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TOXIC INFLUENCE OF CHEMICAL SUBSTANCES ON THE LIVING ORGANISMS

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ABSTRACT

Consequences and effective mechanism of chemical substances on the living organisms are considered; specially some more important microelements which are closely-related to the occurrence of the disease epidemics. In this respect, we are mentioning the results of the theoretical and experimental researches of the problems of the toxicology and the influence of the different chemical substances on the living organisms. **Key words**: disease, pollution, microelements, toxicity

INTRODUCTION

The consequences of the influence of the polluted substances on the living organisms depend on 4 groups of factors: 1) compound chemical and physical properties; 2) doses of the polluted substances; 3) duration of their influence; 4) individual characteristics of organisms. (Djukic, Sanitary microbiology of the land)

Chemical substances that surround population on the Earth can be separated into 2 groups: substances characteristic for nature and strange substances (xenobiotics). All chemical elements which have natural origin in Mendeleev's periodic table of elements are characteristic for the nature. They exist in all natural spheres and spread out depending on their chemical properties and characteristics of that environment (air, water, mythological or even biotic) (Jemcev, Djukic, 2000; Djukic, Djordjevic, 2005) With them being the human, plant, animals and microorganisms' natural components of their organisms, they can't be toxic.

Speaking of xenobiotics (pesticides, preparations of communal chemistry and other), we expect that they will fulfill the functions they are made for (destroying vermin on agricultural plants, undesirable rodents near people, insects and other living organisms). Essentially, they are biocides (from words bio-life and cido-to kill), which means that their remains in the natural environment mustn't get in the living organisms which are not their target. The effect of their toxic influence

on the living organisms, especially the possibility of their binding on the genetical level, requires to be intently researched.

The toxicity (which is it's characteristical property) of the chemical substances to manifest harmful influence on the living organisms in certain concentrations is only manifested by interacting with them. In defining the term "toxicity", it is important to point out the concentration of those substances. There are no toxic substances in the natural ones, but there are some toxic concentrations. (Djukic et al., 2018)

EFFECTIVE MECHANISM OF CHEMICAL SUBSTANCES

Effective mechanism of chemical substances (in the environment) is observed on the example of microelements. Microelements are chemical elements which are located in microcomponents (10⁻³-10⁻⁶ %). For the most of microelements, it is proved that they participate in important biochemical processes. Microelements are found in many enzymes that catalyze important biochemical reactions. The great biochemical activity of microelements is connected to their atomic structure. All of them are transitional elements, known as d-family (Ni, V, Cr, Mn, Fe, Co, Cu), in whose neutral free atoms, d- sublevels are partially filled with electrons. The elements of r-family(As, Se, Ga, Ge) are similar to them based on their characteristics. Properties of those elements are determined with aspiration of the complete d-sublevel. Their abilities to have different oxidation level (Cu, Fe, Hg), high tendency to hydrolysis (Zn, Cu) and the ability of creating complexes (Cr, Zn, Pb, Hg) are important for participating in the most important biochemical processes.

Microelements are the activators of various enzymes, which provide synthesis reaction, decomposition and exchange of substances in the living organisms. Biochemical reactions in the living organisms, where microelements take place are shown in the Table 1.

Living organisms can't function normally without required quantities of microelements in water, air and food. (Djukic, Jemcev, 2003)

The main reactions connected to toxic influence of surplus of microelements are the following: (Kabata-Fendias, Pendias, 1989)

- 1) change in cell membrane compliance-Ag, Au, Cd, Cu, F, Hg, I, Pb;
- 2) reactions between thiol groups and cations-Ag, Hg, Pb;
- 3) competition with vital metabolites-As, Sb, Se, Te, W, F;
- 4) great kinship with phosphate groups and active centers in ADP and ATP-Al, Be, Sc, Y, Zr, heavy metals and lanthanides
- 5) change of vital ions (microcations)-Cs, Li, Rb, Se, Sr;
- 6) taking up places in molecules which are filled up with vital functioning groups, such as phosphate, nitrate, arsenate, fluoride, boron, selenium, tellurium, wolfram;

