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Biogeochemistry of heavy metals in trophic chain in terms of the south of Tumen region

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Abstract

The article considers biogeochemistry of heavy metals in the system soil-plant-animal in the terms of the south of Tumen region. The results of researches showed that soils are impoverished by the active forms of zinc. Its average content in the soils was 0.62 mg/kg that is below normal for the provision of all group of plants. The regions with relatively high content of lead and cadmium (in comparison with other regions) were revealed. Crop cultures grown in Tumen region correspond to the ecological and sanitary-hygienic standards of heavy metal content. Accumulation of studied metals in muscle tissue, liver and kidney of cattle doesn't cause concerns about the quality of the use of this product by a man. There was revealed that chain of elements accumulation in in decreasing order was the following: for the muscle tissue, liver, kidneys and milk Pb> As > Cd >Hg. Calculated coefficient of chemical contamination shows that milk accumulates lead and mercury in a greater degree and muscle tissue is apt to accumulate cadmium and arsenic. Carried out researches of the level of heavy metals accumulation in the organism of pigs in the regions of Tumen region demonstrated that all achieved results were within the allowed limits of norms. It was found out that in animal organism heavy metals are allocated un unevenly, the biggest concentration was found in the liver and kidneys.

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Keywords: heavy metals, concentration, soil, agriculture, organs and muscle tissue of animals.

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1. Introduction

Increasing technogeneous affect on the environment relates to one of the most important problems of modern times. Influence of human activity is mainly significant for agrarian ecosystems since it is connected with wide spectrum of toxicants inflow in human organism with agricultural products [6, 9, 10].

Accumulation of ecotoxines in the soils, plants, animals, mainly, heavy metals is observed in the area of industrial sources of contamination of Russian Federation. The main sources of contamination of agricultural origin are substances for plant chemicalixation and protection and also agroindustrial enterprises and objects (storehousesof chemicals, fertilizers, ameliorants, cattle-breeding farms and complexes). Moreover, intensively developing industry and autotransport make significant contribution into contamination of soils, plants and animals with heavy metals [11, 19].

Heavy metals and their compounds are very dangerous toxicants and their compounds [12, 15]. Heavy metals include more than 40 chemical elements of periodic table with atomic masses exceeding 50 atomic units or elements with specific weight more than 5 g/cm^3 [18].

Numerous scientific works and researches are dedicated to the study of different properties of heavy metals and their compounds, processes of their migration, transformation, accumulation and influence on environmental objects (including man)[4, 7, 8, 14, 16, 17].

All main migration cycles of heavy metals in biosphere (water, atmospheric, biologic) begin in the soil since mobilization of metals and formation of different migration forms take place in it. Soil (its fine-dispersed particles and organic substances) is a very important factor regulating inflow of heavy metal to plants [2, 3, 19].

The main problem arises in connection with the contamination of soil and water with seldom and dispersed elements with biocidal action, for example, mercury, cadmium, lead, arsenic and others which application as pesticides is limited or prohibited. Contamination of soil and water creates constant background providing their stable concentration in the food and fodder.

In connection with this, the necessityarises to evaluate the consequences of their accumulation in soil and plant cover and in organism of agricultural animals. This will allow prognosticationof toxicants accumulation in the products of phytogeneous and animal origin, determining of rates of migration and normalization of their inflow to trophic chains and developing and implementation of new technologies for the decrease of contamination level in agricultural products with the purpose of production pure and good quality food for the population[13, 20].

Complex evaluation of heavy metal content in the system «soil-plants-animals» wasn't carried out in Tumen region in full volume and existing data have uncoordinated and fragmentary character. Such research has an important meaning for scientific understanding of the processes taken place in ecosystems as well for the solution of many practical tasks connected with protection of human health, animals, environment and use of natural resources.

2. Subjects and Methods

The researches of the compliance with the established requirements of heavy metal content in soil, crop production and cattle-breeding production took place in test laboratory. Determination took place on atomic absorption spectrum«MGA-915» according to state standard 30178-96 (lead, arsenic, cadmium), «RA-915» according to МВИ М 04-46-2007 (mercury).

3. Results

Among the contaminants heavy metals have special place in terms of sizes of contamination and negative influence on biological objects. They accumulate in humic horizon and then move from the base of the pyramid to its top increasing concentration by hundreds times. Increased content of heavy metals in soil causes stable change of their properties and functioning of soil organisms, therefore, these researches are the controlled parameter in ecologic and toxicological monitoring [21].

The main source of contamination with heavy metals of agricultural designation soils is obviously use of mineral fertilizers, especially phosphoric and potassium ones [1]. The reason of it is presence of strontium, uranium, zinc, lead, vanadium, cadmium and other elements in row material for the production of mineral fertilizers.