MONITORING OF METALS ACCUMULATION (CU, CD, FE AND ZN) IN LEAFY VEGETABLES SAMPLED FROM PRIVATE PRODUCERS IN THE WESTERN PART OF ROMANIA

MONITORIZAREA ACUMULARII METALELOR (CU, CD, FE ŞI ZN) ÎN LEGUMELE VERDEŢURI PRELEVATE DE LA PRODUCATORII PARTICULARI DIN PARTEA DE VEST A ROMÂNIEI

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Abstract. *This paper presents the study of different metals accumulation in leaf vegetables, lettuce and spinach under the conditions of western Romania. In the period 2005-2007 were sampled from food markets in Timisoara, lettuce and spinach, in order to determine their metal content. These vegetables come from private producers of Timis county localities: Gelu Jimbolia Dudestii Noi, Sanandrei, Cenad Utvin, Sacalaz, Dinias. Analyses were performed in the Laboratory of Chemistry of USAMVB Timisoara, using a spectrophotometer SpectrAA 220. Cadmium, copper and zinc did not exceed the maximum allowed value in any of spinach and lettuce samples analyzed but shows a lack of zinc and copper. Lead is found in excess, exceeding the maximum permissible limit of 0.5 ppm, but not exceeded the critical concentration of 20 ppm, for lettuce samples from the localities Jimbolia and Utvin. This excess is recorded throughout the period analyzed, 2005-2007. Spinach samples analyzed shows the same trend of higher levels of lead in samples from areas where there are roads with heavy traffic: Topolovat, Jimbolia and Utvin .*

Key words: spinach, lettuce, lead, zinc, copper, cadmium

Rezumat. *În această lucrare este prezentat studiul acumulării diferitelor metale în legumele verdeţuri, salata verde şi spanac, în condiţiile din vestul României. În perioada 2005-2007 au fost prelevate de pe pieţele agroalimentare din Timişoara, salată şi spanac, în scopul de a determina încărcarea cu metale a acestora. Aceste legume provin de la producătorii particulari din localităţile: Gelu, Jimbolia, Dudestii Noi, Sanandrei, Cenad, Utvin, Sacalaz, Dinias. Analizele au fost efectuate în Laboratorul de chimie de la USAMVB Timişoara, cu ajutorul Spectrofotometrului SpectrAA 220. Cadmiul, cuprul şi zincul nu depăşesc limita maximă admisă în nici una dintre probele de spanac sau salata verde analizate insa prezinta un deficit de zinc şi cupru. Plumbul se găseşte în exces, depăşind limita maximă admisă de 0.5 ppm, însă nu este depăşită concentraţia critică de 20 ppm pentru probele de salată din localităţile, Utvin şi Jimbolia. Acest exces se înregistrează pe întreaga perioadă de timp analizată, 2005-2007. Probele de spanac analizate prezinta aceeaşi tendinţă de creştere a nivelului de plumb în cazul probelor provenite din zona în care există drumuri cu trafic intens: Topolovat, Utvin şi Jimbolia..*

