UNIT-1

INTRODUCTION TO BIOCHEMISTRY

Proteins are a diverse and abundant class of biomolecules, constituting more than 50% of the dry weight of cells.

This diversity and abundance reflect the central role of proteins in virtually all aspects of cell structure and function.

Biologically occurring polypeptides range in size from small to very large, consisting of two or three to thousands of linked amino acid residues.

Peptides are chains of amino acids, two amino acid molecules can be covalently joined through a substituted amide linkage, termed a peptide bond to yield a dipeptide.

Such a linkage is formed by removal of the elements of water (dehydration) from the α-carboxyl group of one amino acid and the α-amino group of another.

Peptide bond formation is an example of a condensation reaction, a common class of reactions in living cells.

Three amino acids can be joined by two peptide bonds to form a tripeptide; similarly, amino acids can be linked to form tetrapeptides, pentapeptides, and so forth.

When a few amino acids are joined in this fashion, the structure is called an oligopeptide.

When many amino acids are joined, the product is called a polypeptide.

Proteins may have thousands of amino acid residues.

AMINO ACIDS

Proteins are the essential agents of biological function, and amino acids are the building blocks of proteins.

The diversity of the thousands of proteins found in nature arises from the commonly occurring 20 amino acids.

Proteins are polymers of amino acids, with each amino acid residue joined to its neighbor by a specific type of covalent bond.

Proteins can be broken down (hydrolyzed) to their constituent amino acids the free amino acids derived from them. Of the over 300 naturally occurring amino acids, 20 constitute the monomer units of proteins.

All 20 amino acids are biologically essential. Humans can synthesize 12 (nutritionally nonessential) of the 20 common amino acids from the amphibolic intermediates of glycolysis and of the citric acid cycle.

Of the 12 nutritionally nonessential amino acids, nine are formed from amphibolic intermediates and three (cysteine, tyrosine and hydroxylysine) from nutritionally essential amino acids.

Essential	Nonessential
Histidine	Alanine
Isoleucine	Arginine
Leucine	Aspartic acid
Lysine	Cysteine
Methionine	Glutamic acid
Phenylalanine	Glutamine
Threonine	Glycine
Tryptophan	Proline
Valine	Serine
	Tyrosine
	Asparagine
	Selenocysteine
	Pyrrolysine

THE LEVELS OF PROTEIN STRUCTURE

The various levels of protein structural organization are defined as follows.

Primary Structure The amino acid sequence is the primary (1°) structure of a protein,

Secondary Structure Through hydrogen bonding interactions between adjacent amino acid residues the polypeptide chain can arrange itself into characteristic helical or pleated segments.

These segments constitute structural conformities, so-called regular structures that extend along one dimension, like the coils of a spring.

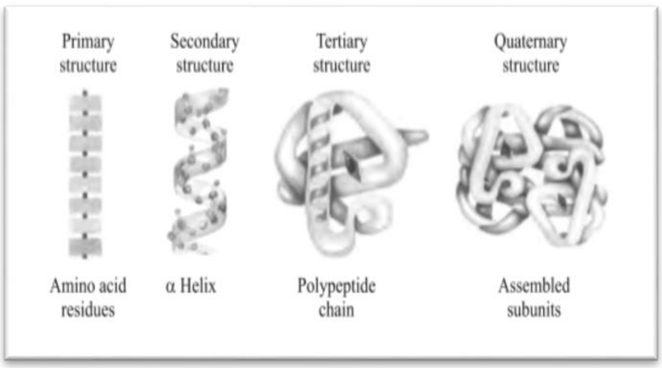
Such architectural features of a protein are designated secondary (2°) structures

Secondary structures are just one of the higher levels of structure that represent the three-dimensional arrangement of the polypeptide in space.

Tertiary Structure When the polypeptide chains of protein molecules bend and fold in order to assume a more compact three-dimensional shape, a tertiary (3°) level of structure is generated .

It is by virtue of their tertiary structure that proteins adopt a globular shape.

A globular conformation gives the lowest surface to volume ratio, minimizing interaction of the protein with the surrounding environment.



Quaternary Structure Many proteins consist of two or more interacting polypeptide chains of characteristic tertiary structure, each of which is commonly referred to as a subunit of the protein.

Subunit organization constitutes another level in the hierarchy of protein structure, defined as the protein's quaternary (4°) structure.

Whereas the primary structure of a protein is determined by the covalently linked amino acid residues in the polypeptide backbone, secondary and higher orders of structure are determined principally by non covalent forces such as hydrogen bonds and ionic, van der Waals, and hydrophobic interactions.

QUALITATIVE TEST FOR PROTEINS

a) Biuret Test:

1. Take a cleaned and dried test tube.
2. Add the food samples of your choice into the test tubes.
3. Add 2ml of sodium hydroxide and 5 to 6 drops of copper sulfate solution to it.
4. Shake the test tube gently to mix the ingredients thoroughly and allow the mixture to stand for 4 – 5 minutes.
5. If there is the appearance of bluish- violet color, it indicates the presence of protein.

(b) Xanthoproteic Test:

1. Take a cleaned and dried test tube.
2. Add the food samples of your choice into the test tubes.
3. Add a few drops of concentrated sulfuric acid and shake the test tube.
4. Heat the test tube gently on a Bunsen burner.
5. If there is a formation of yellow precipitate, then the presence of protein is confirmed.

(c) Millions Test:

1. Take a cleaned and dried test tube.
2. Add the food samples of your choice into the test tubes.
3. Add 2-3 drops of Millon's reagent and shake well.
4. Observe the change.
5. If there is the formation of white precipitate or if the sample changes to brick red on heating then the presence of protein is confirmed.

(d) Ninhydrin Test:

1. Take a cleaned and dried test tube.
2. Add the food samples of your choice into the test tubes.
3. Add 1-2ml of ninhydrin solution to it and shake the test tube.
4. Boil the mixture and observe the change.

5. If there is the appearance of deep blue or purple color then the presence of protein is confirmed.

PROTEIN - ENERGY MALNUTRITION (PEM)

Protein–energy malnutrition (PEM) or protein–calorie malnutrition refers to a form of malnutrition where there is inadequate calorie or protein intake.

Types include:

- Kwashiorkor (protein malnutrition predominant)
- Marasmus (deficiency in calorie intake)
- Marasmic Kwashiorkor (marked protein deficiency and marked calorie insufficiency signs present, sometimes referred to as the most severe form of malnutrition)

MARASMUS

- Marasmus is a form of severe malnutrition characterized by energy deficiency. A child with marasmus looks emaciated.
- Body weight is reduced to less than 60% of the normal (expected) body weight for the age.
- Marasmus occurrence increases prior to age 1

Marasmus Clinical Manifestations:

1. Wasting

2. Muscle wasting

3. Growth retardation

4. Mental changes

5. No edema

6. Variable-subnormal temp, slow PR, good appetite, often w/diarrhea, etc

KWASHIORKOR

- Kwashiorkor occurrence increases after 18 months.
- Marasmus can be distinguished from kwashiorkor in that kwashiorkor is protein deficiency with adequate energy intake