

CADMIUM LEVEL IN SOIL, COARSE FODDER, ORGANS AND TISSUE OF CATTLE WEST SIBERIA

Valeriy L. Petukhov¹, A.I. Syso^{1,2}, K.N. Narozhnykh¹, T.V. Konovalova¹, O.S. Korotkevich¹, O.I. Sebeztko¹, E.V. Kamaldinov¹, L.V. Osadchuk^{1,3}, V.A. Soloshenko^{1,4}, M.A. Myadelets^{1,2}, T.V. Skiba^{1,5}, A.R. Tsygankova^{1,5}, A.I. Saprykin^{1,5}

¹*Novosibirsk State Agrarian University, Novosibirsk, Russia*

²*Institute of Soil Science and Agrochemistry SB RAS*

³*The Federal Research Center Institute of Cytology and Genetics SB RAS*

⁴*Siberian Federal Scientific Center of Agro-Bio Technologies of the RAS*

⁵*Nikolaev Institute of Inorganic Chemistry SB RAS*

vpetukhov@ngs.ru

Keywords: cadmium; soil; coarse fodder; cattle breeds, animal organs and tissues

Introduction

Cadmium is one of the most toxic elements affected human and animals health. It is known that cadmium taken with food is absorbed between 5 and 12% depending on animal species. Comprehensive studies on heavy metals accumulation in soils, plants, organs and tissues of different animal species are conducted in Siberia [1]. It was found the increased accumulation of heavy metals in soils, plants and animals only in some Siberian regions [2]. To produce high-quality healthy food products it is necessary to provide the information about heavy metals pollution, in other words, to organize ecological monitoring of the different Siberian regions.

Methods

In our study we analyzed the cadmium content in 84 samples of soil and coarse fodder (cereal-legume grass hay), tissues and organs of 30 Black and White (zone 1) as well as 30 Hereford bulls (zone 2) aged 18 months in two Novosibirsk regions. 360 samples of muscles, heart, liver, kidneys, spleen and lungs were taken from these breeds. The Cd contents in soils and fodders were determined by the method of atomic absorption spectrometry using a fiery (a mixture of acetylene-air) and electro-thermal variations using atomic absorption spectrometer AAnalyst400 from PerkinElmer. The Cd level in organs and tissues was determined by the method of atomic absorption spectrometry using Zhimadzu AA-7000 spectrometer (Japan).

Results

The Cd contents in the leached chernozemic soils of Novosibirsk region was significantly lower than the maximum allowable concentration (MAC). The Cd level in coarse fodder in the region was below MAC (0.3 ppm). The cadmium is accumulated mainly in the kidneys of Black, White and Hereford cattle within the following limits: 0.120 and 0.202 ppm. The Cd level in liver, muscle, spleen, lung and myocard

of Black and White cattle was determined to be between 0.0220-0.0025 ppm. Its level varied in the range 0.048-0.007 ppm in animals of Hereford breed.

Table 1. Cadmium content (ppm) in soils and coarse fodders of Novosibirsk region.

Sample	n	Mean ± SD(Novosibirsk region)	n	Mean ± SD		
				(Zone 1)	(Zone 2)	
Soil	85	0.10±0.03	21	0.11 ± 0.03	64	0.10 ± 0.03
Coarse	84	0.20±0.07	21	0.18 ± 0.09	63	0.20 ± 0.06

Table 2. Cadmium content (ppm) in cattle organs and tissues.

	Black and White cattle		Hereford cattle	
	Mean ± SD	Range	Mean ± SD	Range
Kidney	0.120±0.083	0.020±0.32	0.202±0.212	0.010±0.730
Hepar	0.022±0.007	0.009±0.034	0,040±0,011	0.024±0.062
Muscles	0.018±0.008	0.009±0.036	0,023±0,018	0.001±0.67
Spleen	0.0056±0.0049	0.0008±0.0180	0,046±0,043	0.002±0.150
Lung	0.0039±0.0013	0.0020±0.0068	0,048±0,044	0.004±0.160
Myocard	0.0025±0.0002	0.0010±0.0051	0,007±0,004	0.0007±0.0150

The average Cd level in different soils types in Novosibirsk and other Siberian regions was found to vary in the range of 0.1-0.4 ppm that was significantly below the MAC (from 0.5-2.0 ppm). In coarse fodder (hay grasses and legumes) from different parts of Siberia the Cd level was between 0.1-0.2 ppm in respect to MAC (0.3 ppm). Consequently our investigation provides evidence that the Cd contents are within normal values in Siberian soil and fodder. Our experiments reveal also that the most Cd accumulation was observed in kidneys of dairy and meat cattle breeds, and was below the MAC (0.3 ppm). The least amount of this element was observed in the myocard of the cattle breeds studied. It is important to emphasize that the element concentration was ten times lower than MAC.

Conclusion

We have succeeded in determining the Cd levels in soils, fodders, organs and tissues in the milk and meat cattle breeds. Our results highlight that the cadmium level in all type of samples was significantly below the MACs that makes sure production of healthy food for people in West Siberia. A significance of our results is that the element levels established in cattle organs and tissues update information on the ecological norms for Cd in the environment of Siberia.

This study was supported by Russian Science Foundation grant No. 15-16-30003.

References

- Chysyma, R.B., Bakhtina, Y.Y., Petukhov, V.L., Korotkova, G.N. and Kochneva, M.L. (2003) Heavy metal concentration in water and soil of different ecological areas of Tyva Republic. *J. Phys. IV France 107; XII International Conference on Heavy Metals in the Environment*. DOI: 10.1051/jp 4: 20030229, 301-302.
- Chysyma, R.B., Petukhov, V.L., Kuzmina, E.E., Barinov, E.Y., Dukhanov, Yu.A. and Korotkova, G.N. (2003) The content of heavy metals in feeds of the Tyva Republic *J. Phys. IV France 107: XII International Conference on Heavy Metals in the Environment*. DOI: 10.1051/jp 4: 20030229, 297-299.