Cuvinte cheie: spanac, salată, plumb, zinc, cupru, cadmiu

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INTRODUCTION

Heavy metals, such as cadmium, copper, lead, chromium and mercury, are important environmental pollutants, particularly in areas with high anthropogenic pressure. Their presence in the atmosphere, soil and water, even in traces can cause serious problems to all organisms, and heavy metal bioaccumulation in the food chain especially can be highly dangerous to human health. (Cozma A., 2007). Heavy metals enter the human body mainly through two routes namely: inhalation and ingestion, ingestion being the main route of exposure to these elements in human population (Catana L., 2002). Heavy metals were determined in different concentrations in soil, water, and air, vegetable or animal food, depending on various factors that determine their pollution. Accumulation of heavy metals is associated with a wide range of sources of metals as smaller industries (including the production of batteries, metal objects, the production of cables), emissions from vehicles and particles generated from the highway diesel engines. All this contributes to the accumulation of metals in green vegetables (Beceanu D., 2002). Other sources of metal contamination of vegetable crops, from urban areas and cities province, may be considered the following: irrigation with wastewater, domestic and industrial effluents leading to contamination of soil and plants, pesticides, fungicides and domestic sludge fertilizers applied in excess or in unsafe way (Krishna M., 2001). Metal toxicity is influenced by the solubility of metal and metal compounds. On the other hand revealed a potency synergism between Co and Zn, Co and As, Co and Sn, Zn and As, but an antagonism between these elements and lead. (Woese, K. et al., 2001 **Cadmium** is used in steel alloys in dentistry, colouring the enamelling vessels, etc. Use of fertilizers (with residues of Cd) leads to its accumulation in soil, where plants take it rapidly and migrates in their organs. Rice, wheat accumulates large amounts of cadmium (Rivis A., 2004). **Zinc** has a significant biological role, but in high quantities causes toxic effects. Is use as compound (oxide, sulfide, sulfate, chloride) in industries. Use of insecticides and fungicides based on organic compounds of zinc lead to contamination to food and feed products (Alexa Ersilia, 2008). **Copper** accumulates in roots and cell walls, being transported in the plant and can be eliminated mainly through the leaves (Cumpătă S.D., Beceanu D., 2005).

MATERIAL AND METHOD

During 2005-2007, were sampled spinach and lettuce, from Timisoara agro-food markets, in order to determine their metal content (cooper, zinc, lead and cadmium).

These leafy vegetables come from different localities of Timis county, such as: Gelu, Jimbolia, Dudestii Noi, Sanandrei, Cenad, Utvin, Sacalaz, Dinias. The metal determination was done with the help of *Varian atomic absorption Spectrophotometer SpectrAA 220* in Laboratory of Agro-chemistry of Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara.

Critical and toxic concentration values of studied metals in vegetables are presented in table 1.

Table 1

Critical and toxic concentration of studied metals in vegetables (Kastori R., 1997)

Metal	Critical concentration (μg/g)	Toxic concentration (μg/g)
Cd	5	10
Cu	15	20
Pb	10	20
Zn	150	200

According to Order No. 640 from 19/09/2001, regarding security and quality conditions for vegetables and fresh fruits for human consumption published in Official Monitor no. 173 from 13/03/2002, maximum admitted limits for metals in vegetables and fresh fruits for sale and human consumption, expressed in mg / kg of fresh product are presented in table 2.

Table 2

Maximum limits of arsenic and heavy metals in vegetables and fresh fruits according with Order No. 640 from 19/09/2001

Vegetables	As	Cd	Pb	Zn	Co
Leafy vegetables (lettuce, spinach, cabbage)	-	0,2	0,5	-	5,0

RESULTS AND DISCUSSIONS

The analysis regarding microelements content in lettuce and spinach were done according with SR EN 14082. The obtained results are shown in figures 1-4.

Regarding Cd, Co and Zn content in lettuce samples taken from agro food markets are within the admitted limits of Order No. 640 from 19/09/2001, regarding security and quality conditions for vegetables and fresh fruits for human consumption. Lead was found in excess amounts, which exceed the maximum limit of 0.5 ppm, but not exceeding the critical concentration of 20 ppm for lettuce samples from Utvin and Jimbolia (figure 1). This excess was recorded throughout the time, ie 2005-2007.

Unlike other heavy metals, **lead** is an exclusive toxic element, he having no role in the body. Lead causes the disease called saturnism, is also a cumulative toxic element, lead poisoning causing blackening gums, abdominal pain, nervous system disturbances and digestive tract lesions. Auto emissions are the major source of lead pollution in plants near the road-traffic are register high values. Dust and gases are carried by air currents and eventually deposited on plants, on the ground or surface waters (Ejazul,I., and all.,(2007).

