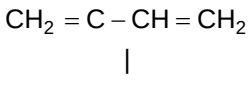
Bile acid : Bile Juice contains different types of steriod acids, e.g. cholic acid, Lithocholic aid etc. They help in emulsification of facts.

(b) **Sterones :** Ketonic steroids, for e.g. sex hormones, Adreno corticoids, ecyson hormone of insects, Diosgenin obtained from yam plant (Dioscorea), is used in manufacture of antiferility pills.

(2) **Chromolipid** = It is also called **terpene.**

- Most complex lipid in protoplasm
- Chromolipids composed of repeated isoprene units

Example : Carotenoids, vitamin A,E,K, Natural Rubber (Polyterpene).



(Isoprene)

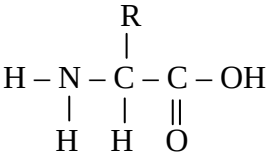
Especial Points :

Prostaglandins - It is Derived lipid. Prostglandins are derivatives of PUFA (Polyunsaturated fatty acid). They are helpful in contraction of uterus and fallopian tube, blood clotting, Muscle contraction.

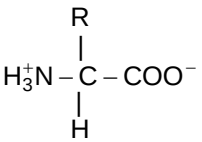
PROTEINS

Protein name is derived from a greek word which means **"holding first place"** (Berzelius and mulder)

- Essential elements in protein are C, H, O, N,
- Most of the proteins contain sulphur. In some proteins iodine, iron and phosphours are present.
- After water proteins are most abundant compounds in protoplasm. (7-14%)% amoung of proteins.
- proteins are polymer of amino acid (Fisher and Hofmeister). There are approximately 300 amino acids known to exist but only 20 types of amino acids are used in formation of proteins



- Each amino acid is amphoteric compound because it contains one weak acidic - COOH and a weak alkaline group -NH_2
- In protoplasm free amino acid occurs as ions (**at iso electric point**)



Zwitter ion

- Iso electric point is that point of pH at which amino acids do not move in electric field.
- Out of 20 amino acids, 10 amino acid are not synthesized in body of animals so they are must in diet. These called **Essential amino acid.** e.g. Threonine, Valine, Leucine, Isoleucine, Lysine, Methionine. Phenylalanine Tryptophan, arginine, Histidine. **Arigine and Histidine are semi essential.**
- 10 amino acid are synthesized in animal body so these called **Non essential amino acids.** for e.g. Glycine, Alanine, Serine, Cysteine, Aspartic acid. Glutamic acid, Asparagine, Glutamine, Tyrosine, Proline

Classification of Amino Acids :

(A) Amino acids can be aclassified on the basis of their R group -

(1) Non-polar R group - Alanine, Valine, Leucine, Isoleucine, Proline, Methionine, Phenyalanine, Tryptopha.

(2) Polar but unchrged R group - Glycine, Serine, Threonine, Cysteine, Tyrosine, Asparagine, Glutamine

(3) Positively charged polar R-group - Liysine, Arginine, Histidine **(Basic Amino acid)**

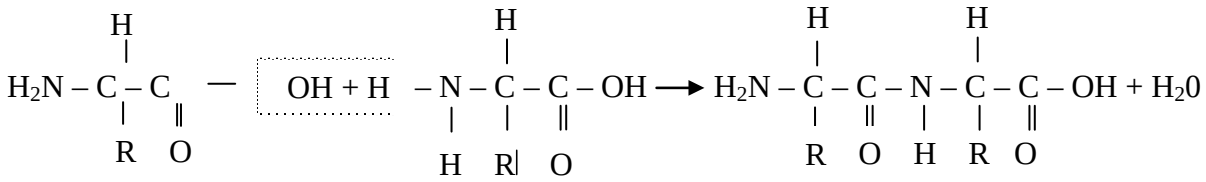
(4) Negatively charged polar R-group- Aspartisc acid, Glutiamic acid **(Acidic Amino acid)**

Except glycine, each amino acid ahs to enantiomeric isomers.



D- amino cid L-amino acid

- Eucaryotic proteins have L - amino acid while D- amino acid occurs in bacetria and antiboides. Amino acid join with peptide bond to form protein.



Dispeptide

- Peptidyl transferace enzyme catalyses the synthesis of peptide bond.
- Property of protein depends on sequence fo amino acid and configuration of protein molecules.

Especial Points on Amini acid:

- Glycine is the simplest and Trytophan is complex Amino acid.
- Cysteine, Cystine, Methionine are the sulphar containing Amino acid.
- Phenyl alanine, Tryosine, Tryptophan amino acids are aromatic Amino acid.
- Serine & Theronine are alcoholic amino acid.
- All the amino acids are laevo-rotaroy, except Glycine which is non-rotatory.
- Amino acid which participate in protein synthesis called protein Amino acid and which do not participate called non-protein.

  eg. GABA, Ornithine, Citrulline.

