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The Negative Effect of Heavy Metal Salts on the Body of Mammal Animals

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Abstract

The main purpose of this presented article was to explain the need to study the amount of heavy metal salts in the environment where animals live, in the water, in air, and in the food and fodder consumed. This article presents materials from the literature on the effects of heavy metal salts on the body of animals and the environment in which they live. The cited analytical data showed that the general information on the negative effects of heavy metal salts on the body is sufficient, but their effects on the digestive tract and morpho-functional properties of rabbits should be studied in depth. Therefore, we planned to focus our scientific work on this topic. The article mainly refers to salts of heavy metals cadmium, lead, and mercury (Cd, Pb, Hg). It is noted in the literature that heavy metal salts have a negative effect on the body of animals. We focused mainly on data on the effects of heavy metals on farm animals, including rabbits. But it is clear that the authors referred to were referring to experimental animals. These negative effects are manifested in the form of disorders of digestive functions, disorders of neurovegetative processes, increasing incidence of cardiovascular disease, rapid heart failure, deterioration of calcium metabolism, as well as impaired haemoglobin metabolism. Disorders of protein metabolism manifest themselves in the form of cases of hyperproteinaemia and dysproteinaemia. The results of the evaluation of the organism of healthy animals in chemically and radioactively contaminated areas showed the accumulation of significant levels of chemical elements in their organism. We mainly looked at the effects of heavy metal salts on farm animals. The cited analytical data showed that the general information on the negative effects of heavy metal salts on the body is sufficient, but the effects on the activity of organ systems in the body (respiration, blood and blood circulation, digestion, reproduction, productivity and immunological systems) have not been comprehensively studied.

Keywords

Chemical Elements, Animals, Organisms, Nutrients, Food Products,

Environment, Diseases, Heavy Metal Salts, Cadmium, Lead, Poisoning

1. Introduction

At the beginning of the XXI century in parallel with the development of industrial production in a number of developing countries, there is a steady increase in population. This, in turn, has to use a number of mineral and chemical compounds in the process of growing them in order to increase the amount of agricultural products produced in the agricultural sector, to ensure their high nutritional value. In addition to production processes, the negative impact of industrial waste, wastewater, vehicles, producing equipment, heat and power plant waste on the environment is clearly shown in the studied foreign literature. However, we have not seen any work in this area that presents the results of complex research in our country.

Hungarian A. Bersényi studied the effects of heavy metals (Cd, Pb, Hg and Ni) in rabbits and broiler chickens. As a result of his scientific work, he came to the following conclusions. Accumulation of Cd, Pb, Hg in the body has a negative effect on some physiological processes of the liver and kidneys, while cadmium increases ALT activity, lead increases AST activity. Cd, Pb, and Hg reduce the activity of pancreatic enzymes. It has been observed that toxic metals such as Cd, Pb, and Hg reduce the rate of spermatogenesis, resulting in impaired sexual performance of male rabbits [1].

Experiments were carried out on cattle milk in the industrialized and rural areas of northern Spain. The results showed that the concentration of cadmium in the liver and kidney tissues of cattle in the industrial area was much higher than in the cattle in the rural area. Another study found that cadmium concentrations were high in the meat and liver of cattle raised around a metallurgical plant. Therefore, cadmium contamination of the environment can cause many negative ecological consequences [2].

In scientific studies conducted by a group of scientists, it was found that cadmium salts caused significant changes in the genital organs and fetuses of rabbits. Among them, $CdCl_2$ was given in two different doses of 5 mg/kg and 10 mg/kg, and the effect on the fetus was studied. The experiment led to the premature birth of the fetus and the death of the embryo. Macroscopic and microscopic examination of the placenta tissue revealed a large amount of fibrin compounds and severe placental necrosis [3].

R.F. Nabiev (2000), in his research, studied the symptoms of mercury, cadmium, and lead poisoning in farm animals and developed drugs to treat them [4].

These waste products continue to pollute and befoul the environment with various toxic chemical compounds as a result of anthropogenic impacts. Based on the above, professors and teachers of the Faculty of Biology of Samarkand

State University named after Rashidov began to study the effects of salts of lead and cadmium elements on the organisms of large and small horned ruminants being propagated in the natural pastures of our country and the effects of the above-mentioned heavy metal salts on the body of rabbits bred are being propagated to obtain dietary meat and fur and laboratory analytical work is underway for the results of the initial experiments. We mainly looked at the effects of heavy metal salts on farm animals, including rabbits. Before starting the research, we used the available literature which is possible to use, and based on the data of this literature, we present our conclusions to you as an analytical article. Based on the above, the main goal of this presented article was to explain the need to study the amount of heavy metal salts in the environment where animals live, water, air, and food. We thought it would be appropriate to let students know which organs and tissue samples are taken for these laboratory analyses.

