CADMIUM PRESENCE IN AGRICULTURAL SOILS FROM IASI METROPOLITAN AREA

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Abstract

The work is part of an extensive study, conducted over two years, which followed the main monitoring mechanisms and relationships involved in the trophic chain soil-plant-animal in an determined area, and continuing with the determination of quality indices of agro-livestock production, as it is known that for agricultural products, food value and quality are assessed by the content of nutrients. Food security depends on the efforts of each partaker in the food chain, from farmer to consumer. The first step is the manufacturer's control, maintaining standard requiring specific methods and techniques with adequate supervision, which verifies food quality, provenience and processing technology used for obtaining it. This paper presents results of the cadmium content in agricultural soils from two locations neighboring Iasi, forage crops area belonging to the Research Station for Cattle Growth Dancu and SC "Daniela" SRL Răducăneni-Iasi. It is widely recognized accumulation of cadmium in the environment due to activities of non-ferrous metal industries and the burning of fossil fuels. Due to the high bioavailability of Cd to plants, plants absorb easily translocated metal in soils containing 2-15 ppm Cd. The present study focused on the determination of cadmium in the first level from the trophic chain - soil, Cd accumulation over limits has a harmful effect in animal nutrition. For both sites, cadmium concentration exceeded the maximum permissible ground level but not the alert value of 3.0 mg / kg^{-1}. This is why the study undertaken, the research starts cadmium concentration in soil, taking into discussion two adjacent areas of Iasi, where are areas with a potential risk of exceeding the permissible limits, forage crops being influenced from industrial emissions.

Key words: cadmium, soil, forage

Heavy metals - Cu, Cd, Zn, Pb, Cr, Co, Ni, Mn, Fe – known as trace elements due to its low content in plants and soil, are chemical elements common to all soils (Budoi, Gh., 2001). Their level of abundance is between the percentages (%) and parts per million (ppm). In some cases, their concentration in soil exceeds the maximum concentration range where the effect is beneficial, causing disturbances of nutrition and thus inhibiting normal processes of growth and development of plants. The negative effect of heavy metals depends on their concentration and a series of physical and chemical properties that define soil such as: organic matter content, texture, reaction, redox potential (Davidescu Velicia., Davidescu D, 1999).

Determination of cadmium in the soil and maintaining its normal limits, thus preventing uncontrolled translocation in plant crops, which can be harmful in high concentrations and can be taken by the consumer as food or as forage by animal. Blood concentration of Cd (human body) is 0.5 µg/100 ml and the process of removing it from the body is extremely slow. Ingestion of food containing heavy metals increase their concentration in tissue and occurs a series of metabolic dysfunction.

This is why the undertaken study, starts with cadmium concentration in soil research, taking into discussion two adjacent areas of Iasi, where forage crops quality are influenced by industrial emissions, areas with a potential risk of exceeding the permissible limits.

In blood, concentration of Cd is extremely low and stays low even if there is an excessive intake. Besides, Cd disappears rapidly from the blood which limits the diagnose of this parameter value. Human blood concentration is 0,5 Cd µg/100 ml, in urine from 2-22 µg /l, and may grow by more than 20 times for exposed persons. A maximum concentration of Cd is situated in renal cortex and testicular tissue. When you manage its concentration changes the Cd oral biopsy and its concentration in the kidneys, liver, hair and nails satisfactorily reflect exposure to Cd as opposed to the bone tissue, muscle and nervous systems that are protected against the original excess of Cd.

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Cadmium can be absorbed in significant quantities and accumulated in different tissues and organs: heart, blood vessels, liver, kidneys, digestive tube, lungs, pancreas, bone marrow. Large quantities of cadmium are found in the blood (fixed by erythrocytes). In the muscle is small content, but enough to be dangerous to humans as durable. It induces proteinuria - the presence of excess proteins in the urine. Removal of cadmium from the animal takes place mainly through the feces and urine, bile and therefore less milk. Disposal from human body is extremely slow, about 20 years, fact that determine its increase in tissues as well as several metabolic dysfunctions.

MATERIAL AND METHOD

The research took place at the Research Station for Cattle Dancu that the administrative point of view is on land of the commune Holboca territory and on municipality of Iasi, in wich main soil types are chernozems, with typical subtypes, bills of exchange and argic, prevailing subtype classically cambic chernozem, mezocalcaric poorly degraded and into sheep farm Raducaneni, SC. Daniela Ltd. Raducaneni-Iasi dominated by an aluviosol gleyic, salt pelic, proxicalcaric, clay loamy / clay lutoasa, evolved on a gleisol cenic. Soil samples were collected from the upper horizon (0-20 cm) of agricultural land in two locations, Dancu (6 samples) and Raducaneni (7 samples).

