

STUDY CONCERNING CADMIUM AND LEAD CONTENT IN SOME MUSHROOMS AND VEGETABLE SPECIES FROM COMMERCIAL AREA

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Abstract

In this paper was determined Cd and Pb content of some mushrooms, vegetables and fruits available in commercial area through atomic absorption spectrometry technique. Regarding the Cd concentration determined, the detection limit was slightly exceeded in the case of a single sample of mushrooms, but significant differences were observed in the case of apricots and capsicum. Lead levels of all of the Champignon samples taken from different locations, at different moments of time, were above the detection limit. The analysis of the same pollutant in the case of vegetables led to results close to the maximum allowed by the current legislation. Thus, capsicum, tomatoes, zucchini, green beans and potatoes have been characterized by Pb content higher than 0.08 mg/kg. Lead content of cauliflower and cabbage was about half from the maximum admissible concentration. Excepting the apricots, a similar situation has been established for fruits, their lead levels ranging from 0.065 to 0.087 mg / kg.

Considering the fact that fruits and vegetables are a major share of food that it is consumed fresh, and lead was found in some samples in relative greatest concentrations, effective measures should be taken by the competent bodies in order to reduce the level of this pollutant.

Keywords: mushrooms, vegetables, cadmium content, lead content, absorption spectrometry technique

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1. INTRODUCTION

Food quality and safety are major issues of current industry, food and nutrition are very important issues in any society with significant consequences from economic, social and environmental point of view (<http://www.romalimenta.ro/press.php#semn11>). A proper diet, however, involves the performance of other essential conditions: consumed products should be free of harmful agents or they can be found below harmful limits (Banu et al., 2005).

On the whole food chain there is the possibility that the food products to become potentially harmful to people through contamination with microorganisms or other organisms, or its pollution with chemicals (Banu et al., 2005).

Environment (air, water, soil), where the raw materials are obtained can be a source of food contamination with chemicals such as heavy metals (lead, cadmium).

Heavy metals are an important part of the substances with an anthropogenic origin,

substances which pollute soil and in line with the international system of stress index for biological systems it is ranked on second place after pesticide (Delian, 1997).

Heavy metal toxicity is the result of their binding to the enzyme systems, important in animal cell or certain components of cell membranes.

Living organisms are suffering directly or indirectly due to increased pollution of the living environment. Thus, the issue of environmental protection requires a thorough study of the influence of different types of pollution on living organisms (Delian, 1997).

In terms of origin, lead in the environment, is present primarily in the soil (Apostol and Stihi, 2007).

Lead is emitted into the atmosphere during the combustion of leaded fuels, manufacture of lead acid batteries, lead ore shred, condensation of gas from smelting lead, solid waste, soil erosion and deposits containing lead, etc.

Lead is very harmful reducing resistance to infection, attacks the nervous system and decreases the ability of blood oxygen by hemoglobin irreversibly transformed. It has synergy with nitrogen oxides (Banu, Preda and Vasu, 1982).

Lead pollutes the atmosphere more than all other metals. Penetration of anthropogenic Pb in the atmosphere is much higher than natural (Apostol and Stih, 2007).

A serious threat is air pollution by cadmium. The major sources of pollution in this case are ferrous metallurgy, coal (38%), burning oil (12%) etc. (Apostol and Stih, 2007).

Heavy metals from the soil surface down to the basement, through processes of diffusion, absorption, dissolution and stripping with water or microorganisms. They are converted to soluble or suspended in water, thus reaching plant roots. Accumulations are selective and vary according to species and soil pH of the solution (Țuțianu, 2006). Following experimental research, it was shown that under similar conditions of culture, plants differ in the amount of toxic metals collected or accumulated (Commission Regulation (EC) No. 629/2008).

Heavy metals are dangerous because they tend to be bio accumulated (Savu and Georgescu, 2004). Health effects of lead are most severe: drastically reduced life expectancy; appear irritability, fatigue, headache, joint disorder occur, kidney, nervous disorders, digestive (Banu et al. 2007).