2. Methods

Among these compounds, heavy metals occupy one of the leading positions, they accumulate in the environment mainly under the influence of anthropogenic activities and other industrial and domestic wastes and are part of the food chain [5] [6] [7]. For example, according to the classification of N.F. Reimers, metals with a density greater than 8 g/cm^3 are included in the list of heavy metals. Eight of them (mercury, cadmium, lead, copper, arsenic, strontium, zinc and iron) are included in the list of components required by the Organization of World Health to control the amount of food products in international trade under the Food Code [8] [9]. The toxic effect of metals varies not only with the level of contamination of the environment, but also with the species of animal affected. Effects on mammals are in the following order: Ag > Hg > Cd > Cu > Rb > So > Sn > Be > Mn > Zn > Ni > Fe > Cr > Sr > Cs > Li > A1. Heavy metals that enter the living organism through food interact with the body's enzymes and other biologically active substances and extinguish their activity. In addition, heavy metals accumulate in the body due to their bioaccumulation capacity, resulting in an increase in their concentration, which accelerates the death of animals [10] [11]. The most dangerous effects of lead on the body of animals are manifested by impaired digestive functions and reorptive effects on pancreatic cells, exacerbation of vascular vegetative dystonia, disruption of neurovegetative processes, increasing incidence of cardiovascular disease, impairing cardiac function and calcium metabolism.

In addition, lead, as an antagonist of iron, disrupts haemoglobin metabolism, causing low blood pressure, which is not associated with a lack of iron atoms [12]. In the Far North, researchers have found that fungi consumed by deer are the main accumulators of heavy metals. The researchers found that laboratory analysis of the muscle tissue and internal organs of the deer showed that the main accumulation of the studied heavy metals were the liver and kidneys. If the

level of lead and cadmium studied in muscle tissue is found to be within the norm, the results of the analysis show that in the organs: lead in the heart—1.19%, in the liver—1.71%, in the kidneys—1.07%, cadmium: in the liver—1.17%, in the kidneys—more than 1.21% [13] [14].

According to the results of studies on the concentration of heavy metals in the muscle tissue of horses fed in different regions of Bashkortostan, the amount of lead and cadmium exceeded the usable amount (for lead UA 1.6 - 2.8 and for cadmium 1.6 - 5.2.) will be more. It has been found that horses fed in forest and desert areas are characterized by high concentrations of lead in meat samples [15]. Long-term toxicity of heavy metals in cows exceeds the amount that can be consumed with food, has a significant negative effect on metabolic processes in animals and disorders of protein metabolism occur in the form of hyperproteinaemia and dysproteinaemia and these have been noted by the authors [16].

According to the results of the research by L.A. Rabinovich, the daily consumption of heavy metals consumed with food by bulls, including 2 times the normal amount of lead, decreased by 17% and the amount of nutrients consumed for their growth and admitted to have increased by 10%. The addition of zeolite to the diet of bulls to prevent heavy metal poisoning reduced the amount of lead in the blood by 8 times, cadmium by 10 times, muscle tissue by 2.8 times and liver cells by 15% - 20%. Researchers have determined the origin of animals under the influence of heavy metal salts, which species they belong to and their gender. Black-and-white and Hereford bulls were the most poisoned, while Simmental and Kazakh white-headed bulls were the least poisoned. According to the author's observations male bulls retain less toxins than neutered (castrated) and heifers [17]. According to the results of a study conducted to assess the microelement composition of the long muscles of the shoulder muscles of beef bulls reared in different geochemical regions of Russia and Kazakhstan, it was found that the chemical composition of the meat of the compared bulls differs in its qualitative characteristics. For example, the concentration of Cu in the meat of Kazakh white head bulls reared in northern Kazakhstan was 35.3% - 32.0% higher than in their peers in Orenburg region and 13.0% - 18.4% higher than in Chelyabinsk Oblast and also noted a tendency to observe analogy differences by the author [18]. Over the last 100 - 150 years, the amount of lead in the environment has increased 4 times due to the fact that the number of vehicles exceeds the norm. This is due to the fact that in one year, one car emits 1 (one) kg of lead into the environment due to the friction of its tires on the asphalt, according to statistics from the Organization of World Health. The above-mentioned accumulations occur primarily in the soil layers, which in turn is observed in all republics of the former Soviet Union, such as Uzbekistan. Because in these countries there is still no time to find a solution to this problem, and there are no funds for the costs. Therefore, no concrete measures have been developed to protect the environment in the former Soviet republics. For example, in the use of ethylene-treated gasoline in automobiles, as in developed western countries, the use of Pt-Pd ab-

