UDC 549.67:616:636.01(470.67)

Use of Dagestan natural zeolites in medicine and veterinary medicine

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Objective: to study the ecological and pharmaco-toxicological properties of zeolites of mountainous Dagestan for their application in medicine and veterinary medicine.
Materials and methods: On mice was conducted a toxicological study of the natural zeolites of the Levashinsky's deposit in Dagestan.
Results: A single dosing of zeolite in the stomach of a mouse in doses of 5, 8, 11, 14, 17 and 20 g per 1 kg of live weight did not cause visible changes in the general condition and behavior of the mice both on the days of introduction of the zeolite and in the following days.For 21 days of observation, the mice were in good condition and put on weight.
Cunclusion: The results of our research show that zeolites of the Levashinsky's deposit of mountainous Dagestan is not acutely toxic.

Keywords: natural zeolites, adsorption properties, neutralizing agents

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For citation: Shapeev BI, Aliev AA, Shapieva KB, Kanbulatova ZS, Khalikov AS. **T**he Use of natural zeolites of Dagestan in medicine and veterinary medicine. Environmental medicine 2018;1(1):80-84.
DOI: 10.34662/EM.2018.1.1.80-84
Translated from Ecologicheskaya Medicina 2018.vol. 1, N.1(1), pp.87-92.
Translated by Kakvaeva S.B.

Natural zeolites are rocks with a porous structure of vol-canogenic-sedimentary origin. Zeolites - aluminosilicates, containing oxides of alkali and alkaline-earth metals, characterized by a strictly regular structure of pores, which are filled with water molecules under normal temperature conditions. This water, called zeolitic, is released during heating, zeolites "boil", with which the origin of this word is connected ("ceo" and "lit", i.e. "boiling stones"). The term "zeolites" was introduced into mineralogy over 200 years ago by the Swedish scientist A.F. Cronstedt.

The properties of natural zeolites are studied and systematized in the works of academicians A.E. Fersman and V.I. Vernadsky.The general chemical formula of zeolites is Me2 / nO • Al2O3 • xSiO2 • yH2O, where Me is the cation of alkali metal and n is its valence. In nature, sodium, potassium, calcium, rarely barium, strontium, and magnesium are usually included in the composition of zeolites as cations. The crystalline structure of zeolites is formed by tetrahedra. Cations compensate for the excess negative charge of the anionic part of the aluminosilicate skeleton of the zeolite.

If water is removed from the zeolite, the pores can be filled again with water or another substance, which predetermines their use in the processes of drying and separation of substances. The reversibility of the processes of hydration and dehydration of zeolites was established in 1840 by A. Damur.

The absorption of the substance occurs mainly in the adsorption cavities of the zeolite. However, not all substances can penetrate into the adsorption cavities of zeolites and be absorbed in them. This is explained by the fact that the adsorption cavities are connected to each other by entrances - the "windows" of a strictly defined size. Only those molecules whose critical diameter is smaller than the diameter of the entrance window do can penetrate through the window. Under the critical di-

ameter, they understand the diameter along the smallest axis of the molecule.

The simplest structure has a frame silicate - sodalite. In the earth's crust, five modifications have been discovered: chlorsodalite (6NaSiAlO4 • naC), hydro-estotalite (6NaSiAlO4 • 2NaOH), lazurite (4NaSiAlO4 • 2Na2S), guinein (6NaSiAlO4; AP) • ct; 3-5, 10]. Ammonia, hydrogen sulfide, methane, nitrates, heavy metals and other substances can freely penetrate into their internal cavities. The porous structure containing active exchange cations K, Mg, Ca, Na, defines unique adsorption, cation exchange and catalytic properties, which simultaneously possess high acid resistance and thermal stability. The main effect of zeolite, which is rightly called “the stone of the XXI century”, is based on this.A mineral with pores of molecular size (4 angstroms), like a sponge, absorbs and firmly holds a variety of contaminants. Among them are heavy metals, radionuclides, nitrates, nitrites, chlorides, ammonia and a whole range of chemical and biological pollution, the presence of which distinguishes clean drinking water from industrial effluent and polluted water. According to the chemical composition, zeolites consist of silica (60-65%), aluminum oxide (10-12%), calcium oxide (4-5%). They also contain potassium, sodium, magnesium, iron, phosphorus, cobalt, zinc, manganese, copper, titanium and other elements (more than 40 in total). The content of harmful impurities does not exceed the allowable values, and the mass fraction of the beneficial substance (clinoptiololite) is over 60%. Large deposits of natural zeolites are found in Siberia, Yakutia, and in the Far East. The positive effect of zeolites on the animal organism is based on their sorption and ion-exchange properties, as well as the presence in them of certain microelements with which the animals replenish their diet.

