PROTEIN

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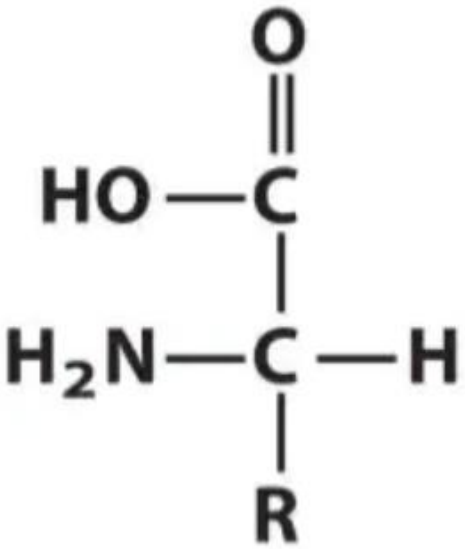
AMINO ACIDS

- An amino acid is bi functional organic molecule that contain both a carboxyl group, -COOH as well as an amine group,-NH_2, an R-group and a hydrogen.
- Amino Acids are the building blocks of proteins. There are 300 amino acids that occur in nature. Among these only 22 are known as standard amino acids that commonly occur in proteins.
- The amino acids differ in the nature of R-group attached to α carbon atom. The nature of R-group determines the properties of proteins.

General formula



Classificaton of Amino Acids

- According to the structure of side chain
- According to the polarity of the side chain(R group)
- According to the nutritional requirements
- According to the metabolic fate

Nutritional classification of amino acid

- Essential amino acid
- Non-Essential amino acid

Essential amino acid

- Essential amino acids are not synthesized by the body.
- Need to be supplied through diet.
- Required for proper growth and maintainance of individual.

Arginine, valine, Histidine, Isoleucine, Leucine, Lysine, Methionine, Threonine, Tryptophan, Phenylalanine

Semi-essential amino acid

- Arginine and Histidine can be synthesized by adults but not by growing children, hence these are considered as semi-essential amino acids.

Non-Essential amino acid

- These can be systhesized by the body to meet the biological needs.
- Need not be consumed through the diet.

Glycine, Alanine, Serine, Cysteine, Aspartate, Asparagine, Glutamate, Glutamine, Proline, Tyrosine.

Classification of amino acid based on polarity

- Non –polar, aliphatic amino acid.
- Aromatic amino acid
- Polar uncharged(R group) amino acid
- Polar positively charged amino acid

Physical properties of amino acid

- **Solubility**: most of the amino acids are soluble in water but insoluble in organic solvents.
- **Melting point**: Amino acids generally melt at high temperature, often above 200^{o}C.
- **Taste**: Amino acids may be sweet(Gly, Ala, Val); tasteless(Arg, Ile)

Some terms

- Enantiomer: Enantiomers are chiral molecules which are non-superimposable mirror images of each other.

- Isoelectric pH: Isoelectric pH may be defind as a pH at which a molecule exist as a zwitter ion or dipolar ion and carries no net charge.

PROTEIN

Classification of Protein

- An infinite number of proteins could be synthesized from the 20 natural amino acids.
- As proteins perform a wide variety of biological functions, they are classified in a number of ways.
- On the basis of function they are classified as Catalytic proteins, Contractile Proteins and Structural Protein.

- On the basis of composition, protein can be classified as Simple Protein and Conjugated Protein.
- Simple proteins yield only amino acid on hydrolysis.
- Conjugated proteins yield amino acid and an organic or inorganic moiety called the prosthetic group. The prosthetic groups of conjugated proteins are Carbohydrates, Lipids, Nucleic Acids, Metal ions or Phosphates.

Simple protein

- Albumin
- Globulin
- Glutelin
- Prolamine
- Histone
- Protamine
- Albuminoids

- LIPOPROTEIN:

  These are proteins complexed with lipids and are found in cells and the blood stream. The lipids are very firmly held to the proteins and cannot be easily removed. The lipids in lipoproteins are triglycerides, phospholipids, cholesterol or derivatives of cholesterol. Lipoproteins serve as transporters of lipids in blood. Based on density, lipoproteins are grouped into 3 groups-High-density, low-density and very low-density lipoproteins.