Regarding cadmium, it affects kidney function (increased excretion of glucose, amino acids, uric acid, protein), liver (increased gluconogenesis leading to hyperglycemia), prostate (atrophy occurs) and adrenal glands (hypertrophy occurs).

Also, cadmium increase circulating epinephrine and norepinephrine and dopamine levels in the brain. It is considered that this element has hypertensive effects, teratogenic and carcinogenic (Banu et al. 2007).

2. MATERIALS AND METHODS

The research was conducted using vegetables from the family *Cucurbitaceae* (zucchini, cucumber, capsicum), *Solanaceae* (eggplant, tomato, potatoes), family *Cruciferae* (cabbage, cauliflower), *Umbelliferae* family (carrot), family *Fabaceae* (green beans, green peas).

Agaricus mushrooms harvested species are known as the "champignon." Were analyzed also mushrooms of the genus *Pleuretus*. Samples 2 and 6 from figure 1 were taken from SC CDER INTEREX SA – Târgoviște, samples 3 and 4 from SC REWE ROMANIA SCS – Târgoviște, sample 5 from PF CRISTEA CORNELIA ȘI ANDREI – Buciumeni, and sample 8 from SC DISTRANG SRL – Buzău. In figure 2. samples 2 and 5 were taken from SC CDER INTEREX SA – Târgoviște, samples 3 and 4 from SC REWE ROMANIA SCS – Târgoviște, and sample 6 from DC DISTRANG SRL – Buzău.

The sample of eggplants from figure 3 and figure 5 were taken from SC CDER INTEREX SA – Târgoviște (sample 6 for figure 3, respectively sample 4 in figure 5), SC PODARU PROD SRL – Târgoviște (sample 7 in figure 3, and sample 2 in figure 5) and SC KAUFAND ROMANIA SCS – Târgoviște (sample 8 and sample 3). Fruits collected belong to the family *Rosaceae* (apricots, peaches, apples, pears), *Vitaceae* family (grape), *Rubus* family (raspberry). Sample 7 from figure 8 was taken from SC RADUCANU PROD COM SRL- Târgoviște, and sample 8 from SC MINIMAX DISCOUNT SRL- Târgoviște.

Samples were representative and were collected according to the Regulation EC 333/2007 - laying down the procedures for sampling and analysis for official control of levels of lead, cadmium, mercury, tin in food.

To determine the heavy metals occurs first the samples calcining at 450⁰C with a gradual increase in temperature, following the dissolution of ash in hydrochloric acid and evaporation to dryness the solution obtained. Then there is made another dissolution of the final residue in nitric acid (0.1 mol / l) and the

determination of metals with a flame atomic absorption spectrophotometer (SR EN 14082:2003).

The research was carried out using atomic absorption spectrometer GBC Avanta. The calibration curve was drawn from five points - 0.2 / 0.4 / 0.6 / 0.8 / 1 mg / l for Pb and 0.1 / 0.3 / 0.5 / 0.7 / 1 mg / l for Cd, and correlation coefficients were enrolled between 0.9990 and 0.9999. Solution absorbance was measured at wavelength $\lambda = 217$ nm and 228.8 nm for Pb and Cd respectively.

The maximum level of heavy metals (lead, cadmium) was established through Commission Regulation (EC) No. 1881/2006 and in accordance with Regulation (EC) No. 629/2008.

3. RESULTS AND DISCUSSION

Figure 1 shows a higher amount of lead contained in the genus *Agaricus bisporus* mushrooms representing 46% from the maximum permissible value. It may be noted that the amount of lead determined in the case of the mushroom hybrid *Pleuretus* is reduced, falling to below the limit of detection. The values obtained are comparable to most hovering below the limit of quantification (0.08 mg / kg).

