the linear sequence of AA in a polypeptide chain.

→ Here amino acids are held together by covalent bond (peptide bond)

→ Primary structure of a protein is determined genetically and this in term determined secondary, tertiary, quaternary.

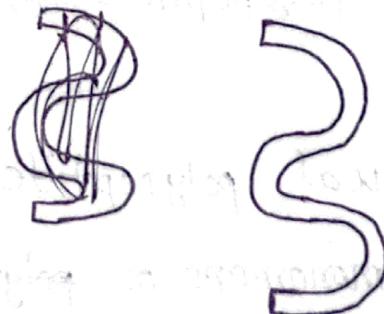
Exm with Linear sequence of AA of Insulin



Secondary structure: It is the helical or pleated like conformation produced by a definite, periodic, folding, twisting or coiling of primary structure.

→ stabilizing by non-covalent bond (hydrogen bond)
→ It is found in fibrous protein.

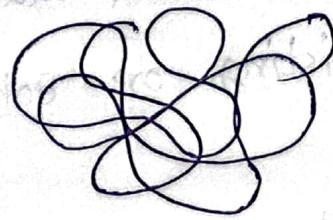
Exm: Elastin, fiber



Tertiary structure: It is a three dimensional (having length, breath & thickness) globular form of protein produced by further folding & twisting of secondary structure about itself with the hydrophobic group buried interiorly and hydrophilic group exposed outside.

- Stabilized by hydrogen bond disulfide bond
- In this conformation protein is biologically active, known as native protein.

Example: Albumin, Globulin, Antibody etc



Quaternary Structure: It is a multi chain oligomeric protein showing spacial relationship of individual polypeptide chain among each other.

- The individual polypeptide chains are known as monomers or ~~polymer~~ protomers or subunits.
- 2 or more subunits are held together by hydrogen, ionic bond, hydrophobic bonds.

Exm: Haemoglobin

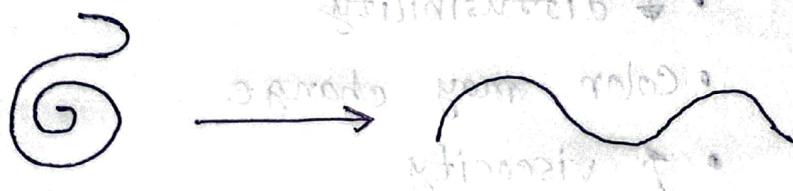
CK (dimer)

IGM (Pentamer)

Denaturation

When protein lost its secondary, tertiary & quaternary structure but intact primary structure is called denaturation.

- Denatured protein misfolded, thus lost its physical, chemical and biochemical properties.



Denatured reduced ribonuclease

Denaturing agents:

(i) Physical agents: Heat, freezing, x-ray, UV-ray
(~~extreme~~) vigorous shaking.

(ii) chemical agents: Extreme pH, strong acid, strong alkali, acetone, detergent, heavy metals.

Characteristics of denaturation

- The natural folding pattern - secondary, tertiary & quaternary structure is lost.
- Primary structure remains intact.

- Biological properties are lost.
- Denaturation usually irreversible but rarely may be reversible.
- No change in molecular weight.

Physical and chemical properties altered.

→ - ↓ Solubility

• ↓ diffusibility

• Color may change

• ↑ viscosity

• Loss of function

• Digestibility ↑

Exm: Boiled egg, cooked meat & fish

(Irreversible denaturation)

Ribonuclease at high urea concentration

(Reversible denaturation)

Peptide Bond

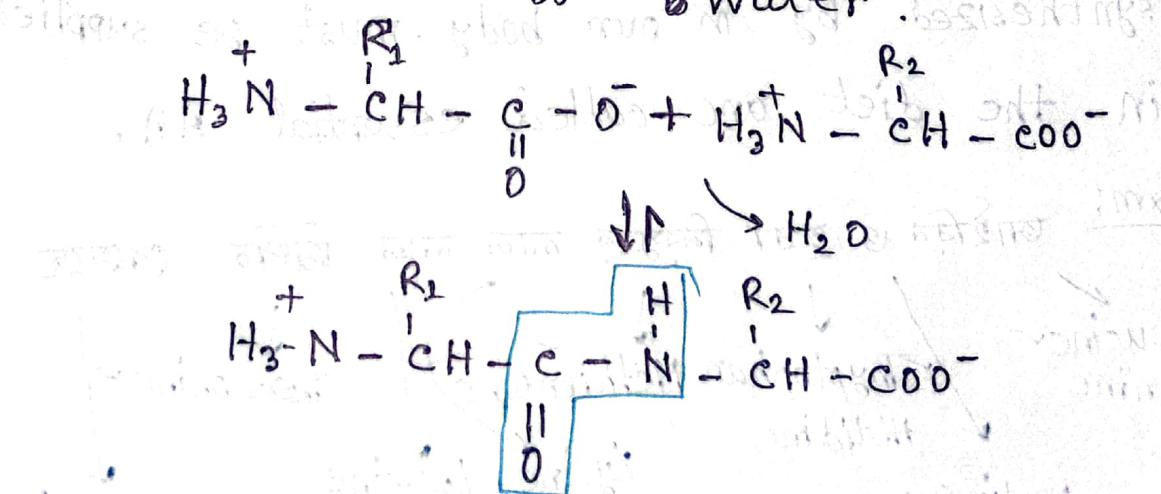
Short note

Def: The AA are held together in a protein by a covalent bond known as peptide bond.

