

ОПРЕДЕЛЯНЕ НА Pb, Cd И Zn В ЗЕЛЕНЧУЦИ В МЕСТОСТ БЛИЗО ДО ВЕЛЕС

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DETERMINATION OF Pb, Cd AND Zn IN THE VEGETABLES IN THE AREA NEAR VELES

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Heavy metals can be turned from land contaminated with heavy metals into plants and their fruits. Different species of plants can have different ability to absorb heavy metals. We conducted an analysis of three vegetables: spinach, parsley and scallions. Vegetables were taken from three different areas of Veles, which is polluted with Pb, Cd and Zn because of thirty year work of the smelter with Pb and Zn. Samples were taken of two contaminated and one non contaminated area. . The results showed that in all types of vegetables from contaminated areas the concentration of Pb, Cd and Zn is several times higher than concentration in non contaminated areas. Scallions contain low concentrations of Pb, Cd and Zn, even in contaminated areas. Analyses were performed by atomic emission spectroscopy with inductively coupled plasma (AES-ICP).

Key words: heavy metals, vegetables, determination, AES-ICP

Introduction

Heavy metals in vegetables are found in very low concentrations that are not life-threatening. However, daily consumption of vegetables containing heavy metals leads to accumulation of heavy metals in certain organs of the human organism. Then they cause disruption of the biochemical balances in humans, causing various mutations, side effects and even death [1]. Major detrimental impacts on the human organism are causing Pb and Cd. Lead can harm every organ, but the most sensitive are central nervous system, kidneys and immune system. Cadmium and its compounds are carcinogenic. Long-term consumption of Cd in high but lethal concentrations cause damage to kidneys, liver, it causes bones and sense of smell thinning. Zinc is an important trace element and its toxicity is low but the introduction of higher concentrations than recommended may cause stomach cramps, nausea and vomiting.

Materials and methods

There are analyzed three types of vegetables:

Vegetables contain higher concentrations of heavy metals if are grown on soils with higher concentrations of heavy metals [2-3]. In Macedonia there are more regions whose soil is contaminated with heavy metals. Veles region is one of these contaminated areas [4]. The reason is thirty year work of the Smelter for Pb and Zn. Today this factory is closed, but soils still contain high concentrations of heavy metals which threw the food chain come to vegetables.

In region of Veles there are areas whose soil is contaminated with heavy metals and it is not suitable for growing vegetables. Bashino Selo and Rechani are near the Smelter and in their soil there are high concentrations of heavy metals, or this soil is contaminated.

Atomic absorption spectroscopy (AAS) and Atomic Emission Spectroscopy (AES) are methods that determine heavy metals in various types of samples [5-9]. The advantage of AES is the simultaneous determination of heavy metals.

spinach, parsley and scallions. It was taken vegetable from three different areas of Veles region: Bashino Selo, Rechani and Ivankovci. In Basino Selo and Rechani soil is contaminated with heavy metals and

Ivankovci is non contaminated control area.

The analysis is performed by the following procedure: 2 to 5 g nicely washed and dried vegetables are flaming 8 hours at a temperature of 450° C. The ash we got was dissolved with 8 mL concentrated HNO₃ and 2 mL H₂O₂. The solution is filtered into weighed flask of 250 mL, we add water and it is weighed.

The determination of heavy metals is carried out by atomic emission spectrometer with inductively coupled plasma - Perkin Elmer Optima 2000. In Table 1 are given wavelengths used for determination of heavy metals. All reagent used are analytical grade purity.

Table 1. Wavelength of determination elements for AES-ICP

Heavy metals	Wavelength (nm)
Pb	220,353
Cd	228,802
Zn	206,200

Results and discussion

From three areas near Veles were analyzed three types of vegetables. Basino Selo and Rechani are contaminated areas which are located in the immediate vicinity of the Smelter and Ivankovci is uncontaminated area which is located away from the Smelter and it was taken as control area.

From Bashino Selo and Ivankovci were taken samples of parsley, spinach and scallions, and from Rechani only parsley and scallions. The

concentration of Pb was highest in contaminated areas like Basino Selo and Rechani, and lowest in non contaminated Ivankovci in all three types of vegetables (Fig. 1). The highest concentration of Pb is measured in spinach from Basino Village- 0,3 mg / kg, from all analyzed samples of vegetables. In parsley as well as in spinach were measured high concentrations of Pb. Parsley from Rechani contains Pb the most and parsley from uncontaminated Ivankovci has the least concentration of Pb. The concentrations of Pb in scallions are low in samples from all three measurement points.