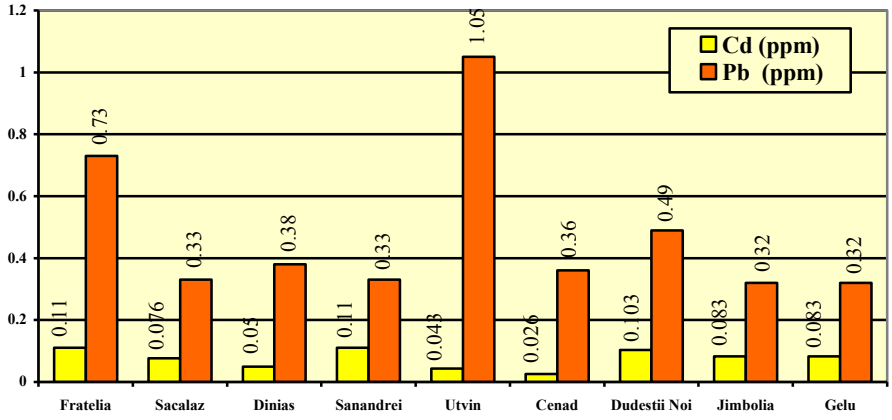

Fig. 1 - Cd and Pb (ppm) content in analysed lettuce samples.

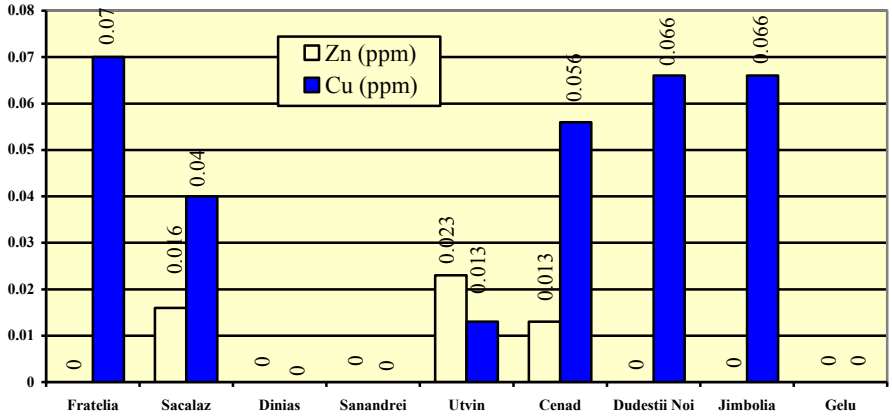

Fig. 2 - Cu and Zn (ppm) content in analysed lettuce samples.

Maximum admitted limit for lead of 0.5 ppm in analyzed lettuce samples was exceeding (figure 1) in samples coming from locations near European and national roads (city Jimbolia and Fratelia) and the area immediately around Timisoara (Utvin is to 5 km from Timisoara) where traffic is very intense and the risk of lead dust deposition on plants, from the exhaust gas is increased.

Double values recorded over the maximum allowable limit in Utvin (***1.12, 1.04, 0.99 ppm)*** (Figure 1) and which was kept at this level during the 3 analyzed years is *a warning signal about the danger caused by lead contamination of lettuce sampled in Timisoara and adjacent area* (Negrea M., (2009). Sag locality situated on European road linking Timisoara to Serbia, with intense road traffic, the values obtained for lead in lettuce samples is approaching maximum allowed limit of 0.50 ppm, but not exceed it, registering (0.37-0.40 ppm). Dudestii Noi lettuce samples also recorded values near to the admissibility limit values (0.45 – 0.52 ppm).

Vegetable plants grown in places less exposed to road traffic, *Ortisoara, Sanandrei, Gelu*, are less likely to be contaminated with lead from the exhaust gases.

Regarding ***copper content*** of analyzed lettuce samples, there is a deficiency compared to the normal level in all analyzed samples (figure 2). *Copper content* does not exceed 0.10 ppm in no one of the studied samples, the normal level of copper in vegetables is up to ***5 mg/kg*** (Ordinul nr. 640 din 19/09/2001). Plants require small amounts of copper, an average content for normal growth is situated between *5-20 mg/kg*. Over this value, copper is considered toxic.