GLYCOPROTEIN:

- These are proteins whose prosthetic groups are heterosaccharides containing hexosamine, galactose, mannose.
- Glycoproteins are found in mucous secretions of mammals and function as Lubricating Agents.
- Egg-white contains ovomucoid which cannot be coagulated by heat and is a glycoprotein.
- Certain pulse proteins are glycoproteins.

METALLOPROTEIN:

- These are complexes of proteins and heavy metals.
- In most metalloprotein, metals are loosely bound and can be easily removed. However, in some proteins such as haemoglobin and myoglobin, the metal iron is firmly bound to the prosthetic group.
- Liver and Spleen contain the metalloprotein ferritin and haemosiderin with about 20 percent iron content.

NUCLEOPROTEIN:

- These are complexes of proteins and nucleic acids.
- Nucleic acids readily combine with proteins to form the complexes.

PHOSPHOPROTEIN:

- These are conjugated with inorganic phosphate.
- The most widely used phosphoproteins are the milk protein Casein and the Enzyme Pepsin.

Properties of protein

- Microbial spoilage occurs under unsatisfactory conditions when the food is not properly processed. Microbial proteases brings about decarboxylation and deamination resulting in undesirable changes in flavour and texture, and production off offensive odours and toxins. These changes are refferred to as Putrefaction.

Denaturation

- It brings about many changes in a protein. It makes the peptide bonds of protein more readily available for hydrolysis by proteolytic enzyme, solubility is decreased and biological properties such as catalytic , hormonal, etc are lost.
- It is the result of the modification of the secondary, tertiary or quaternary structure of the protein molecules, excluding the breakage of covalent bonds.

Denaturation

- Both physical and chemical agents bring about denaturation. Heat is the most important physical agent.
- For every $10^{o}C$ rise in temperature the increase in denaturation rate is 600-fold.The effect of denaturation can be reduced by working at a reduced temperature.
- The rate of heat denaturation is affected by the water content of protein, ionic strength, pH, and types of ions present in the solution.

Food protein

- Both plants and animals require proteins for growth, survival and propagation of the species.

Animal Protein:

- Meat: i)Edible muscle of cattle, Sheep, Swine. Designated as “red meat” due to the presence of Myoglobin in them.

ii) White meat

- Milk: cow milk contains 3.5 % protein. Milk proteins are generally divided into two classes-Casein and Whey proteins.
- Egg : 13-14% protein, about 2/3 of which is present in egg-white and the rest in egg-yolk. Egg-white consists of a number of proteins which are readily denatured and coagulated. yolk is a mixture of lipoproteins and phosphoproteins.
- Fish: The protein content of fish varies from 10 to 21 percent.

- Vegetable proteins: Potatoes, green beans and Fresh peas.
- Cereal Grains: Protein ranging from 6 to 20%.

Protein content of rice: 7-9%

Protein content of Wheat: 12-15%

- Pulses: More than 20% proteins.

Structure of Protein

- The structure of protein is normally considered under four levels-Primary Structure, Secondary Structure, Tertiary Structure and Quaternary Structure.
- **Primary Structure**: within a protein,multiple amino acids are linked together by peptide bonds, thereby forming a long chain..The linear sequence of amino acids within a protein is considered the primary structure of protein.

- **Secondary Structure**: Two main types of secondary structure, the α-helix and the β-strands or β-sheets.(intralinked polypeptide chain).here, polypeptide chains twisted or bands.
- In helix hydrogen bonds form between amino acids (specially between carboxylic acid group and amino group in the near by amino acids).the hydrogen bonds holds the turns of the helix together.

- **Tertiary structure:** It refers to the 3-D structure created by a single protein molecule(a single polypeptide chain). It may be include one or several domains.(intra+inter linked polypeptide chain).here, polypeptide chains twist and folded upon itself.Bonds present in tertiary structure is Hydrogen bond, peptide bond, disulphide, electrostatic interaction(ionic bond)(COOH and NH3), vanderwall's forces and hydrophobic interaction(between side chain of amino acids).eg: myoglobin.

- **Quaternary Structure**: when a protein contains two or more polypeptide chains (subunits), the structure formed when individual polypeptide chains interact to form the native protein molecule, is referred to as the quaternary structure.eg: Haemoglobin