GENERAL DESCRIPTION OF PROTEINS

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Annotation: The article provides information on the general characteristics, properties and important features of proteins, their elemental composition, methods of purification.

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Protein is an important component of living tissue. Proteins contain high-molecular-weight nitrogen-fixing organic compounds whose molecules are composed of amino acid residues. The fact that these substances are called proteins (Greek protos - primary) indicates that they are essential for life. The name protein is derived from the word egg white, which can be explained by the fact that when a chicken egg is cooked, it becomes white (denaturation).

Proteins are an integral part of all living organisms - plants, animals and viruses, which are on the border of inanimate nature with the human body. Any chemical change that takes place in a cell cannot take place without the presence of proteins.

The amount of protein in human organs and tissues varies. For example, 70-80% of the dry weight of muscles, lungs and kidneys is protein, and 45-50% of the whole body is protein. In the study of the chemical composition, structure and properties of proteins, they are isolated from liquid tissues or protein-rich organs of animals by special methods from blood serum, milk, muscle, liver, skin, hair.

There are an infinite number of types of proteins in a cell. Each type of organism has its own proteins. One of the simplest organisms, the biochemically well-studied bacterium E. coli, contains about 3,000 types of protein molecules.

There are 5,000,000 types of protein in the human body, but so far very few of them - about 2,000 - have been identified and well-tested. However, the quantitative predominance of proteins does not determine their important functions. They have the following properties that are not typical for other organic substances:

a) Proteins are the most complex structured organic compounds in nature. The number and type of protein molecules are infinite, ensuring the uniqueness of organisms at the level of species, organs and tissues;

b) performs a variety of reactions based on the biological functions of the organism, with a large number of functional groups and the complexity of the conformation of proteins;

c) the complexes formed by proteins with each other and with other compounds, forming the internal structure of the cell, allow it to recognize and selectively bind to the desired molecule between different molecules. This property determines the structural structure of matter in a living cell, the direction of metabolism and the order of sequence.

d) controls the ability of the molecule to respond to internal and external influences through the laws of change of the conformation of the molecule and to return to its state after the impact;

e) biocatalytic (enzymatic) properties of proteins, biosynthesis and its regulation, participation in the transfer of genetic information together with nucleic acids - participation in the processes of cell growth and differentiation.

Important features of proteins. Proteins are high-molecular, nitrogen-containing organic compounds with a complex structure, consisting of a chain of amino acids joined by peptide bonds.

Important features of proteins include:

1) constant nitrogen content (16% of dry weight);

2) formation of amino acids, which are structural units;

3) peptide bonds that bind amino acids in the peptide chain

availability;

4) have a high molecular weight

5) the complex structure of the polypeptide chain that determines the physicochemical and biological properties of proteins.

Table 1. Elements in proteins.

In% relative to the dry mass of the protein			
Element	Percent (%)	Element	Percent (%)
Carbon (C)	51-55	Sulfur (S)	0,3-2,5
Hydrogen (H)	6-7	Nitrogen (N)	15-18
Oxygen (O)	21-23	inorganic substances	0,5

The nitrogen content of most plant, animal and microbial proteins is constant, unlike other elements - about 16%; The amount of protein can be calculated from this number: the amount of nitrogen found in the analysis is multiplied by a factor of 6.25 (100: 16 = 6.25). However, for some proteins, this figure is not appropriate. For example, the content of nitrogen in protamine reaches 30%, so it is difficult to clearly distinguish protein from other nitrogen-fixing substances in terms of elemental content.

The structural composition or monomers of proteins can be determined by acid hydrolysis. This method is used to study the protein content. L-series α-amino acids are protein monomers.

Amino acids are linked by covalent peptide bonds in the chain.

Molecular weight of proteins. Molecular mass of proteins size is an important property of them. All polypeptides can be divided into three groups depending on the length of the chain:

1) peptides - 2-10 amino acids;

2) polypeptides - 10-40 amino acids;

3) proteins - consisting of more than 40 amino acids.

If the average molecular weight of each amino acid is assumed to be 100, then the molecular weight of peptides is 1,000, that of polypeptides is 4,000, and that of proteins is 4,000-5,000.

The complexity of the structural level of proteins. Some natural (consisting only of the same amino acid) and artificially obtained polypeptides cannot be incorporated into proteins due to their high molecular weight only, because natural proteins, unlike them, undergo peptide bonds when denatured. It also loses its physicochemical and, most importantly, biological functions, which are unique features of proteins. Denaturation refers to the complex spatial structure of a natural protein molecule, rather than to simple polypeptides.

Extraction and purification of proteins. Proteins are extracted from animal tissues and macro-organisms by special methods.

The method of homogenization in the separation of proteins.

To separate the proteins, the tissues must first be thoroughly ground, that is, homogenized. This disrupts the cell structure and dissolves the proteins. The following methods are used in homogenization:

1. Crushing (grinding) the fabric with sand in a porcelain mortar;
2. Potter - grinding in Elvegay homogenizers;
3. Grinding in spherical mills;
4. By freezing vigorously and then thawing;
5. Ultrasonic crushing;
6. Under the influence of pressure (passing the frozen tissue through a fine-mesh steel mesh);
7. With the help of nitrogen gas (nitrogen gas is saturated under pressure, then sharply reduced. As a result, nitrogen easily breaks down the cell and dissolves the protein).

The extraction method is used to separate proteins from the homogenate prepared using the above methods. The resulting homogenate is dissolved in 8-10% saline solution. Protein extraction often uses buffer solutions with a known pH, organic solvents, and nonionic detergents. For this purpose, long-used solutions of organic matter: buffer solutions with a mixture of glycerin in water, sucrose solution, citric acid and borate.

To separate the whey protein, it is precipitated under the influence of ethyl alcohol, acetone, butyl alcohol. Various detergents are used to separate proteins from pure homogenates. They extend the protein-fat complex and protein-protein bonds. In the purification of proteins (enzymes) is used a substance that binds to the mitochondrial biomembrane or cell organelles - triton X-100 and sodium deoxycholate. These detergents break down protein-protein complexes and disrupt the quaternary structure of proteins. Homogeneous separation of proteins allows to study their levels of primary, secondary, tertiary and quaternary structure. Free amino acids formed as a result of hydrolysis of proteins are tested using special analyzers.

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