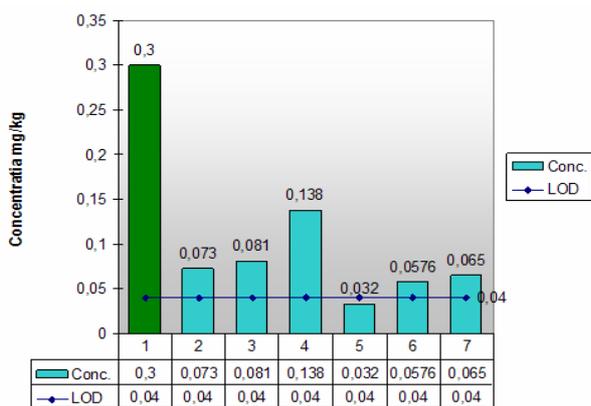


Figure 1. Pb concentration of mushrooms

1. Maximum permissible concentration of Pb in mushrooms
2. Champignon mushrooms
3. Champignon mushrooms
4. Champignon mushrooms, *Agaricus Bisporus*
5. *Pleuretus* P4 hybrid mushrooms

6. Champignon mushrooms
7. Mushrooms culture

According to the Figure 2, the mushrooms had a very low amount of cadmium, all the samples being below the limit of detection.

Following the experimental data obtained can be concluded that the mushrooms "champignon" contains lead, but its level is below the maximum permissible hybrid fungi containing a small amount of lead compared to other varieties.

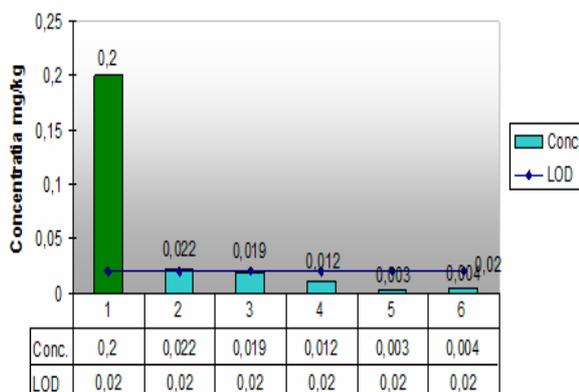


Figure 2. Cd concentration of mushrooms

1. Maximum permissible concentration of Cd in mushrooms
2. Champignon mushrooms
3. Champignon mushrooms
4. Champignon mushrooms, *Agaricus Bisporus*
5. Champignon mushrooms
6. Mushrooms culture

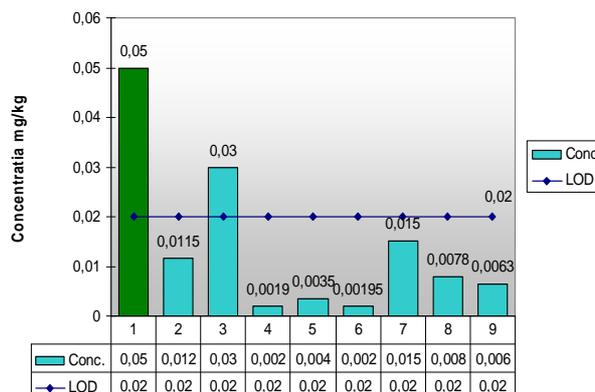


Figure 3. Cd concentration in vegetables and fruit

1. Maximum permissible concentration of Cd for vegetables and fruits
2. Cucumber
3. Capsicum
4. Tomatoes

5. Zucchini
6. Eggplant
7. Eggplant
8. Eggplant
9. Carrot

Analysis of experimental data shows that vegetables contain small amounts of cadmium. From the vegetables analyzed, only capsicum had a higher amount of cadmium (60% of the maximum permitted level), but is hovering below the maximum allowed level, however the amount due is below the limit of quantification.

The amount of cadmium retained by eggplant was below the limit of detection in all three analyzed samples. Tomatoes hold a very small amount of cadmium.

