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FUNCTIONAL PURPOSE OF PROTEINS IN THE HUMAN IMMUNE SYSTEM AND BODY

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The proper functioning and restoration of the human body is associated with the availability of sufficient energy, normal metabolism, growth and development of a person. These processes, in turn, depend on various factors of human life, in particular, on a balanced diet. However, proteins are indispensable substances that provide all vital processes in the human body. In view of the above, it is relevant to study the functional purpose and role of proteins in the human body, particularly in the immune system.

The human body has 20 types of essential amino acids, which, repeating in different combinations and sequences, form the entire variety of protein compounds.
The nutritional value of proteins depends on the amount and combination of the corresponding amino acids.

In modern domestic and foreign scientific literature, the following functions of proteins in the human body can be distinguished: 1) a catalytic function (enzymatic) within which, with the help of enzymes, catalytic processes of splitting (catabolism) and synthesis (anabolism) of complex molecules occur, in particular, synthesis and degradation of DNA, RNA, proteins, lipids and sugars. In addition, enzymes catalyze a number of other reactions that are vital for the human body. Without this function, not a single biochemical reaction in a living cell can take place. That is, enzymes are biocatalysts that are proteins or complexes of proteins with low molecular weight non-protein compounds (coenzymes, cofactors) by their chemical nature; 2) a structural function within which proteins are included in the structure of biomembranes, form the basis of the cytoskeleton (microtrabecular meshwork, microfilaments), intercellular matrix (collagen, elastin) and certain specialized tissues (creatins); 3) the regulatory function is provided by numerous bioregulators — hormones, mediators and modulators that are produced in the endocrine system and neurons of the brain. In the immune system, bioregulators are represented by simple proteins (insulin, glucagon, etc.), glycoproteins (tropical hormones of the pituitary gland, etc.), low molecular weight peptides (oxytocin, vasopressin, brain opioid peptides, thymocyte peptides, etc.) [1, p. 18-20]; 4) the receptor function is represented by the ability of membrane receptors to influence physiologically active compounds that receive a chemical signal from hormones, neurotransmitters (adrenoceptors, cholinergic receptors, histamine receptors, etc.)[1, p.18]; 5) the transport function binds and transports substances between tissues through membranes. Proteins that perform this function include: lipoproteins that carry oxygen to muscle tissues, hemoglobin (a source of free chemical energy), binds oxygen of the air as it passes through the lungs and delivers it to peripheral tissues, where food components are oxidized, permeases that bind glucose, amino acids and other food substances and transfer them through membranes into the middle of the cell; 6) the contractile function of proteins is associated with the fact that the latter are molecular structures that implement the contractile function of muscles (actin, myosin), flagella and cilia (tubulins, dyneins), etc. [2, p.237]; 7) the immune function of proteins is determined by the possibility of their implementation of immune protection (immunoglobulins, lymphokines, interleukins, etc.), resistance to bleeding and thrombus formation (proteins of the blood coagulation, anticoagulant, and fibrinolytic systems) [1, p.19].

The functional purpose of proteins in the human immune system is determined by the need for theoretical research of the concept of the "immune system". The immune system protects the human body from various pathogens and consists of innate (natural) and acquired (adaptive) systems. These two systems are closely linked by cytokine and signaling molecule. The innate immune system consists of physical barriers (the skin, the layer of endothelial cells in the respiratory tract and the gastrointestinal tract), mononuclear phagocytes (for example, monocytes and macrophages), dendritic cells, polymorphonuclear granulocytes (e.g., neutrophils, eosinophils, and basophils), artificial cells, natural killer cells, platelets, and humoral factors. The adaptive (acquired) immune system consists of T-lymphocytes, B-lymphocytes and humoral factors [5, p.159].

The marrow is primarily responsible for hematopoiesis and lymphopoiesis, while the thymus is essential for T-cell development. The spleen, lymph nodes, and mucosa-associated lymphoid tissues in the gastrointestinal, respiratory, and reproductive tracts and other organs are secondary lymphoid tissues. Since each lymphocyte contains surface receptors for one antigen, the acquired immune response is highly specific. This immune system becomes effective within couple of days of initial stimulation and has an immunological memory [3].

Amino acids play a decisive role in human immune function. Thus, alanine is the main substrate for the hepatic synthesis of glucose, an important energy substrate for leukocytes, thereby influencing immune function. Arginine is synthesized from citrulline, as a direct precursor in almost all types of cells. The amino acid arginine is a powerful accelerator of insulin, somatotropin, and prolactin secretion. In particular, insulin and somatotropin regulate glucose and amino acid metabolism in major tissues, including skeletal muscle, adipose tissue, liver, and heart, thereby affecting the availability of these nutrients to leukocytes. Growth hormone can also increase the production of T-lymphocytes in the thymus, the number of hematopoietic progenitor cells in the marrow [3,4 p.114-117]. The amino acid asparagine plays a significant role in immune function, which is associated, first, with the expression of asparagine synthetase, which is markedly increased in lymphocytes and macrophages in response to mitogens and other stimuli. Secondly, asparagine affects the increase in the activity of ornithine decarboxylase for the synthesis of polyamines in thymocytes. Thus, asparagine is useful for establishing a successful immune response in healthy organisms.

Branched-chain amino acids (BCAAs) predict the ability of lymphocytes to express BCAA transaminase and branched-chain 2-oxoacid dehydrogenase to degrade BCAAs. BCAA transport and utilization by lymphocytes is dramatically increased in response to mitogens. The amino acid glycine is involved in the synthesis of many physiologically important molecules. Moreover, glycine itself is a powerful antioxidant, scavenging free radicals. Thus, glycine is necessary for the proliferation and antioxidant protection of leukocytes. The amino acid tyrosine is a degradation product of phenylalanine and is a direct precursor for the synthesis of catecholamine hormones (adrenaline and noradrenaline), thyroid hormones (triiodothyronine and thyroxine), as well as dopamine and melanin. Thyroid hormones regulate many important physiological processes in the human body, including gene expression, as well as metabolism and differentiation. In addition, dopamine and melanin reduce the synthesis of pro-inflammatory cytokines (including TNFα, IL-1β, IL-6, and IL-10) by monocytes and macrophages, induce the production of anti-inflammatory mediators by leukocytes, and regulate lymphocyte proliferation, platelet aggregation, and neutrophil phagocytic activity. Proline is catabolized by proline oxidase in various organs, including the small intestine, liver, kidney, lymphoid organs, and placenta, with forming pyrroline-5-carboxylate (P5C) and H2O2, stimulates cell growth, and promotes antibody production. And proline makes up one-third of the amino acids in collagen, so it is critical in wound healing and post-injury recovery [3]. Amino acid threonine is the main component of intestinal mucin. Due to protein synthesis and cellular signaling mechanisms, the addition of threonine to the culture medium prevents apoptosis, stimulates cell growth, and promotes the production of antibodies in lymphocytes [3].

Thus, proteins are the most important class of biomolecules, with the presence of which, as well as nucleic acids, they connect the very chemical essence of life on Earth, and constitute, together with nucleotides, the molecular alphabet of any living cell. They can be enzymes that catalyze chemical reactions, structural proteins that form the framework of cells and organs, antibodies that provide immune protection against pathogens, hormones that regulate body functions. Proteins are important for transport of substances, signaling pathways, regulation of genetic information and many other processes.

Accordingly, amino acids are necessary for protein synthesis and regulate most vital processes in the human body, including key metabolic pathways of the immune response to infectious pathogens. So, everything that mentionad above emphasizes the importance of proteins and amino acids for the functioning of the immune system and the human body as a whole.

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