Table 1. Participation of microelements in important biochemical reactions

Element	Function Davidova, Tagasov, 2002)
V	Nitrogen fixation; oxido-reduction of catalysis; iron metabolism
Cr	Speaking of animals, cofactor of impulses (glucose tolerance factor)
Mn	Reactions of oxido-reduction, photosystem- photosynthesis, fat
	metabolism; micropolysaccharides and their synthesis in cartilage
Fe	Reversible reactions (Fe(II)/ Fe(III)), which are fundamental for various
	processes, O2 metabolism, in oxidase and peroxidase, necessary for
	synthesis of porphyrin, in hemoglobin
Со	In B_{12} vitamin composition, necessary for nitrogen fixation in
	cyanobacteria (Cyanophyta)
Ni	In urease, stabilizes the structure of RNK, DNK and ribosomes
Cu	In systems of oxido-reduction of chloroplast, ascorbate,
	polyphenyloxidase, which participate in phenolic compounds
	metabolism, O2 transmitter in reactions of fixing collagen and forming
	pigment
Zn	In composition of 70 enzymes which contain zinc, carbonic hydrase,
	dehydrogenase and alkaline phosphatase; takes part in silicatefixation,
	nucleic acids metabolism and cell division
Mo	Important for nitrogen fixation, in nitrate reductase; copper antagonist

It was determined that direct connection between microelement content (Mn, Cu, Mo, B and others) in the environment, protein exchange, photosynthesis, growth processes and plant resistance exists.

Microelements and disease epidemics that are caused by them:

Microelements have huge influence on the fate of living organisms, which are react sensitively on their either lack or surplus in the environment. There are 3 geochemical situations which cause living organisms' dysfunction, which can cause endemic diseases: 1) micronutrient deficiency in environmental components; 2) increased amount of microelements; 3) disruption of a vital relationship between microelements.Those geochemical situations manifest specific influence on the living organisms. (Djukic, Djordjevic, 2005)

Specific influence is caused by chemical elements' participation in some biochemical reactions in living organism. As a rule, it manifests with expressed deficiency or with influence of high concentrations of those elements. There are various kinds of the specific influence of chemical elements on the living organisms. (Jemcev, Djukic, 2000). They manifest:

- Carcinogenic influence; creating malignant formations. We differentiate the real carcinogenic, carcinogens similar and carcinogenic substances. Those which constantly cause malignant cell in living organisms are the real carcinogenic substances. This ability is specific for semi-aromatic hydrocarbons, nitroso compounds and on of the greatest carcinogens-benzopyrene. Carcinogens similar are substances which metabolisms manifest carcinogenic influence. Carcinogens are substances which cause development of a malignant process (resin, croton oils, emulsifiers, phenols, some fractions of tobacco smoke and overheated fat);
- 2) Teratogenic influence, which is connected to individual development defects and also different organisms' anomalies. Those changes can be noticed on the individual, but can also be at the genetic level (some kinds of cells or genotype of organisms). Gigantism and dwarfism of plants can be used as an example of those. The presence of morphological changes of plants is used in finding some metal ores. Teratogenic effect can cause surplus and lack of elements in the environment or their ratio disorder. It could be affected by xenophobes, pesticides for example;
- 3) Embryotropic influence is caused by disruption of embryonic development, which is followed by occurrence of freaks and other anomalies with the living organisms. Under the influence of alcohols, lead, hydrargyrum and insufficiently studied medicines there are possible intrauterine defects of yield in different stadiums of it's evolvement and also it's death. Thalidomide was recommended for sleeping influence, but soon it was forbidden because it caused nervous system disease, growth retardation and skin ulcers;
- 4) Allergic influence is caused by disturbance of reaction of organism and influence of microorganisms and strange proteins on them, followed by decreased immunity. It is caused by different natural and toxic substances. Toxicity of chemical substances is shown in the Table 2.