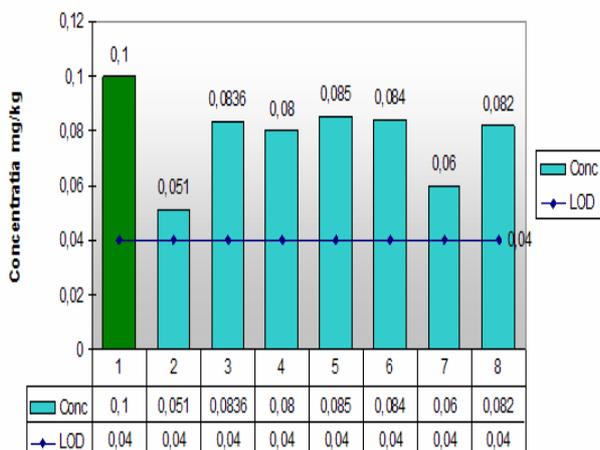


Figure 4. Concentration of Pb in vegetables

1. Maximum permissible concentration of Pb in vegetables
2. Cucumber
3. Capsicum
4. Tomato
5. Zucchini
6. Green beans
7. Green peas
8. Potatoes

As it can be seen, in the vegetables was established a significant amount of Pb, accumulated level being above the limit of detection. The smallest amount gained was recovered in the case of cucumbers and green peas.

Among the vegetables analyzed, capsicum, tomatoes, zucchini, green beans, potatoes were

evidenced by a high content of lead, close to the maximum allowed level. In the zucchini case, the amount of pollutant analyzed was represented 85% from the maximum stipulated level in legislation.

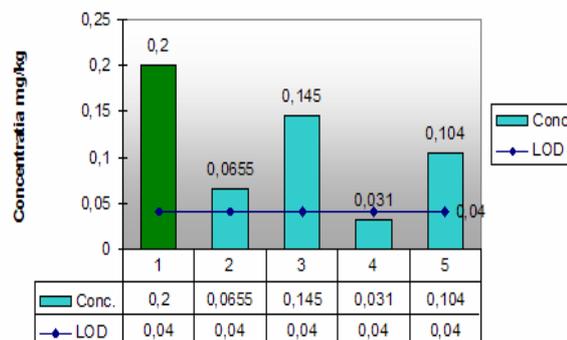


Figure5. Pb concentration in cereals, vegetables and legumes

1. Maximum permissible concentration of Pb in cereals, vegetables and legumes
2. Eggplant
3. Eggplant
4. Eggplant
5. Carrot

In the case of cereals, vegetables and legumes, the maximum permissible level of lead is 0.2 mg/kg. As it can be seen, eggplants were contained a different amount of Pb due to different sources of origin. The highest percentage of lead found in the case of eggplant is 72.5% of the maximum allowed. According to the law in force, the lead content of carrots was by 34.85% from the maximum allowed concentration.

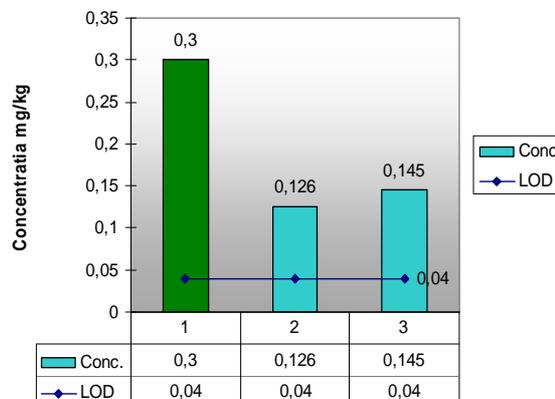


Figure 6. Pb concentration in the Brassica vegetables

1. Maximum permissible concentration of Pb in the plant Brassica

2. Cabbage
3. Cauliflower

If the genus *Brassica* vegetables, the maximum allowed level is higher than in the case of the other vegetables and it can be seen that they accumulate a higher amount of Pb. Cauliflower contains greater quantities of Pb than cabbage, but anyway the determined amount was comparable. Level absorbed both cabbage and cauliflower was situated at about half of the maximum allowed by law (42% and 48.33% from the maximum level for cabbage and cauliflower respectively). In both cases the amounts have exceeded the limit of quantification determined.