sorbers, which purify gases from cars, is not allowed [19]. G.B. Rodionova and the others [20] conducted research on the storage of heavy metals in grain. The amount of copper, zinc and lead in all studied grains should be within the norm, respectively, 3.27 - 4.31; 16.58 - 21.22; 0.18 - 0.34 mg/kg was detected. In the absence of the element cadmium in the grains, and in all the examined grains, arsenic is relatively homogeneous, it has the lowest amounts of copper and zinc: 3.37 and 16.58 mg/kg, respectively, were found in the millet plant. The amount of lead was found to be slightly higher than that of other crops and averaged 0.34 mg/kg.

Livestock products obtained from animals fertilized under man-made pollution do not meet the required sanitary standards for the storage of heavy metals, and it poses a certain risk to the body of healthy people who consume the above products [21].

As determined by G.M. Topuria and the others [22], the use of lead near the copper-sulfur plant in Mednogorsk exceeded the norm by 24%, similarly, near the cryolite plant in the Orenburg region, an increase of 2% was reported. The location of the farm is influenced by the presence and amount of heavy metals in cow's milk when they bear [23] [24]. For example, in the immediate vicinity of the metallurgical plant (JSC "Argazinskoe"), farm-born calves get 15.8 times more nickel, 32 times more iron and 17.8 times more lead than the amount that can be used with cow's milk when they bear, which in turn leads to toxicosis and the death of calves has been reported by the Russian Ministry of Health. The negative impact of lead on the quality of dairy products obtained by researchers N.I. Morozova [25] and B.B. Britov [26] admitted in the data obtained from their investigations. The authors note that the amount of lead in the soil of man-made areas was in the range of 2.84 - 4.57 mg/kg, and in the remaining areas it was 2 times less. However, in recent years, data from areas 50 km from the Orenburg-Orsk highway have shown that farmland is particularly rich in lead. If lead storage was not detected in the soils of a number of districts of the Orenburg region surveyed in the 1960 s, there is now a tendency for all farms to increase the amount of lead element [27]. Based on data from the research of G.N. Veyzenenand the others [28] according to the classical chain of food products derived from livestock: soil-plant (food)-animal-livestock products, people stressed the need to conduct an examination in all areas every 5 - 10 years, recommended every year if it would be necessary. The above authors have also identified the possible storage parameters of heavy metals in livestock products. Comparing the maximum levels of lead in milk and beef, it was noted that meat has the highest percentage (3.6 times) of its content in meat [15] [29].

Based on the results of toxic-environmental studies conducted on livestock facilities in different regions of Russia, the concentrations of lead and cadmium that can be used are 5.0 and 0.3, respectively, their concentration ranges from 5.61 to 6.19 mg/kg, from 25% to 37% of the studied samples and ranged from 0.53 to 0.76 mg/kg [30].

3. Results and Discussions

In general, heavy metals are naturally present in the earth's crust and participate in certain physiological processes in living organisms. But if the amount of heavy metals in the body exceeds the permissible percentage, it can harm the body and even lead to death. The accumulation of heavy metals in the body is caused by heavy metal pollution of the environment. The reason is that heavy metals in the environment enter the body through water, air, and products grown in soil and cause various physiological processes in the body to be disturbed. The main part of them accumulates in the kidneys, liver, bones, testicles and has a negative effect on their activity. Also, salts of heavy metals cause a decrease in erythrocytes in the blood of animals and cause anemia, and also reduce their medical resistance. In addition, heavy metals accumulate in fat tissues, muscles, and sometimes in animal milk, causing a decrease in the quality of food products. At a time when the world's population is increasing day by day, providing ecologically clean and high-quality food products is one of the urgent problems. As can be seen from the above data, heavy metal salts accumulate in the environment based on industrial waste, agricultural herbicides and insecticides, mining and vehicle waste, and enter the food chain. Therefore, it is of great practical importance to study the biotoxicological properties of heavy metals and to develop measures to reduce their toxic effects on the body.

4. Conclusion

An assessment of the health of animals in chemically and radioactively active areas showed a significant concentration (5 - 10 times higher) of zinc, aluminium, manganese, copper, cadmium, lead, and fluoride than the established norm. In addition, it was observed that the organs and tissues of animals in the most unfavourable ecological zones exceeded the allowable level of 5 to 7 elements at a time. Similar results were obtained for the concentration of elements in plants. But it should be noted that it did not go beyond the norm of usable amount.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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