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PROTEIN BIOCHEMISTRY

Annotation: *This article discusses high-molecular nitrogen-containing organic substances, the molecules of which are built from amino acid residues*

Key words: *Protein, function, protection, classification*

БИОХИМИЯ БЕЛКОВ

Аннотация: *В статье рассматриваются высокомолекулярные азотсодержащие органические вещества, молекулы которых построены из аминокислотных остатков.*

Ключевые слова: *белок, функция, защита, классификация.*

Proteins are high-molecular nitrogen-containing organic substances, the molecules of which are built from amino acid residues. The name proteins (from the Greek proteos - the first, most important) reflects the paramount importance of this class of substances. Proteins play a special role in the reproduction of the main structural elements of the cell, as well as in the formation of such essential substances as enzymes and hormones.

Hereditary information is concentrated in the DNA molecule of cells of any living organisms, therefore, with the help of proteins, genetic information is realized. Without proteins and enzymes, DNA cannot replicate and self-produce. Thus, proteins are the basis for the structure and function of living organisms.

All natural proteins are composed of a large number of relatively simple structural blocks - amino acids linked to each other in polypeptide chains. Proteins are polymeric molecules containing 20 different AAs. Since these AAs can combine in a very different sequence, they can form a huge number of different proteins and their isomers.

Proteins perform a wide variety of functions:

Nutritious, reserve. These proteins include the so-called reserve proteins, which are the source of nutrition for the development of the fetus (egg white, milk). A number of other proteins are used as a source of AA, which in turn are precursors of biologically active substances that regulate metabolic processes.

Catalytic - due to enzymes, biological catalysts.

Structural - proteins are part of organs, tissues, cell membranes (biomembranes). Collagen, keratin in hair and nails, elastin in skin.

Energy - when proteins break down to end products, energy is generated. When 1 g of protein breaks down, 4.1 kcal is formed.

Transport - proteins provide oxygen to tissues and remove carbon dioxide (hemoglobin), transport of fat-soluble vitamins - lipoproteins, lipids - blood serum albumin.

Proteins carry out the function of transmitting heredity. Nucleoproteins are proteins, the constituent parts of which are RNA and DNA.

Protective function - (antibodies, □-globulin) the main defense function in the body is performed by the immunological system, which ensures the synthesis of specific protective proteins - antibodies in response to the intake of bacteria, viruses, toxins in the body. The skin is keratin.

Contracting function - many proteins are involved in the act of muscle contraction and relaxation. The main role is played by actin and myosin - specific proteins of muscle tissue.

Hormonal - regulatory. The metabolism in the body is regulated by hormones, some of which are represented by proteins or polypeptides (hormones of the pituitary gland, pancreas).

Each protein contains a known number of amino acids linked together in a strictly fixed sequence using peptide bonds. This unique protein-specific AK sequence is defined as the primary structure of the protein.

It has been established that the polypeptide chain is in a twisted state in a protein molecule in the form of an alpha-helix. Helicalization is provided by hydrogen bonds that arise between the residues of carboxyl and amine groups located on opposite turns of the helix. This is the secondary structure of the protein.

The spatial packing of the alpha helix is defined as the tertiary structure of a protein. The main type of bond that holds the helices in a certain position is the disulfide bond, which occurs between two cysteine molecules at different parts of the helix. The tertiary structure of the protein is also stabilized by various covalent bonds, van der Waals forces. Depending on the spatial arrangement of the polypeptide chains (tertiary structure), protein molecules can have different shapes. If the polypeptides are folded in the form of a ball, then such proteins are called globular. If in the form of threads - fibrillar.

The quaternary structure of a protein is several individual polypeptide chains that are linked to each other in a certain way (for example, hemoglobin). The term subunit is usually used to designate a functionally active part of a protein molecule. Many enzymes are composed of two or four subunits. Due to the various combinations of subunits, the enzyme exists in several forms - isoenzymes.

All proteins are hydrophilic, i.e. have a great affinity for water. The stability of a protein molecule in solution is due to the presence of a certain charge and a water (hydration) shell. If these two factors are removed, the protein precipitates. This process can be reversible and irreversible. Reversible precipitation of proteins (salting out) - protein precipitates out under the influence of certain substances. after removal of which it can again return to its original native (natural) state. Irreversible precipitation is characterized by significant intramolecular changes in the structure of the protein, which leads to the loss of its native properties. such a protein is denatured, the process is denaturation.

Thus, denaturation should be understood as a change in the unique structure of the native protein molecule, leading to the loss of its characteristic properties (solubility, electrophoretic mobility, biological activity).

Most of the protein molecules retain their biological activity only within a very narrow range, temperature, pH. Under normal conditions of temperature and pH, the polypeptide chain of a protein has only one conformation, which is called native. Its stability is high, which makes it possible to isolate and preserve protein. Most proteins can be completely precipitated from an aqueous solution by adding trichloroacetic and perchloric acids, which form acid-insoluble salts with proteins. Proteins can also be precipitated using cations (Zn2 + or Pb2 +).

With denaturation, the biological activity inherent in proteins is lost. Since it is known that when denaturation does not break the covalent bonds of the peptide backbone of the protein, it was concluded that the cause of denaturation is the unfolding of the polypeptide chain, which in the native protein molecule is characteristically folded. In the denatured state, polypeptide chains form random and disordered loops and tangles. Renaturation of denatured protein is a process that does not require chemical energy from the outside; this process occurs spontaneously at pH and t values that ensure the stability of the native form.

A protein molecule of any type in a native state has a characteristic spatial structure, conformation, depending on it, proteins are divided into fibrillar and globular.

In addition to the 20 common ones, there are several rare AKs - they are derived from regular AKs. These AAs are part of proteins, but differ from conventional AAs in a genetic sense, because there are no coding triplets for them. They arise by modifying the original AAs after these AA precursors are incorporated into the polypeptide chain. There are over 150 more AAs, which are found in various cells and tissues or in a bound state, but never found in proteins. Some of them play the role of precursors of metabolic products. The amino acids found in fungi and higher plants are of exceptional diversity and unusual structure. Their role in metabolism is unknown, some of them are toxic to other life forms.

Higher vertebrates are not capable of synthesizing all AAs. Higher animals can use ammonium compounds N for the synthesis of nonessential amino acids, but not nitrites, nitrates or N2. Ruminants can use nitrite and nitrate, which are reduced to ammonia by rumen bacteria. Higher plants are able to create all the AAs themselves, which are necessary for protein synthesis, using both ammonia and nitrates. Leguminous plants fix molecular nitrogen of the atmosphere, converting it into ammonia and further synthesizing AA. Fungi and bacteria also use nitrite and nitrate.

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