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DETERMINATION OF CADMIUM IN SOME VEGETABLES PRODUCED IM THE AREA NEAR THE LEAD AND ZINC SMELTING PLANT IN VELES, MACEDONIA

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ABSTRACT

Stafilev, T. and Jordanovska V. (1996). Determination of cadmium in some vegetables produced in the area near the lead and zinc smelting plant in Veles, Macedonia. Ekol. Zast. Zivot. Sred., Vol. 4, No. 1, Skopje.

The occurrence of cadmium in soils samples and some vegetables (onion, lettuce, cabbage, carrot, spinach, gherkin, leek) produced in the area near the lead and zinc smelting plant in Veles city, Macedonia has been presented. The determination of cadmium was performed by atomic absorption spectrometry. The results from the cadmium content in the soil and vegetable samples taken from the different distances of the smelting plant (1, 1.5 and 3 km) are compared. The concentration of cadmium in the soil samples which are near to the Pb-Zn smelter is higher than in the samples which are far-away from the smelter. From the results of the investigations it can be also concluded that the cadmium concentration in vegetable samples depends from the distance of kitchen-gardens from the smelting plant. It was found that the content of cadmium in some leafy vegetables is higher than in the other. It is also found evident differences in the cadmium concentrations in washed and unwashed vegetable samples. In the most of the investigation vegetables the content of cadmium is higher than those permitted by Macedonian government regulations (maximum 0.05 mg/kg).

Keywords: Cadmium, vegetable, soil, determination, lead and zinc plant, contamination

ИЗВОД

Стафидов, Т. и Јордановска, В. (1996). Определување на кадмиум во зеленчуци произведени во околината на топилницата за олово и цинк во Велес, Македонија, Екол. Зашт. Живот, Сред., Том 4, Бр. 1, Скопје.

Во трудот се прикажани резултатите од определувањето на кадмиум во проби од почви и некои видови на зеленчук (кромид, салата, зелка, морков, спанаќ, краставица, праз) произведени во околината на топилницата за олово и цинк во Велес, Македонија. Определувањето на кадмиумот е вршено со атомска апсорпциона спектрометрија. Направена е споредба на резултатите за содржината на кадмиумот во проби од почви и зеленчук земени на различни растојанија од топилницата (1; 1,5 и 3 km).

Клучни зборови: кадмиум, зеленчук, почва, определување, топилница за олово и цинк, контаминација.

INTRODUCTION

The presence of heavy metals in the plants is expected in small quantity. As a result of polluted environment their concentrations can be increased, and metals which are not normally present in the constitution can be found in the plants. One of the most present contaminants is cadmium. The main threat from cadmium is in places near zinc smelters, as cadmium may escape as dust with flue gases. It is known that cadmium is an extremely toxic element. Toxic effect of cadmium arises from its

bending with the active -SH group in enzymes. By this action the normal physiological functions of enzymes are avoided. If cadmium is ingested it accumulates in the kidneys. It causes malfunction of the kidneys and also replaces zinc in some enzymes, thus preventing them from working (Evans et al., 1978). Because of that it is very important to determine the content of cadmium in food.

The survey of the literature has shown that there are many data on cadmium determination in

food It can be seen that usually the methods of flame atomic absorption (AAS) (Feinberg et al., 1980, Brzowska and Zawadzka, 1981, Hsieh et al, 1982, Dellar, 1983) and electrothermal atomic absorption spectrometry (ETAAS) (Dabeka, 1979, Muys, 1984), were used.

In this work the determination of cadmium by AAS in soil, as well as in some vegetables samples, taken from different places near the lead and zinc smelting plant in Titov Veles city, Macedonia has been done

EXPERIMENTA

L Instrumentation

A Perkin-Elmer models 303 and 703 atomic absorption spectrophotometer equipped with a deuterium background corrector, HGA-72 graphite furnace and model 056 strip chart recorder were used. A cadmium hollow cathode lamp was used as a source. Low concentration of cadmium were determined by ETAAS and for higher by flame

AAS. Optimal instrumental conditions for cadmium determination by ETAAS (temperature and time) are: drying: 110 °C, 20 s; charring: 300 °C, 20 s; atomize: 2000 °C, 5 s and cleaning 2700 °C and 3 s. Argon was used as an inner gas. Gas mixture of acetylene and air was used for flame AAS determinations.

Procedure for the cadmium determination in soils

1 g of fine milled soil sample was transferred in a glass beaker and 50 cm³ of acid mixture of HCl and HNO₃ (3+1) were added, A mixture was heated 3-4 hours on a hot plate to obtained a mini-

um volume. Then, 50 cm³ of deionized water were added and the solution was filtered off. The filtrate was collected in a volumetric flask of 100 cm³.

Procedure for the cadmium determination in vegetable samples

10 to 20 g of food samples were put in an Erlenmeyer flask. 20 cm³ of hydrochloric acid solution (2:1, v(HCl)/v(H₂O)) was added, brought to a boil on a hot plate and simmered for 5 minutes.

The solution was cooled, filtered and transferred to a 50 ml volumetric flask and made to volume with deionizer water.