- Proline, Hydroxy proline contain imino group $\left(\begin{matrix}-NH\\|\end{matrix}\right)$ instead of amino group so they are also called **imino acid.**

Congifuration of Protein Molecule :

(1) Primary configuration or structure : A straight chain of amino acids linked by peptide bonds form primary structure of proteins. This structure of protein is most unstable. Newly formed proteins on ribosome's have primary structure.

(2) **Secondary configuration :** Protein molecules of sec. structure are spirally coiled. In addition to peptide bond, amino acids are linked by hydrogen bonds form between oxygen of one amide group and hydrogen of another amide group. This structure is of two types -

(i) α **-Helix** -Right handed rotation of spirally coiled chain with approximately $3\frac{1}{2}$ amino acids in each turn. This structure has intramolecular hydrogen bonding i.e. between two amino acids of same chain e.g. Keratin, Myosin, Tropomyosin.

(ii) β **-Helix or pleated sheath structure :** Protein molecule has zig - zag structure. Two or more protein molecules are held together by intermolecular hydrogen bonding. **e.g.** Fibroin (silk).

✎ Proteins of sec. structure are insoluble in after and fibrous in appearance.

✎ Keratin is a fibrous, tough, resistant to digestion, sclero protein. Hard ness of keratin is due to abundance of cysteine amino acid in its structure.

(3) **Tertairy Structure :** Proteins of tertiary structure are highly folded to give a globular appearance. They are soluble in water (colloid solution). This structure of protein has following bonds -

(i) Peptide bonds = strongest bond in proteins.

(ii) Hydrogen bonds

(iii) **Disulphide bond :** These bonds form between - SH group of amino acid (Mehionine, Cysteine). These bonds are second strongest bond and stabilIse tertiary structure of protein.

(iv) **Hydrophobic bond :** Between amino acids which have hydrophobic side chains for ***e.g.*** Aromatic amino acid

(iv) **Hydrophobic bond :** Between amino acids which have hydrophobic side chains for **.e.** Aromatic amino acid

(v) **Ionic bond :** Formation of ionic bond occurs between two opposite ends of protein molecule due to electrostatic attraction.

Majority of proteins and enzymes in protoplasm exhibit **tertiary** structure.

(4) **Quaternary Structure :** Two or more poly peptide chains of tertiary structure unit by different types of bond to form quaternary structure of protein. Different polypeptide chains may be similar (lactic-dehydrogenase) or dissimilar types (Haemoglobin, insulin).

Quaternary structure is most stable structure of protein.

Significance of Structure of Protein :

☛ The most important constituents of animals are protein and their derivatives. Proteins form approximately 15% of animals protoplasm. They physical and biological properties of proteins are dependant upon their secondary and tertiary configurations. protein is electrically charged because is has $-NH_3^+$ and $-COO^-$ ionic components. In an acidic medium the $-COO^-$ group of protein converts to -COOH and the protein itself becomes positively charged. In contrast, in an alkaline medium the $-NH_3^+$ group of protein changes to $-NH_2 + H_2O$ and as a result it becomes negatively charged. Therefore, at a specific pH a protein will possess an equal number of both negative and positive charges and it is at this specific pH a protein becomes soluble.

☛ In the pH changes towards either acidic or alkaline side, then the protein begins to precipitate. This property of protein has great biological significance. The cytoplasm of cells of organisms has an approximate pH of 7 but the pH of proteins present in it is about 6 and thus, the proteins are present in a relatively alkaline medium. Therefore, the proteins are negatively charged and also are not in a fully dissolved state. It is because of this insolubility, proteins form the structural skeleton of organisaml cells. Similarly, the pH of nucleoplasm is about 7 but the pH of

proteins, namely, histones and protamines, in it is relatively more. Therefore as a result they are positively changed and do not remain fully dissolved in the nucleoplasm forming minute organelles, the most important being the chromosomes.

- As has been described above, the structural units namely amino acids of proteins contain both a carboxyl group (-COOH) or acidic group and an amino group ($-NH_2$) or alkaline group attached to the same carbon atom. Therefore, proteins depending upon the pH of the medium can exhibit both alkaline and acidic properties. Such compounds which exhibit both acidic and alkaline properties are called amphoteric compounds or zwitter ions. In the protoplasm, this duel property of proteins is utilized for neutralization of strong acids and alkalis since the protein acts as an ideal buffer in either of the situations.
- Besides changes in pH, salts heavy metlas, temperature, pressure, etc. also cause precipitation of proteins. Because of these changes, the secondry and tertiary configuration of proteins is destroyed and many times the tertiary strucutred gobular proteins become converted to secondary configuration fibrous proteins. Such alterntions in the physical state of proteins is called denaturation. It the change in the medium of protein is mild and for a short period, then denaturation of the protein is also temporary, however, if the change in medium is strong and prolonged then denaturation is permanent and the protein becomes coagulates into fibours insoluble form. It is clear, that stron alternations result in the denaturation of proteins and they lose their biological properties and significance. It is this reason, that cells of organisms are unable to bear strong chagnes and they ultimately die.