Zeolites can be used as a neutralizing agent, especially against the background of feeding of synthetic nitrogenous substances (urea) and feed with a high content of nitrates and nitrites. Passing through the gastrointestinal tract, zeolites remove excess fluid, harmful gases, endotoxins, heavy metals, radionuclides, reduce the incidence of tympania (bloating), prevent certain eating-rhenium disorders (diarrhea and others). Zeolites stimulate the activity of microbial synthesis in the rumen, promote better utilization of nutrients of the feed, increase the activity and stability of digestive enzymes, increase the strength of bones, wool and eggshell. All this ultimately provides an increase in the productivity of animals while reducing the cost per unit of production [1, 2, 6].

The largest volume of toxicological studies of zeolite raw materials was carried out during the study of the Sivyrtui deposit (Chita district), one of the largest in Russia. At one time, this ensured the approval of the country's first permanent technical conditions for the use of zeolites in animal husbandry. It was experimentally established that when using minerals orally, they do not have acute toxicity. When using zeolites in moderate doses, they did not cause pathological changes in the intestine and internal organs.During long-term feeding of rats with zeolite, no signs of embryo-toxicity and teratogenicity were also detected [6, 9].

Similar cycles of biomedical research, only in smaller volumes, were performed for zeolite rocks of almost all explored deposits. Their results turned out to be of the same type and testified that when taken orally at acceptable doses, the clinoptilolite-smectite rocks are harmless to animals and have only to some extent pronounced biologically active properties. Zeolites have been shown to positively affect metabolic processes associated with maintaining mineral balance, excretion of toxic substances and metabolic products from the body, and effects on symbiotic microflora [4, 6, 9].

According to researchers [9], practically all large and small cities and settlements use water from the surface layers of reservoirs, rivers, wells, and to a lesser extent - water wells. In some cases, the drinking water goes through purification through quartz sand and cogulants. However, this cleaning system does not solve the problem of clean drinking water. But there is still a big problem with the water supply network with its specific contamination, which is almost impossible to solve. Theoretically, this is possible by replacing all the pipes with a high-strength plastic with the installation of filter sumps. But it is a big expense. Practically all of us are gradually forced to switch to autonomous (individual) water purification at home.

Trading networks today offer a lot of filter systems: from expensive complex systems to cheap filters with replaceable cartridges.

Filters with cartridges based on activated carbon, which is a good adsorbent, are widely sold. But the terms of its action are relatively short, because at the end of its cartridge (ac) begins to accumulate a different kind of bacte-

ria, which leads to the opposite effect. And only zeolite has a resolving ability to neutralize physical, chemical and biological contamination at the same time. First, the water must be purified from harmful substances and impurities: heavy metals, nitrates, nitrites, iron, chlorides, decomposition products of organic substances, bacteria, etc. All these problems are successfully solved by zeolite, mineral-adsorbent fraction 1-4 or 3-5 mm. Based on the calculation of the optimal amount of zeolite per unit of water, 1 kg per 1 m3, or 100-150 grams, is recommended. 3-liter capacity with constant use of it.Secondly, not less important feature of zeolite is its ability to enrich (ionize) water with such elements as calcium, potassium and magnesium. These trace elements are beneficial for the cardiovascular system, especially the cerebral cortex, to strengthen the walls of blood vessels.

By the beginning of 2000, enterprises specializing in the production of zeolite medical products appeared in Russia. One of them ("Cast") was registered in Tyumen. Its products were dietary supplements based on raw materials from the Lyulinskoye field (Subpolar Urals). The second enterprise was organized in Moscow (“Tsamaks”) and the third (“Ark III”) in Vla-divostok. The production of zeolite-containing nutritional supplements in Moscow and Vladivostok was organized from chemically purified raw materials from the Chuguevskoye field. In 2003, the first foreign drug appeared on the basis of natural zeolite (Megamin), developed with the participation of Croatian, Austrian, German and American scientists.

To date, the whole range of dietary supplements and medications produced on the basis of natural zeolites has been tested in experiments and clinics under various pathological conditions. They found the greatest efficacy as therapeutic aids in sorption therapy for diseases accompanied by intoxication of the body. The most thorough experimental studies of the mechanism of the antitoxic action of zeolites in our country were carried out at the Research Institute of Clinical and Experimental Lymphology of the Siberian Branch of the Russian Academy of Medical Sciences (Novosibirsk) [8, 9].

