DEPENDENCE OF THE BIOLOGICAL ACTIVITY OF ELEMENTS ON THE ELECTRONIC STRUCTURE OF THEIR ATOMS

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Introdaction. Eighty-one elements out of one hundred and ten chemical elements of the periodical system are found in the human body. Classification, which is based on the biological role of elements, divides the elements that are in the body into three groups: vital (biogenic, esential); conditionally necessary and elements with an unidentified role. Famous Russian geochemist O. P. Vinogradov called biogenic elements all the chemical elements that participate in biological processes of living organisms.

Aim. It is known that the physical-chemical properties of elements and their biological role are determined in a living organism by their position in the D.I. Mendeleyev's periodic system, in particular the electronic structure of atoms. It is of interest to discover some regularities of this dependence of biological activity on the electronic structure of the atom.

Materials and methods. Depending on the average content of the element in the human body, they are divided into 3 groups:

1. Macroelements (the content in the body is more than 10^{-2}%)
2. Microelements (the content in the body is 10^{-2} -10^{-5}%)
3. Ultra-microcelements (the content in the body is less than 10^{-5}%)

The main function of macroelements is to build the tissues and skeleton of the body, to observe the constancy of osmotic pressure, ionic and acid-base composition.

The macroelements are divided into organogens (C, H, O, N, P, S - in the body 97.4%) and electrolytic background elements (Na, K, Ca, Mg, Cl), depending on the functional role.

Organogens form the basis of all living organisms. They are part of proteins, nucleic acids, carbohydrates, fats. In addition to hydrogen, organogens are p-elements of the second and third periods, which have small atomic radiuses, intermediate values of electronegativity. They are capable of forming strong but reactive covalent bonds, and carbon derivatives are able to easily form cycles.

In turn, elements of the electrolytic background K, Na, Mg, Ca are s-elements that have 1 or 2 valence electrons in the period and the lowest value of the ionization energy. They exist in the form of cations in the body, easily penetrate the cell membranes and form electrical biopotentials and biocurrents.

Except the s-elements of K, Na, Mg, Ca, six d-elements of Fe, Zn, Cu, Mn, Mo, Co are also called "metals of life ". They are vital for the existence of a living organism. These elements are in the body in the form of complexes with bioligands - amino acids, proteins, nucleic acids, hormones, vitamins.

From a biological point of view, complexing elements are the organizers of life. These are d-elements mainly. They have small atomic radiuses and atomic orbitals with free energetically, which may accept ligand's electrons.

Among the d-elements, vitally important, elements of the 4th period: Mn, Fe, Zn, Cu, Co. Recently, biological role was established and some other d-elements of this period: Ti, V,Cr. They are the lightest among the d-elements, with the lowest atomic radiuses and energy of ionization.

Such a similarity in the characteristics of these elements predetermines their interchangeability and close biological action. So the d-elements of the 4th period elements, other than Zn, provide the process of blood formation. All of them increase metabolism and affect the biosynthesis.

It is established that the ability of chemical elements to exert a catalytic effect increases millions of times if they form metal complexes.

The organism is harmed by both the shortage and the excess of the element. Elements in higher concentrations become toxic, but in small amounts are essential. There are 20 metals the list of the most toxic substances. Usually, the toxicity of an element of this group increases and their content decreases in the body, with an increase in the atomic nucleus charge.

So, an organism weighing 70 kg contains: nitrogen 2.1 kg, phosphorus 0.7 kg and antimony 0.9 g. N, P, Sb are elements VA group. Nitrogen and phosphorus are organogens, and antimony is a toxic element. The elements of period 6 are Pb, Te, Hg and the element of period 5 is Cd exert the most toxic effect.

Results. The elements of s-, p-, d-blocks with a small value of the charge of the nucleus, mainly elements of 2 and 3 periods for s- and p-elements and 4 periods for d-elements, belong to biogenic elements.

Conclusions. The biological role of the element and its toxicity is determined by the electronic structure of their atoms. With an increase in the nuclear charge, and the number of electrons correspondingly, the toxicity of the elements of this group increases, and their content decreases in the body.