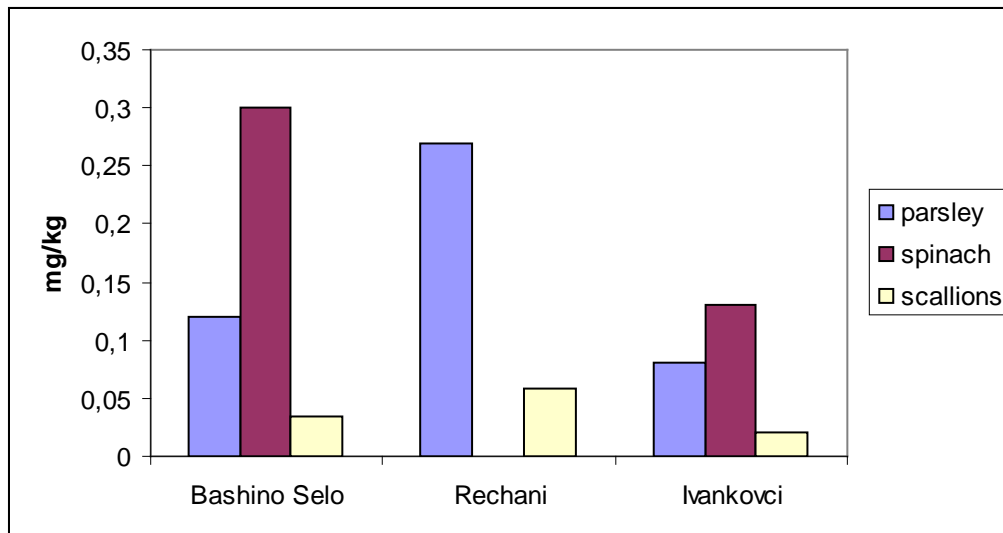


Fig. 1. Pb in vegetable in different areas

The concentration of Cd as well as Pb is highest in spinach (Fig. 2). Samples from Basino Selo and Rechani that were found near the Smelter and whose land is contaminated with heavy metals have a high concentration of Cd compared to samples from Ivankovci where Cd is in very low concentrations in

all three types of vegetables (in parsley from Ivankovci Cd failed to detect).

The concentration of Cd in spinach from Basino Selo is 0,18 mg/kg and it is even 9 times higher than the concentration of spinach from polluted control area Ivankovci. The difference in concentrations of

Cd is even higher in samples from scallions. In scallions from Rechani is measured even 33 times

higher concentration of Cd than in the scallions from Ivankovci.

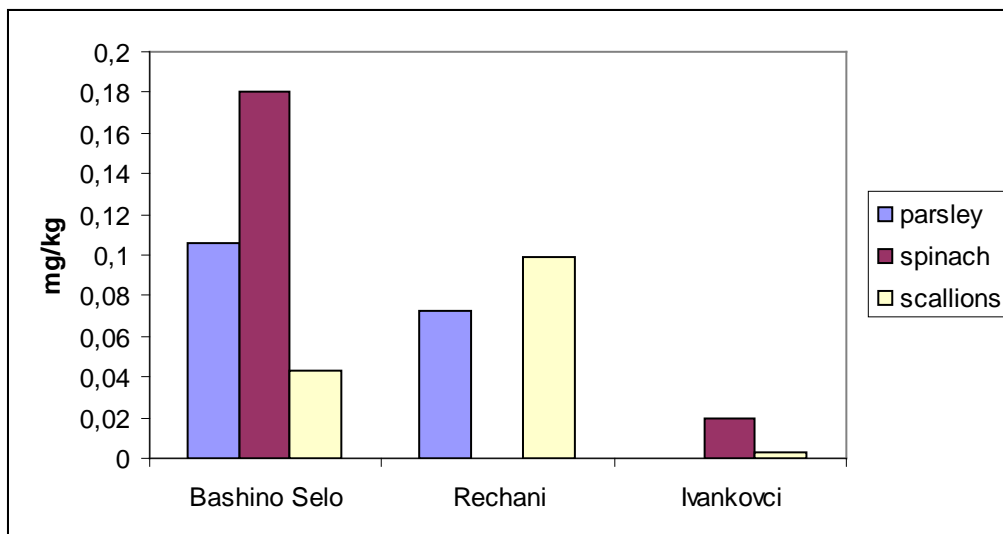


Fig. 2. Cd in vegetables in different areas

The concentration of Zn in the analyzed vegetables is much higher than values obtained for Pb and Cd. Highest concentration of Zn was found in the parsley from Rechani- 11,16 mg/kg, the least in scallions from Ivankovci 0,87 mg/kg (Fig. 3). In any

kind of vegetable, the samples from Ivankovci again have the lowest values for Zn. According to the Regulation on food safety in Republic of Macedonia there is no limit to the concentration of Zn in the vegetables.