RESULTS AND DISCUSSION

The results from the cadmium determination in soils from three different places (1, 1.5 and 3 km from the smelter) in the Veles area are given in Tab. 1. It can be seen that in the soil samples which are nearer to lead smelting plant, cadmium content is higher than in the samples which are faraway from Pb-Zn smelter. It is obviously that dust

from the lead and zinc smelter influence on the contamination of the soil. From these results it can be concluded that even in the region of 3 km distance from the Pb-Zn smelter the contamination of soil is higher than those permitted by Macedonian government regulations (maximum 2.0 mg/kg).

Tab. 1 Results from the cadmium determination in soil from different distances of the smelting plant (1, 1.5 and 3 km)
Таб. 1 Резултати од определувањето на кадмиум во почви од различна оддалеченост од топилницата.

No.	Distances of the smelter оддалечености од топилницата	Content of cadmium (mg kg ⁻¹) содржина на кадмиум (mg kg ⁻¹)
1	1 km	20.4
2	1.5 km	14.6
3	3 km	13.5

To check the content of cadmium in different type of vegetables produced in these regions near Pb-Zn smelter, are analyzed. From the results

of the investigations (Tab 2) it can be concluded that the cadmium concentration in vegetable samples depends from the distance of kitchen-gar-

dens from the smelter. For example, the content of cadmium in the lettuce taken from the distance of 1.5 km from smelter is 2.4 mg/kg and of 3 km 0.80 mg/kg. It was found that the content of cadmium in some leafy vegetables (lettuce, spinach, parsley) is higher than in the other kinds of vegetable. It is also found evident differences in the cadmium concentrations in washed and unwashed vegetable samples. For example, the content of cadmium in

unwashed sample of dock is 2.70 mg/kg and in washed sample 1.70 mg/kg. In the most of the investigation vegetables (washed or unwashed), such as: lettuce, dock, carrot, spinach, onion, the content of cadmium is higher than permitted value (maximum 0.05 mg/kg). On the other hand, the content of cadmium only in a few samples (cabbage, leek, gherkin) is smaller than permitted value

Tab. 2 Results from the cadmium determination in different vegetable samples taken in the region of Veles

Таб. 2 Резултати од определувањето на кадмиум во различни проби од зеленчук земени во околината нема Велес

Vegetable/зеленчук	Content of Cd/содржина на Cd (mg kg ⁻¹)		
	1 km	2 km	3 km
Onion/кромид			
Unwashed/немиени	0.20	-	0.20
Washed/миени	<0.05	-	0.10
Parsley/магданос			
Unwashed/немиени	0.93	-	2.1
Washed/миени	1.7	-	-
Celery leafs/листови од целер			
Unwashed/немиени	2.4	-	-
Dock/штавел			
Unwashed/немиени	-	2.7	-
Washed/миени	-	1.4	-
Lettuce/марула			
Unwashed/немиени	-	2.4	0.8
Washed/миени	-	1.7	-
Carrot/морков			
Washed/миени	-	0.4	0.1
Carrot leafs/листови од морков			
Unwashed/немиени	-	2.7	2.1
Spinach/спанаќ			
Unwashed/немиени	-	3.2	2.1
Washed/миени	2.0	1.3	-
Cabbage/зелка			
Unwashed/немиени	-	-	<0.05
Washed/миени	-	-	<0.05
Cucumber/краставица			
Washed/немиени	-	-	<0.05
Leek/праз			
Unwashed/немиени	-	-	<0.05
Washed/миени	-	-	<0.05
Meant tea/чај			
Unwashed/немиени	-	-	2.8

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ОПРЕДЕЛУВАЊЕ НА КАДМИУМ ВО ЗЕЛЕНЧУК ПРОИЗВЕДЕН ВО ОКОЛИНАТА НА ТОПИЛНИЦАТА ЗА ОЛОВО И ЦИНК ВО ВЕЛЕС, МАКЕДОНИЈА

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РЕЗИМЕ

Во трудот се прикажани резултатите од определувањето на кадмиум во проби од почви и некои видови на зеленчук (кромид, салата, зелка, морков, спанаќ, краставица, праз), произведени во околината на топилницата за олово и цинк во Велес, Македонија. Определувањето на кадмиумот е вршено со атомска апсорпциона спектрометрија. Направена е споредба на резултатите за содржината на кадмиумот во проби од почви и зеленчук земени на различни растојанија од топилницата (1; 1,5 и 3 km) Утврдено е дека концентрацијата на кадмиумот во пробите од почви земени во близината на топилницата е повисока во однос на онаа во проби земени на поголема оддалеченост. Од добиените резултати може да се заклучи дека концентрацијата на кадмиумот во пробите од зеленчук зависи од оддалеченоста на градините од топилницата. Утврдено е дека содржината на кадмиумот во некои лиснати зеленчуци е повисока отколку во другите видови на зеленчук. Исто така, најдени се забележителни разлики во концентрацијата на кадмиумот во немиени и миени проби од зеленчук. Во повеќето испитувани зеленчуци содржината на кадмиумот е повисока отколку максимално дозволената концентрација за кадмиум според прописите кои важат во Република Македонија ($\max. 0,05 \text{ mg} \cdot \text{kg}^{-1}$).