PROTEINS

Proteins are complex organic compounds of high molecular weight. In common with carbohydrates and fats they contain carbon, hydrogen and oxygen, but in addition they all contain nitrogen and generally Sulphur.

Proteins are found in all living cells, where they are intimately connected with all phases of activity that constitute the life of the cell. Each species has its own specific proteins, and a single organism has many different proteins in its cells and tissues. It follows therefore that a large number of proteins occur in nature.

Amino Acids

Amino acids are produced when proteins are hydrolyzed by enzymes, acids or alkalis. Although over 200 amino acids have been isolated from biological materials, only 20 of these are commonly found as components of proteins. Amino acids are characterized by having a basic nitrogenous group, generally an amino group (**–NH2**), and an acidic carboxyl unit **(–COOH).** Most amino acids occurring naturally in proteins are of the α type, the carbon atom adjacent to the carboxyl group.

The exception is proline, which has an amino **(–NH)** instead of an amino group. The nature of the R group, which is referred to as the side chain, varies in different amino acids. It may simply be a hydrogen atom, as in glycine, or it may be a more complex radical containing, for example, a phenyl group.

Properties of amino acids

Because of the presence of an amino group and a carboxyl group, amino acids are amphoteric, i.e. they have both basic and acidic properties. Molecules such as these, with basic and acidic groups, may exist as uncharged molecules, or as dipolar ions with opposite ionic charges, or as a mixture of these.

Essential amino acid (indispensable amino acid): An essential amino acid is one needed by the animal that cannot be synthesized by the animal in the amounts needed and so must be present in the protein of the feed as such.

Non-essential amino acid (dispensable amino acid): A non-essential amino acid is one needed by the animals that can be formed from other amino acids by the animals and so does not have to be present as the particular amino acid in protein of the feed. Those amino acids which function in animal nutrition are usually classified on the basis of their essentially as follows: (in rat & man)

PROPERTIES OF PROTEINS

1. All proteins have colloidal properties; they differ in their solubility in water, ranging from insoluble keratin to albumins, which are highly soluble. Soluble proteins can be precipitated from solution by the addition of certain salts such as sodium chloride or ammonium sulphate. This is a physical effect and the properties of the proteins are not altered. On dilution the proteins can easily be redissolved.
2. Although the amino and carboxyl groups in the peptide linkage are nonfunctional in acid–base reactions, all proteins contain a number of free amino and carboxyl groups, either as terminal units or in the side chain of amino acid residues. Like amino acids, proteins are therefore amphoteric. They exhibit characteristic isoelectric points and have buffering properties.
3. All proteins can be denatured or changed from their natural state. Denaturation has been defined by Neurath and coworkers as ‘any non-proteolytic modification of the unique structure of a native protein, giving rise to definite changes in chemical, physical or biological properties’. Products of protein hydrolysis are not included under this term. Several agents can bring about denaturation of proteins; these include heat, acids, alkalis, alcohols, urea and salts of heavy metals.

Classification of proteins

Proteins may be classified into three main groups according to their shape, solubility and chemical composition.

1. Fibrous Proteins: These proteins are insoluble and very resistant to animal digestive enzymes. They are composed of elongated, filamentous chains, which are joined together by cross linkages. **They are as follows:**

1. Collagens are the main proteins of connective tissues.

2. Elastin is the protein found in elastic tissues such as tendon and arteries.

3. Keratins are the protein of hair, hoof, nails etc.

2. Globular Proteins: This group includes all the enzymes, antigens and hormones that are protein.

1. Albumin is water-soluble and heat coagulable and occurs in eggs, milk, blood and many plants.

2. Globulins are present in eggs, milk and blood and are the main reserve protein source in seed.

3. Histones are basic protein, which occur in cell nucleus where they are associated with DNA.

4. Protamines are basic protein of relatively low molecular 66 The Protein in Animal Nutrition weight, which are associated with nucleic acid and are found in large quantities in the nature, germ cells of vertebrates.

3. Conjugated Proteins: Conjugated proteins are composed of simple protein combined with some non-protein substances as prosthetic group.

1. Phosphoprotein is the protein' which on hydrolysis yields phosphoric acid and amino acids. Casein of milk and phosvitin of egg yolk are the best known phosphoproteins.

2. Glycoproteins are conjugated proteins with one or more heterosaccharides as prosthetic groups. In most of the glycoproteins, glucosamine or galactosamine or

both, in addition galactose and mannose may be present. Glycoproteins are components of mucous secretions which act as lubricants in many parts of the body.

3. Lipoproteins are proteins conjugated with lipid lecithin and cholesterol. They are the main components of cell membranes and playa basic role in lipid transport.
4. Chromoproteins contain pigment as a prosthetic group. Examples are haemoglobin, haemocyanin, cytochrome and flavoproteins.

5. Nucleoproteins are compound of high molecular weight and conjugated with nucleic acid.

6. Metalloproteins a large group of enzyme proteins contain metallic elements, such as Fe, Co, Mn, Zn,' Cu, Mg, etc. which are essential part of these proteins.

4. Derived Proteins: This class of proteins includes those substances formed from simple and conjugated proteins.

1. Primary derived proteins: If there is a slight change in the proteins molecules.
2. Secondary derived proteins: If there is a large change in protein structure.

Nucleic Acids

Nucleic acids are high-molecular-weight compounds that play a fundamental role in living organisms as a store of genetic information; they are the means by which this information is utilized in the synthesis of proteins. On hydrolysis, nucleic acids yield a mixture of basic nitrogenous compounds (purines and pyrimidines), a pentose (ribose or deoxyribose) and phosphoric acid. The main pyrimidines found in nucleic acids are cytosine, thymine and uracil. The relationships between these compounds and the parent material, pyrimidine.

OTHER NITROGENOUS COMPOUNDS

A considerable variety of nitrogen-containing compounds, other than proteins and nucleic acids, occur in plants and animals. In plants, free amino acids are usually present; those in greatest amount include glutamic acid, aspartic acid, alanine, serine, glycine and proline. Other compounds are nitrogenous lipids, amines, amides, purines, pyrimidines, nitrates and alkaloids. In addition, most members of the vitamin B complex contain nitrogen in their structure.

NITRATES

Nitrates may be present in plant materials and, whereas nitrate itself may not be toxic to animals, it is reduced readily under favourable conditions, as in the rumen, to nitrite, which is toxic. Oat hay poisoning is attributed to the relatively large amounts of nitrate present in green oats.

Function of proteins

1. Proteins form muscles and tissues of the body; hence it is essential for the growth and development of the body.

2. They help in maintaining the loss of body tissues and muscles.

3. They help in the formation of enzymes, hormones, antigen, antibody, digestive juices of the body and regulate body osmotic pressure and acid-base balance.

4. They help in the repair of body cells as well as for the production of new cells.

5. They also supply energy to the body.

6. They are essential for the formation of egg, milk protein, wool and hairs of the animals.

7. They provide the basic cellular matrix within which the bone mineral matter is deposited.

8. Under condition of non-digestion and no-chances for denaturation, the protein accumulates inside the cells and produce toxicity. i.e. venoms of snakes and insects are infected by biting into the blood.

9. Endorphins (peptide) are found in brain and are involved in the suppression of pain.