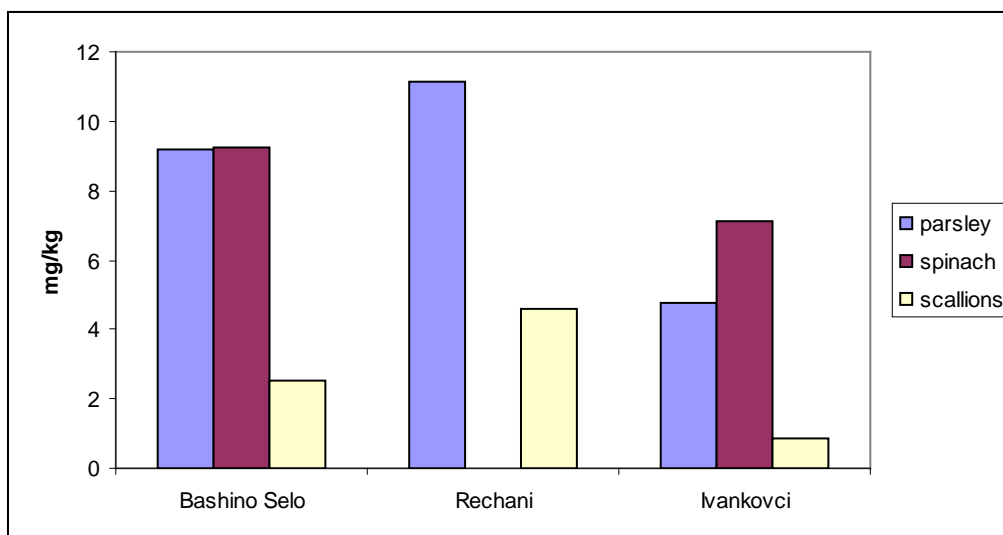


Fig. 3. Zn in vegetables in different areas

Figure 4 is a comparison of the maximum measured and maximum allowable concentrations (MAC) of Pb and Cd in the analyzed vegetables. The maximum values for all vegetables were measured in contaminated areas. In the spinach was the highest measured value for Pb and it is equal to the MAC for Pb in vegetables according to the Regulation for food

safety in Republic of Macedonia. The highest concentration of Cd was measured also in spinach and it is only slightly lower than the MAC. The concentration of Pb and Cd in parsley is also high and close to the MAC. In the scallions were not only measured the lowest concentrations of Pb and Cd, but they are several times lower than the MAC.

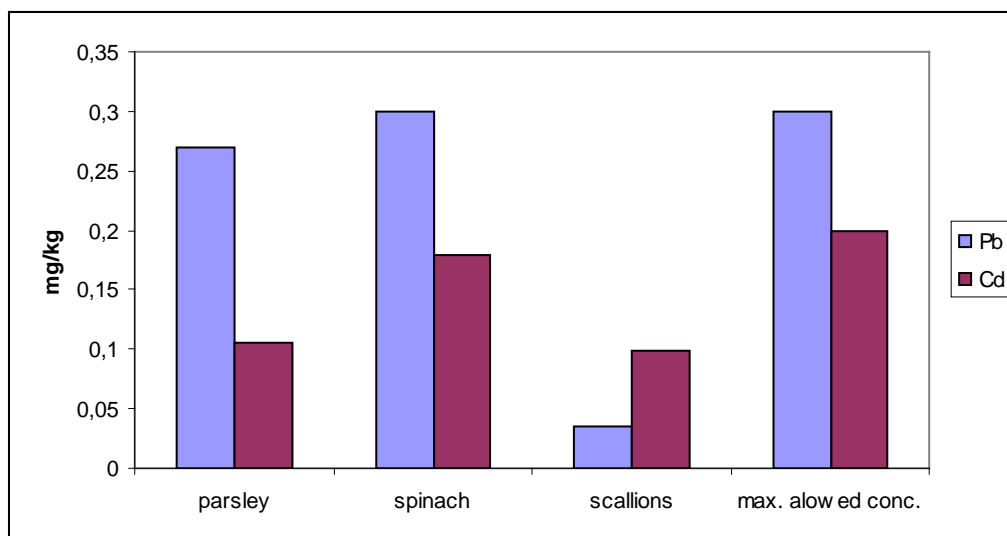


Fig. 4. The maximum measured and maximum allowable concentrations of Pb and Cd in the analyzed vegetables

Conclusion

It was made a determination of heavy metals like Pb, Cd and Zn in spinach, parsley and scallions from three measuring locations near Veles. Two of them (Bashino Selo and Rechani) are located near the Smelter and its soil is contaminated with heavy metals and Ivankovci is located in a great distance from the Smelter and was taken as control, uncontaminated area.

Analyses were performed by AES-ICP. The results show that the presence of heavy metals in the analyzed vegetables is several times higher in samples from contaminated areas Basino Selo and

Rechani than samples Ivankovci which is uncontaminated area. From the tested vegetables, concentration of Pb and Cd was highest in spinach, while the concentration of Zn was highest in parsley. This means that spinach absorbs mostly Pb and Cd from contaminated soils and parsley mostly Zn. The concentration of Pb and Cd in the parsley and spinach from contaminated areas is equal or very close to the MAC. Scallions contain low concentrations of Pb, Cd and Zn, even in contaminated areas. According to the Regulation on food safety the concentration of analyzed metals in the tested samples although are high they did not exceed the maximum allowable concentrations.

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