Unordinary influence of chemical substances on the living organisms is also possible and it is noticed with small concentrations of those substances in the longer period of time. It causes intensification of diseases caused by the influences which are not connected to disruption of biochemical processes. They are increasing the affection of direct disease sources, followed by strengthening of chronic diseases, disruption of system operation and system disharmony.

 Table 2. Effects of selective toxicity of polluted substances on people(OECD, Paris, 1991)

Element	Disease
Arsenic	Lung cancer; skin diseases (ulcers); hematological effects (anemia)
Beryllium	Dermatitis; mucositis
Cadmium	Acute respiratory diseases; renal dysfunction; malignant formations
Chrome	Lung cancer, malignant formations in gastrointestinal tract; dermatitis
Saturn	Hematopoiesis disorder; neurological effects; liver and kidney injury
Hydrargyrum	Influence on neurotic system (short-term memory); sensory functions and coordination disorder; kidney defects
Nickel	Respiratory diseases (asthma); protective system disorder; yield diseases and defects
Thallium	Bioaccumulation and toxicity connected to plants and animals
Vanadium	Respiratory tract irritation; asthma; nervous disorder; blood change

THE POLLUTED SUBSTANCES OF THE LAND AND THE PEOPLE'S HEALTHINESS

Kovaljski (1974) elaborated the theory of interaction between chemical composition of the living organisms and the content of chemical elements in natural environment. According to this theory, optimal concentrations of chemical elements in the environment are favorable for the living organisms, but either lower or higher concentrations of those elements are dangerous for them Picture 1.

Picture 1. The connection between levels of the content of chemical elements in the environment and living organisms' conditions (V. V. Kovalski, 1974)



According to the concept of possible borders of normal evolution of the living organisms, all chemical elements, which are made by nature, are necessary for the living organisms. Specialists have clarified the causes of the deficiency in the land of those microelements as Cu, Zn, Mo and Mn and have elaborated the ways of getting rid of them lately (around 1950/1960s). On the contrary, in centre of attention today there is a situation connected to surplus of those and other elements in the environment, which are called hard metals. If there aren't convincing proofs about necessity of some elements, then it can lead to lack of information about them, which is followed by imperfection of modern methods of analysis.

Pathological processes inside living organisms, which are caused by surplus or lack of some chemical elements, were known several thousand years before the discovery of the elements themselves. (Veskovic, Djukic, 2017) However, one of the first-known diseases-endemic goiter- is even mentioned in Chinese literature about four thousand years ago. Seaweed had been recommended as a cure for that disease since olden times. But in the middle of the 19th century it has been determined that a lack of iodine in the land, water and other products could cause thyroid disease with vertebrates. Because of that, treatment with seaweed was efficient because they are full of iodine and it's preparations.

Attention was evinced in the year 1931, in regard to Se, when was determined that animals' lameness is caused by poisoning with selenium. 25 years after that, it was discovered that a lack of selenium leads to animals' muscular dystrophy. Now, it is known that Se provides living organisms' resistance toward the influence of chemical substances and that it hasn't got carcinogenic effect.

Speaking of arsenic, it was always considered that it is poison. However, in the year 1975 it was confessed that it was necessary for providing living organisms' normal functions and reproducibility. The products of biological transformations of As were now admitted to be the poisonous ones (trimethyl arsine and dimethyl arsine) and that they can make micellar mold.

The influence of the polluted substances from the land on the people's healthiness has it's own specifics. As a rule, chemical substances from the land don't directly enter people's organism, but through the food chain: the land-water-human, the land-water-plants-human or the land-plants-animals-human. We must have this in mind when we are ranking the influence of the chemical substances from the land on people.

Organic pollutants manifest carcinogenic activity. Methyl substituted PAU, benzopyrene and benzofluoranthene are specially dangerous. Their carcinogenic effect depends on the way of entering the organism. It is shown that (speaking of benzopyrene) with influence on the sample animals, cancer was developed inside stomach and influence on lungs. As a rule, blastomogenic effect doesn't depend on the way of entering.