According to previous international studies fresh fruits can contain maximum 0.5 mg/kg As, 0.05 mg/kg Cd, 0.5 mg/kg Pb, 5 mg/kg Zn, 5 mg/kg Cu, and leafy vegetables can contain up to 0.2 mg/kg Cd, 0.5 mg/kg Pb (Gherghi, A. et al., 2001).

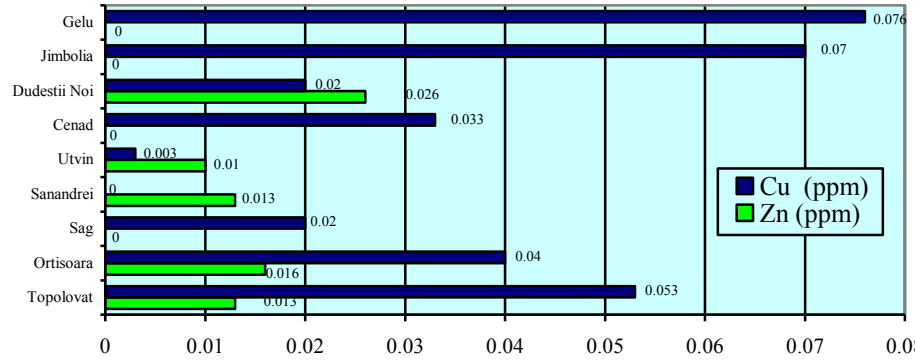

Fig. 3 - Cu and Zn (ppm) content in analyzed spinach samples.

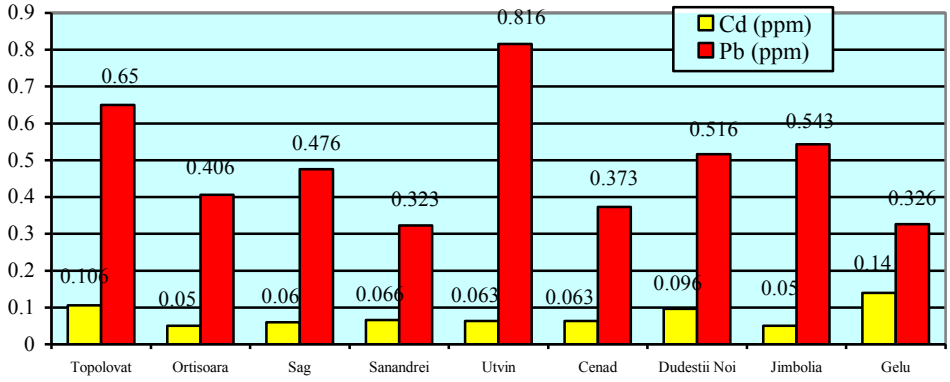

Fig. 4 - Cd and Pb (ppm) content in analyzed spinach samples.

To spinach samples (figure 3) were registered the same trend of increasing levels of lead in samples taken from the area in high traffic roads. Localities where were registered high values of lead, above maximum allowable limit, were: Topolovat, Utvin and Jimbolia, thus demonstrating once again, the negative impact of lead pollution in villages near roads (town Jimbolia and Topolovat) and

the area immediately around Timisoara (city Utvin) where traffic is very intense and the risk of lead dust accumulation from vehicles exhaust gases are high.

The average of lead values of spinach samples coming from the Utvin was 0.816 ppm, exceeding the allowable limit of 0.5 ppm. Moreover, values that exceeded the permissible limit of lead in spinach occurred in samples coming from localities Topolovat 0.65 ppm and Jimbolia 0.543 ppm (figure 4).

CONCLUSIONS

1. Cadmium, copper and zinc did not exceed the maximum admitted limit in none of the spinach and lettuce samples, studied during the 3 years of research. Low content of copper and zinc show a deficiency of these elements in analyzed leafy vegetables.

2. Lead was exceeding the admitted limit in lettuce and spinach in samples coming from localities near national roads with intense traffic (Topolovat, Utvin and Fratelia).

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