characteristics of Peptide bond

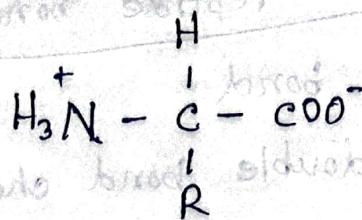
- It is covalent bond
- Show partial double bond character.
- Rigid, planer & don't rotate
- Not broken by denaturing agents, broken by Proteolytic enzyme

Peptide bond formation: Peptide bond is formed by the joining of ~~one~~ carboxylic and amino groups of two AA with removal of one molecule of water.



Amino Acids

Amino acids are the monomer of protein containing two functional group (amino - NH₂ & carboxyl - COOH)



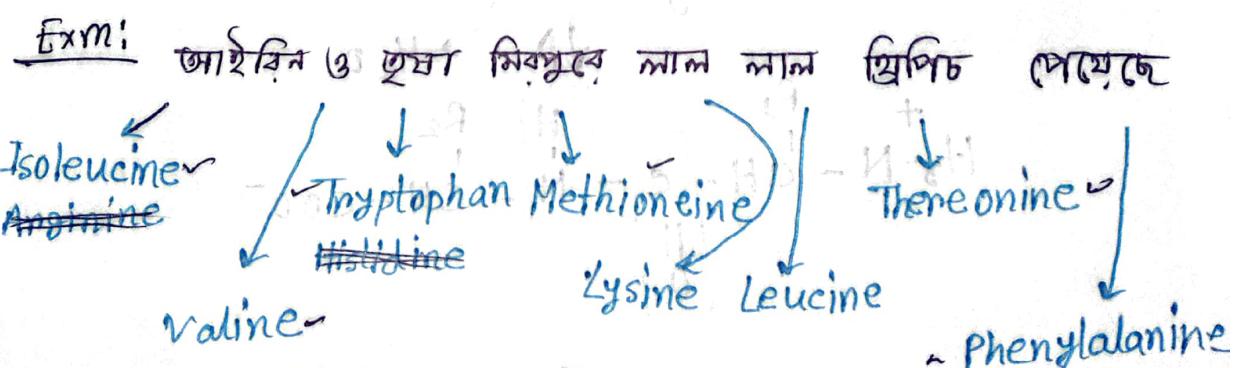
- There are 20 different amino acids in human body.

→ Essential AA → 8

Semi-essential AA → 2

Classification

1. Essential amino acids: AA that can't be synthesized by in our body, must be supplied in the diet are called essential AA.



Glucogenic	Glucogenic & Ketogenic	Ketogenic
Histidine	Isoleucine	Lysine
Methionine	Phenyl-alanine	Leucine
Threonine	Tryptophan	
Valine		

2. Semi-essential AA: They are synthesized in small amount by the body but whenever body can't synthesize, they become essential. (growing child, pregnancy)

*Exm: Arginine, histidine

- 10 AA is essential for growing child
- 8 AA is " " " adult.

3. Non-essential: They are synthesized by the body in adequate amount, so their presence in diet is not essential.

e.g.: Alanine, tyrosine, glycine

B. Based on metabolic fate:

1. Glucogenic AA: The amino acid having carbon skeleton and produce glucose.

2. Ketogenic AA: produce ketone

3. Both: Produce glucose & Ketone body.

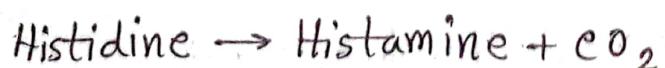
Properties of AA

Physical

- (i) Soluble in water
- (ii) Melting high point $> 200^\circ\text{C}$
- (iii) All the AA are optically active & shows isomerism.

Chemical

- (i) Act as ampholytes (isoelectric)
- (ii) Have definite iso-electric PH.
- (iii) forms esters (-COOR) with alcohols.
- (iv) Decarboxylation to form amines.



- (v) Forms salt with acid & base by reacting with NH_2 or COOH group.

Functions

- (i) Act as the building block of peptide, polypeptide & protein.
- (ii) Supports gluconeogenesis during fasting & starvation.

- (iii) Source of sulfur in body.
- (iv) Source of methyl group in body.
- (v) Participate in the synthesis of hormone, N₂ bases, heme etc.

peptide → up to 10 AA

Polypeptide → 10 - 100 AA

Protein → > 100 AA (one or more polypeptide chain)

Proteases & Peptones → Breakdown products of protein

***** Summary:

protein → Def*, Importance, functions, classification.
structural cla