Sampling of soil, the most important operation, harvesting was done on plots with agrochemical probe, the depth of 0-20 cm. Each composite sample of soil samples consisted of 25 to 30 part, in the best area of land cultivated with some crops. Area that has been a mixed sample ranged from 2-5 ha to field crops and pastures and hay fields 5-20 ha depending on the relief.

Samples were dried in oven for 3 hours at 105 ° C, then brought to a grain size ≤ 0.02 mm.

Disaggregation of soil samples for cadmium determination: treatment with perchloric acid concentrated and nitric acid concentrated, in two stages, on a sand bath with 400-450 ° C temperature. The solutions were brought into 100 ml volumetric flask with nitric acid 2%. In each flask was added, 10 ml CsCl 1% concentration, before being brought to the 100 ml volume. Cadmium has been determined through several methods:

Determination by atomic absorption spectrometry with flame ionization (ASA-FL). Camera: ASA-FL spectrometer Vario 6.0 monoelement lamp. Flame: acetylene / air. Wavelength: 283.30 nm. The lamp current intensity: 3.00 mA. Acetylene flow: 65 L / hour. The stoichiometric C / O flame: 0.13. Flame height: 9 mm. Nebulizer: 1.3. Ionization buffer: 0.1% CsCl. Interference: Cu (216.5 nm), Fe (216.7 nm) We (216.6 nm), Sb (217.6 nm), Pt (216.5 nm). (2 samples average)

*Determination by X-ray fluorescence spectrometry Camera: X-ray fluorescence spectrometer Epsilon 5 model. Standard working conditions after the device's technical manual. (an average sample)

*UV-VIS Spectrophotometric determination. Device: UV-VIS spectrophotometer model MPM 1500, quartz cuvettes with 1 cm thick. Dithizone method, extraction in chloroform. Spectro Dithizone method, extraction in chloroform. Spectro at 500 nm (an average sample).

RESULTS AND DISCUSSIONS

After performing the analysis, the cadmium concentration values were exposed in tab. 1 and 2.

Table 1

Cadmium content in soil, in Dancu and Raducaneni area (µg/g)

No	Area	No. Labora-tory test	Cd (µg/g)				
			AAS	AAS	XRF	UV-VIS	Average
1	Raducaneni (Corn of Beslegii)	AV-1	2.4980	2.7020	3.0474	2.1058	2.5883
2	Raducaneni (Ostrov 1)	AV-2	2.6023	2.4809	2.7116	2.3093	2.5260
3	Raducaneni (Canal 2)	AV-3	2.2884	2.0002	2.6022	2.4077	2.3246
4	Raducaneni(after Pompa)	AV-4	2.6362	2.4775	2.5007	2.7123	2.5817
5	Raducaneni (after Pompa)	AV-5	2.4944	2.5896	2.5568	2.6624	2.5758
6	Raducaneni (Ostrov 2)	AV-6	2.8273	2.6842	2.8388	2.7537	2.7760
7	Raducaneni (Canal 2)	AV-7	2.1514	2.0364	2.0616	2.2073	2.1142
1	Dancu (Sole Aron Voda I)	AV-8	1.8889	1.7755	2.0035	1.9295	1.899402
2	Dancu (sole Chirita)	AV-9	1.9721	1.8577	1.8633	2.0619	1.938778
3	Dancu(sole Securitate I)	AV-10	1.8805	1.9373	1.7309	2.0628	1.902921
4	Dancu(sole Aron Voda II)	AV-11	2.15912	2.2015	2.1094	2.2531	2.180817
5	Dancu (sole Bazin)	AV-12	1.987774	1.8993	2.1145	2.1026	2.026064
6	Dancu(sole Securitate II)	AV-13	2.0220	1.8805	2.0502	2.1180	2.0177

Table 2

Specifications

Specifications	Cd
Average deviation	0,1402
Standard deviation (mean square error)	0,2178
Dispersion selection	0,1338
Mean squared error of the mean selection	0,1061

Average Average deviation: $$\bar{d} = \frac{\sum_{i=1}^{n} \left| X_i - \overline{X} \right|}{n}$$

Standard deviation (mean square error): $$s = \sqrt{\frac{\sum_{i=1}^{n} \left(X_i - \overline{X} \right)^2}{n-1}}$$

Dispersion selection : $$s^2 = \frac{\sum_{i=1}^{n} \left(X_i - \overline{X} \right)^2}{n-1}$$

Mean squared error of the mean selection: $$S_{\overline{X}} = \frac{s}{\sqrt{n}}$$