TYPES OF PROTEINS

1. **Simple Proteins** = proteins which composed of only amino acid.
   (i) **Fibrous Protein :** e.g. Collagen, Elastin, Keratin
   (ii) **Globular Proteins : e.g.** Albumin, Histones, Globin, Protemines, Prolamines (Glaidin, Gluten, Zein), Gluteline - slimy part of gluten of wheat.
2. **Conjugated Proteins :** Simple protein + non protein part (Prosthetic group)
   (i) **Nucleoproteins** - e.g. Chromatin, Ribosomes etc.
   (ii) **Chromoprotein** - Prosthetic group is a porphyrin pigment, e.g. Haemoglobin, Haemocyanin, Cytochromes etc.
   (iii) **Lipoprotein** e.g. cell membrane, Lipovitelline of Yolk.
   (iv) **Phospho proteins** - Casienogen, Pepsin, Ovovitelline, Phosvitin.
   (v) **Lecitho protein** -Fibrinogen.
   (vi) **Metallo protein** - Cu - Tyrosinase, Zn-Carbonic Anhydrse, Min-Arginase, Mo-Zanthine Oxidase Mg-Kinase
   (vii) **Glycoproteins and Mucoproteins** : Glyco proteins have less than 4% Carbohydrates in their structure. They are most specific type of protein. e.g. $\alpha, \beta\gamma$ -globuline of blood, blood group proteins, Mucin Erythropoetin etc.
   Muco proteins have more than 4% Crbhohydrates e.g. Mucoids of synovial fluid, Osteomucorprotein of bones, Tendomuco protein of tendons, Chodro mucoprotein of cartilage.
3. **Derived Protein** : These form by denaturation or hydrolysis of protein.
   (i) **Primary derived proteins** are denaturation product of nomarl proteins e.g. Fibrin, Myosan
   (ii) **Secondry derived proteins** are digestion products of proteins e.g. Proteoses, Peptones, Peptides.

Especial Point on Protein :

- **Monomeric protein :** Protein composed of one poypeptide chain.
- **Oligomeric/Polymeric/Multimeric protein :** Protein composed of more then one polypeptide chains.
- **Peptide :** A molecule of a short chain of Amino acid like dipeptide, Tripeptide, Tetrapeptide.
- **Polypeptide :** It usually has more than 20 Amino acids.
- **Protein :** it contins minimum 50 Amino acids or more than 50 Amino acids.

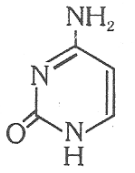
NUCLEIC ACIDS

- Meischer discovered mucleic acids in nucleus of pus cell and called it “nuclen”. The name nucleic acid proposed by **“Altman”**
- Nucleic acids re polymer of **nucleotides.**

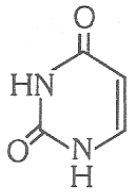
  = Nitrogen base + pentose + phosphate

  On the basis of structure nitrogen bases are broadly of two types :

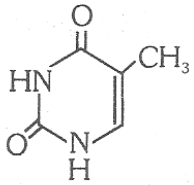
1. **Pyrimidines** - Consist of one pyrimidine ring. Skeleton of ring composed of two nitrogen and four Carbon atoms e.g. Cytosine, Thymine and Uracil.



CYTOSINE

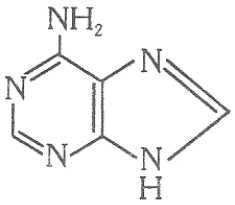


URACIL

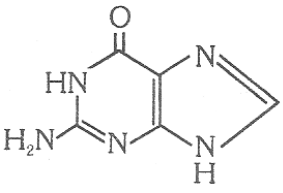


THYMINE

2. **Purines** - Consist of two rings i.e. one pyrimidine ring (2N + 4C) and one imidazole ring (2N + 3C) e.g. Adenine and Guanine.

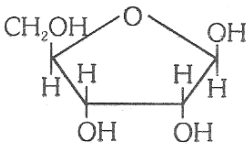


ADENINE

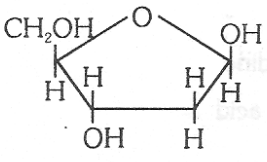


GUANINE

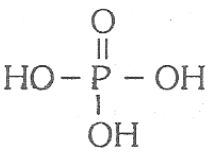
Pentose Sugar :



Ribose



Deoxy ribose



Phosphate

Nitrogen base forms bond with firt Carbon of pentose sugar to form a nucleoside. Nitrogen of third place (N_3) forms bond with sugar in case of Pyrimidines while in purines nitrogen of ninth plce (N_9) forms bond with sugar. Phosphate forms easter bond (covalent bond) with fifth Carbon of sugar to form a complete nucleotide.