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PHYSIOLOGICAL ACTIVITY NANOAQUACITRATES OF GERMANIUM, CHROMIUM AND SELENIUM IN RATS

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Results of previous studies of the effects of mineral and organic compounds of germanium, chromium and selenium on physiological and biochemical processes in farm animals and their productivity confirm the positive influence of these elements. However, at the present time the question of receiving the trace element supplementation in bioavailable organic form, without toxic effects appears to be important. Since it is found that their organic form shall better stimulate the activity of antioxidant and immune systems, improve protein, vitamin and mineral blood picture, and enhance detoxification processes in animals. Enrichment of food additives in the form of carboxylates obtained by interlocking of compounds of metals with citric acid shall be perspective. However carboxylates obtained by classical approaches do not always meet the purity requirements for such salts as far as containing byproducts of chemical reactions. Published data represent the possibility of using chelates of biogenic microelements produced by nanotechnology as high activity compounds in animal husbandry and veterinary medicine. However, given the property changes of compounds residing in nanosuspensions, the impact of such solutions on humans and animals shall require for careful examination determining the choice of direction of our research.

The studies were conducted on the three groups of white laboratory rats. The female rats were divided into groups on the principle of counterparts and were kept on experimental ration 1 month before fertilization, during pregnant and lactation period; the offspring remained on rations of the female rats of the appropriate groups for the first three months of the life. The animals of the first group (control) were kept on a standard balanced ration throughout the study period. Animals of the second (experimental) group except basic ration were fed with drinking water with Chromium and Selenium citrates with the concentrations of 50 μg/kg bw per day and Germanium citrate with the concentrations of 15 μg/kg bw per day. Animals of the third (experimental) group were fed with diet according to the second group excepting Selenium citrate. The three-month rats were subjected to euthanasia with the following decapitation to take blood for physiological and biochemical studies. All citrates solution, obtained by the nanotechnology method at the Ukrainian State Scientific Research Institute of Nanobiotechnologies and Resource Reservation.

Morphometric research of the internals of rats at the age of 3 months showed no adverse or toxic effects of the applied doses of nanoaquacitrates of germanium, chromium, and selenium on their growth and development. Outcome analysis of the research of reproductive ability of female rats and their offspring postnatal development highlights the positive impact of the applied compounds of chromium, selenium and germanium on infant rat viability. In particular, the offspring safety rate at the age of 2 months was higher for the infant rats of the II and the III research groups by 12.9 and 6.5 % respectively. Feeding with waters of citrates of germanium, chromium and selenium of the females and offspring also stimulated the growth and development of the infant rats in the postnatal period. Body weight of the infant rats of the second and third groups exceeded its performance in the control group throughout the study period, and at the age of three months the difference was 5.5 and 7.4 % respectively. This may indicate a positive influence of the applied doses of citrates of the trace elements on female lactation and infant rats resistance, as evidenced by higher levels of glycoproteins in their blood. These changes were more pronounced for the second experimental group of animals, also fed with selenium nanoaquacitrate.

It is found that the level of ceruloplasmin, haptoglobin and hexoses bound to proteins increased in the blood of rats of the second and third groups. The reported intergroup difference of its content in blood of rats of both experimental groups may be indicative of the same immunobiological effect of germanium, chromium and selenium, in the second, and germanium and chromium in the third groups. Among the glycoproteins under study haptoglobin and ceruloplasmin gave an active response. These glycoproteins, in addition to immune function, play an important role in iron metabolism in human body, and in functioning of the antioxidant system. In particular, the Hp-Hb complex has a peroxidase activity and can inhibit lipid peroxidation; and ceruloplasmin, in turn, shows this effect because of the ability to inhibit reactive oxygen species. Analysis of these data indicates a strong antioxidant effect of chromium, selenium and germanium in rats. This is also confirmed by the results of studying the level of lipid peroxidation products in their blood. In particular the true weakening of lipid hydroperoxides and TBA- active products concentration in the blood of rats of both experimental groups as compared to controls has been set.

So, feeding of nanoaquacitrates of germanium, chromium and selenium to rats leads to a higher lactation of females, and activity of immunobiological and antioxidant systems of the animal body. Also, the results obtained indicate the same direction of the antioxidant effect of chromium, selenium and germanium in the infant rat body. Enzyme strength and lipid peroxidation indicators point to the same direction of the antioxidant effect of germanium, chromium and selenium in the infant rat body.