Maximum permissible values in cadmium concentration in soil, through which major changes occur over plant growth and development, established by Kloke (1980) are used in different countries, including our country. (*fig. 1*). Maximum permissible values for cadmium is 1 mg·kg^{-1}
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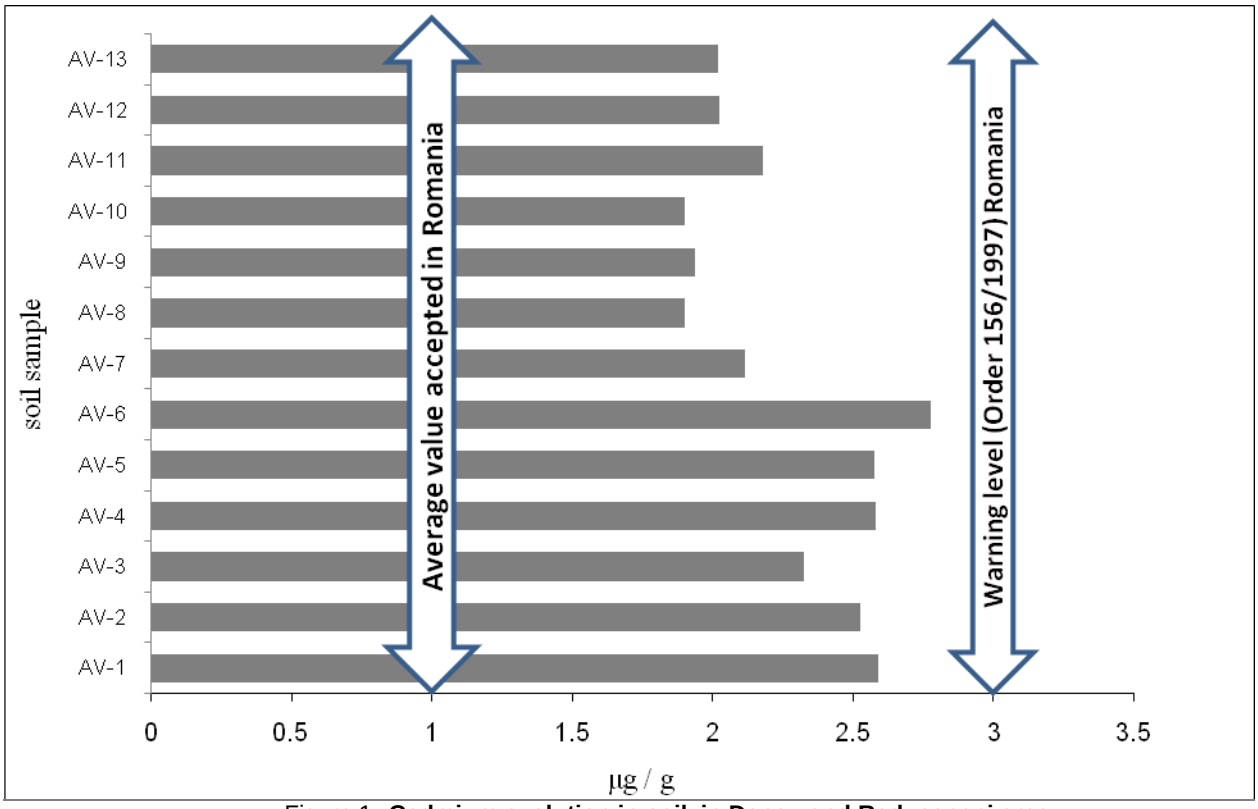

Figure 1 **Cadmium evolution in soil, in Dancu and Raducaneni area**

According to this value, is found that in Raducaneni location for all sampling points are significant overruns values, respectively 0.8994 and 1.1808 for AV8 and AV4 sample. For location Dancu, overtaking from the maximum permissible values are also larger and ranges from 1.1142 to 2.7760 for sample AV7 until AV6.

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It is worth noting that for both locations, the values of cadmium content in soil do not exceed the alert level is 3.0 mg • kg-1 (*Fig. 1*)

CONCLUSIONS

Cadmium is a potentially toxic metal, high cumulative and accumulate in the environment, mainly due to the activities of non-ferrous metal industries and the burning of fossil fuels.

In the Raducaneni area cadmium concentration ranged inside 2.1142 µg/g and 2.7760 µg/g and in the Dancu, the concentration ranged from 1.8994 µg/g and 2.1808 µg/g. For both sites is not exceeded the alert level of 3.0 mg • kg^{-1}.

These values give us the right to affirm that fodder plants growing in these areas, acquired and stored over the limits cadmium that is placed in normal insurance state of soil and there is the real danger to be ingested by feeding the animals which induce multiple malfunctions.

Enrich the soil with Cd over the normal range may be due to various factors: anthropogenic pollution caused by industry, fertilizer use in agriculture, the upward movement in soils due to repeated precipitancy (Dumitru M., et al.,1994).

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