According to [6], the first systematic information about the zeolitic potential of Nagorny Dagestan was obtained in the process of studying the siliceous rocks of the Eastern Pre-Caucasus by the staff of the Rostov State University, who in carbonate, siliceous, siliceous-carbonate (siliceous limestone, dia-tomites, tripoli, spongolites) rocks of the mid-Eocene green marl group revealed the Sulak - Rubaschai zeolite-bearing area more than 150 km long. For priority study were recommended Levashinskaya and Rubaschay-area. Specialists of OAO North Caucasus Geology in 2007-2009 prospecting studies of zeolites and zeolite-containing rocks were carried out on the Leva-Shinskaya and Rubaschay areas. They justified the possibility and feasibility of creating a sustainable mineral resource base and the construction of enterprises for the extraction and processing of zeolite raw materials. Due to the fact that this type of mineral raw materials for the North Caucasus region is new, the focus is on the validity of the assessment of forecast resources, their qualitative characteristics and rational spheres of application [6, 7].

Consequently, with the advent of new deposits of zeolites and zeolite-containing rocks in the Republic of Dagestan, specialists and scientists of various fields and areas are given completely new tasks to study the environmental, pharmaco-toxicological aspects of the application, the development of scientifically-based recommendations for effective use -vany them in medicine, veterinary medicine and animal husbandry.

In connection with the above, we set a purpose - to study the ecological and pharmaco-toxicological properties of zeolites of the Levashinsky area of upland Dagestan for their practical use in medicine and veterinary medicine.

Materials and methods

Studies were conducted in 2013-2015. in the laboratory of toxicology of the Dagestan State Agrarian University. M.M. Dzhambulatova and the biochemical laboratory of the Research Institute of Medical Ecology of the Dagestan State Medical University according to the methodological guidelines [5]. The scheme of the experiment is presented in the table.таблице.

For the experiment, 7 experimental groups of white mice were formed (10 mice for each dose). The first group served as a control, and the rest were experienced. The animals were injected with zeolite in the form of suspended matter in a 20-50% aqueous solution, so that the total dose was contained in 0.5-1 ml. Zeolite was injected into mice on an empty stomach into the stomach using a syringe with a metal zone-house (needle with a blunt end).

Table. The scheme of the experiment on white laboratory mice

Group	Dose of zeolite in g per 1 kg of live weight	Number of experimental animals	The time of occurrence and nature of intoxication, its severity, reversibility, periods of death of animals or their recovery
1 (control)	did not receive	10	Not observed.
2 (experience)	5	10	Not observed.
3 (experience)	8	10	Not observed.
4 (experience)	11	10	Not observed.
5 (experience)	14	10	Not observed.
6 (experience)	17	10	Not observed.
7 (experience)	20	10	Not observed.

Note: the average live weight of laboratory white mice was 18-20 g

The control group of animals instead of zeolite was given tap water in an amount of from 0.5 to 1 ml. The following indicators were taken into account: the appearance and behavior of animals; the condition of the coat and visible mucous membranes; attitude to feed; mobility; rhythm and frequency of breathing; time of occurrence and nature of intoxication; her hardness, reversibility; terms of death of animals or their recovery.

Results and its discussion

According to modern nutritional science, livestock products used in human diets should be obtained from healthy animals with no impaired metabolic processes, while animal body tissues should not contain chemicals harmful to human health. According to the existing international requirements, products obtained from farm animals and poultry, which included new feed components in the diet, should be studied for harmlessness to the population [6].The table shows that a single injection into the stomach of laboratory mice of zeolite in doses of 5; eight; eleven; 14; 17 and 20 g per 1 kg of body weight did not cause visible changes in their general condition and behavior both on the days of introduction of the zeolite, and in the following days. For 21 days of observation, the mice were in good condition and gaining weight.

When orally administered to white mice, the maximum amount of zeolite from the Levashinskoye deposit in the Nagorny Dagestan 20g / kg we did not establish signs of acute poisoning. Due to the low toxicity of zeolites, we could not determine the mean lethal dose (LD50).

Further ecological toxicological studies on the effect of zeolites and zeolite-containing rocks of the Levashinskoye and Rubaschayskoye deposits of the Republic of Dagestan on the human and animal organism are continuing.

Conclusion

The results of our research have shown that zeolites of the Levashinskoye deposit in the mountainous Dagestan are not acutely toxic.

Funding and Conflict of Interest Information

The authors declare the absence of overtand potential conflicts of interest related to the publication of this article.

The search and analytical work on the preparation of the manuscript was carried out on the personal funds of the authors.

Participation of the authors: the concept and design of the research, analysis of the data obtained - Aliev AA, Shapiev BI; collection and processing of materials - Shapieva KB, Kanbulatova Z.Sh .; text editing - B. Shapiev

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