With cobalt, we are going to consider the connection between the content of the elements in the environment and the living organisms' state.

Cobalt is important and irreplaceable component of B_{12} vitamin, which molecule has one atom of Co. Prosthetic group of B_{12} vitamin has structure similar to helium's, whereby Co is in it trivalent. The question of the influence of effective mechanism of cobalt on living organisms hasn't been solved yet. It is obvious that the biological activity of Co is connected to it's ability to form complex with enzymes by creating connection to sulfhydrylic and n-histidinic groups. The prosthetic group in living organisms plays an important role as a metallizing agent and as a coenzyme mutase that catalyzes the transport of hydrogen. The element is irreplaceable for cell's breathing, producing energy and oxidation reactions. The lack of Co, for example with ruminants, causes disease which is differently known in different countries: coastal disease, primitive shrub disease and most oftenexhaustion. With the importation of cobalt salts, the disease is being treated (in case with animals).

Increased doses of Co are dangerous for the living organisms. Toxicity of Co is being studied with various sample animals in different ways of it's salts' influence. The most important clinical and physical symptoms of acute poisoning with Cobalt are breathing and cardiac activity disorder, slowness, eye bleeding and hind limb paralysis. These symptoms are spotted in cases of inhalation of aerosol particles which contain Co from different kinds of rodents. Entry of Co salts in pigs with their food causes anorexia, coordination disorder and tremor of hind limbs. Speaking of rats, dogs, mice and rabbits, it causes hyperglycemia, pancreatic dysfunction, pulmonary, splenic and cardiac hypertrophy. Speaking of guinea pigs, rats, dogs and rabbits, which were eating food with increased amount of Co, it caused cardiopathy. Co salts' solutions caused malignant tumor to sample mice. In experiments with rats and Co salts, their toxic influence on reproduction and growth was noticed. In experiments with bacteria and yeasts, mutagenic effects were noticed. (Djukic and others, 2018)

Cobalt is necessarily element in human's organism and we have around 1mg of it, mostly in our lungs. Average daily consumption of this element is close by that level. The main sources of B12 vitamin for humans are meat, fruits, vegetables and cereals. When the optimal content level of Co in organism is disturbed, pathologic changes are noticed.

Cobalt salts are manifesting toxic influence on the humans' health, especially one ones' that use products which have added cobalt in them, according to the technologies. The effect is manifested through heart pathology. Confirmations about Co being the metal with expressed allergic potential have been obtained. It's salts have influence on skin, causing dermatitis. It is confirmed that consequences of contact between humans and cobalt, such as producing wolfram and cemented carbides. Numerous diseases of workers of those industries sectors have been

discovered (lung diseases such as bronchial asthma-cobalt's lungs and alveolitis and also hard breathing, odor loss and gastrointestinal pathology).

According to the mechanism of forming cobalt's biological activity, which is connected to it's ability to make enzyme complexes, antidotes for humans are being elaborated. Positive effect is received specially with using competitive complexoge. For treating those diseases, preparations which have EDTA, DTPA and n- acetyl-h-cystine are being used. They have to provide decomposition of cobalt complex compounds which cause toxic effect.

The results of theoretical and experimental researches of toxicology problems and the influence of chemical substances on the living organisms (at the end of 20th and the beginning of the 21st century) have just confirmed the great idea from the middle of 16th century "What is poison and what is not? All substances can be poisonous and there's no substance that is not. Only the dose defines it's toxicity.", by the great German medic and researcher.

CONCLUSION

Based on the results of the theoretical and experimental researches of the influence of some polluted substances on the living organisms, the following findings could be segregated:

-The influence of the polluted substances on the living organisms depends on their chemical and physical properties, dose, the treatment duration and the individual characteristics of an organism;

-Microelements are participating in the various biochemical processes: because of the oxidation ability, hydrolysis and creating of complexes;

-There is direct connection between the microelements' content and the intensity of photosynthesis, growth and plants' resistance for unfavorable factors of the environment;

-Inappropriate doses of microelements could manifest cancerous, allergic and toxic influence.

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