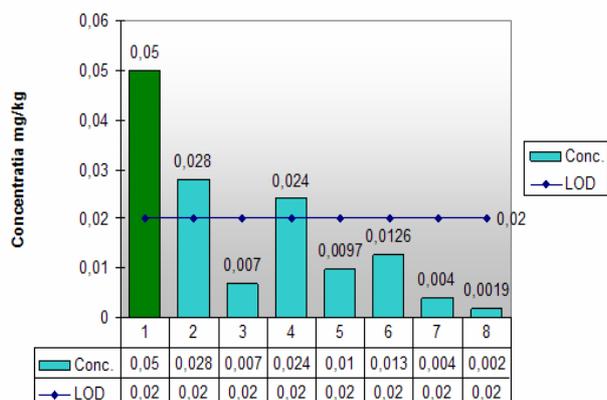


Figure 7. Cd concentration of fruit

1. Maximum permissible concentration of Cd in fruit
2. Apricots
3. Peaches
4. Apples
5. Grapes
6. Pears
7. Golden Delicious apples
8. Idared apples

According to the data presented is obviously that the analyzed fruits contain a small amount of cadmium, excepting Idared apples and apricots, all values being below the limit of detection.

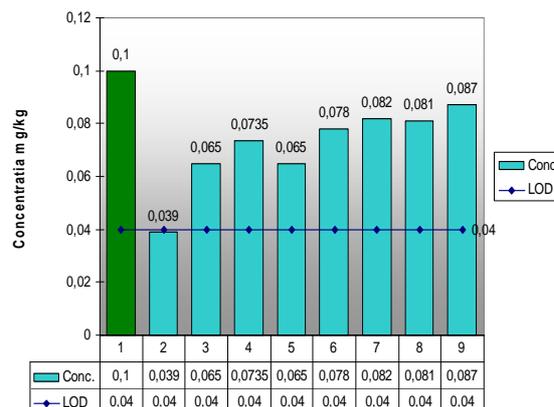


Figure 8. Pb concentration of fruit

1. Maximum permissible concentration of Pb in fruit
2. Apricots
3. Peaches
4. Grapes
5. Raspberry
6. Pears
7. Idared apples
8. Idared apples
9. Golden Delicious apples

According to the Figure 8 it can be seen that the fruit were retained a significant amount of Pb. The lowest Pb concentration obtained from the analysis, the case of apricots, which was below the limit of detection, while the highest was in the case of apples and pears - Idared and Golden Delicious. As percentage lead found in apples - samples 7, 8 and 9, this one was by 81%, 82% and 87% respectively from the maximum permissible value.

4. CONCLUSION

Following the experimental data obtained it can be concluded that both mushrooms, fruits and vegetables are prone to accumulate a larger amount of lead compared to cadmium, possibly due to heavy traffic. It may be noted that mushrooms accumulate Pb, the maximum value found standing at 46% of the maximum permissible, however cadmium is not found in mushrooms. *Pleuretus* hybrid mushrooms did not contain lead. Both tomatoes and zucchini were contained a large amount of Pb (80% and 85% of the maximum permitted), but did not contain cadmium, the values obtained are hovering below the limit of detection. It may be noted that potatoes were contained a

percentage by 82% Pb from the maximum allowed. Referring to the genus *Brassica* vegetables, they retain a larger amount of Pb, the percent was 42% for cabbage and 48.33% for cauliflower from the maximum permitted concentration. The last two graphs analysis was showed that Idared and Golden Delicious apples were characterized through a large amount of lead (81%, 82% and 87% of AML) and that the Cd retained can not be detected. In the case of Apricots, which were highlighted through the highest concentration of Cd between the analyzed products, their Pb content can not be detected.

Given the analysis performed shows that the vegetables subject to analysis, the amount of heavy metals (Pb and Cd) did not exceed the maximum amount allowed in food.

In conclusion, reducing pollution will have to leave the sources of pollution in industrial upgrading, expansion of automation, improve the functioning of existing equipment, qualified workforce, in other words, pollution prevention, and then introducing technical and organizational systems to combat pollution.

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