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VEGETABLE AND FRUITS QUALITY WITHIN HEAVY METALS POLLUTED AREAS IN ROMANIA

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Abstract: There are, in Romania, three areas, Copşa Mica, Zlatna and Baia Mare, very strongly polluted with heavy metals caused by non-ferrous ores extraction and processing industry performed more than two centuries. Intensifying of these activities, especially in the last part of the twentieth century, most often without environment protection measures, has led to pollution of all environment components, particularly soil.

The soil cover in these three areas is composed of very contrasting soils in terms of origin, physical and chemical properties, fact that leads to a differentiate absorption of heavy metals in edible parts of vegetable and fruits. The soils belonging to these three zones are prevalent acid, with small areas covered by neutral or slight alkaline, oligo-mezo-basic soils. The humus and total nitrogen content level is different. Phosphorous and potassium soil supply is low, up to medium level. Loamy texture is dominant.

The heavy metals total contents in soil take up to 2.3 times (Cd), 1.7 times (Cu) and 2.1 times (Zn) the maximum allowable limits. The mobile forms contents are 4.2 times to 10.5 times higher than maximum allowable limits values. The most part of the cadmium total content in soils (63%) belongs to the soil solution, exchangeable colloidal complex and organic matter. The lead in soil solution and exchangeable colloidal complex represents only 13% from the total content. The most part of the lead is bounding by the organic matter.

In the edible part of the fresh root vegetables (carrots, radish, potatoes) high cadmium and lead contents were recorded, that exceeded up to 2.5 times, respectively 11 times, the maximum allowable limits. In leafy vegetables (lettuce, parsley, dill, orach) were recorded systematic contents of heavy metals higher than the normal, reaching up to 7 times for Cd, or 17 times for Pb higher than normal concentration.

Between content in mobile forms of heavy metals in soils and vegetables were set up direct proportionality, in most cases provided statistically. Systematic consumption of vegetables and fruits polluted with heavy metals by the inhabitants of thus polluted zones is leading to the healthiness state altering and to appearance of some chronically diseases with unpredictable final.

Key words: heavy metals, absorption, accumulation, pollution index, vegetables, fruits.

1. INTRODUCTION

Absorption and accumulation of heavy metals in vegetables and fruits are influenced by many factors, including: concentration of heavy metals in soil, composition and intensity of atmospheric deposition, including precipitations, phase of plant vegetation (Vontsa et al., 1996). To all of these, can be added other sources generated by agricultural technologies such as: irrigation with wastewater, the administration of organic and mineral fertilizers with the load of heavy metals, or application of pesticides, which contain in their structure such chemical elements (Singh et al., 2004; Sharma et al., 2006).

Urban, industrial and household activities, traffic, contribute significantly to increasing the load degree with heavy metals containing particles of inferior atmosphere (Lăcătuşu et al., 2008), from where these particles will settle down on the plants foliage system and soil. Many times, the plants foliage system is represent the edible part of vegetables (lettuce, parsley, dill, lovage etc.). The heavy metals are overtaking in the edible parts of vegetables and fruits by physiological path, either from soil, from leaves surface or with these kinds of chemicals loaded irrigation water.

The intake of heavy metals can lead to altering of humans and animals healthiness state. Thus, the carcinogenic effects generated by continuous consumption of fruits and vegetables loaded with heavy metals such as Cd, Pb or even Cu and Zn are known. There are already published works related to the incidence of gastrointestinal cancer (Trichopoulos, 1997; Turkdogan et al., 2002), and cancer of the pancreas, urinary bladder or prostate (Waalkes & Rehm, 1994). There are, in Romania, three areas (Copşa Mică - Sibiu County, Zlatna – Alba County and Baia Mare – Maramures County) very strongly polluted with heavy metals, caused by nonferrous ores extraction and metallurgical processing.

The contents of Cd, Cu, Pb and Zn in the soils around these localities are up to sometime higher than the maximum allowable limits. As a result, the plants, inclusive vegetables, accumulated high quantities of such chemical elements.

The paper presents some results concerning the relationships soil-plant in these areas and absorption of heavy metals in edible part of vegetables and fruits.

2. MATERIAL AND METHODS

Soil, vegetables and fruits samples from vegetables gardens within the areas influenced by emissions loaded with heavy metals, were collected. The soil samples collected from the 0-20 cm depth of the A horizon, were been analyzed from point of view of general chemical properties as pH, organic carbon, total exchangeable basis, mobile forms of phosphorous and potassium and total and mobile forms of heavy metals (Cd, Cu, Pb and Zn).

The soil reaction (pH values) carried out by potentiometric method in aqueous suspension, using a double glass-calomel electrode. Soil organic carbon and humus content were analyzed by the procedures of Walkley-Black method, modified by Gogoasa, and the total nitrogen content by the Kjeldahl method. Mobile forms of phosphorus and potassium carried out by spectrophotometry, respectively flame spectrometry, in acetate-lactate ammonium solution (AL) at 3.7 pH, by Egner-Riehm-Domingo method. The degree of bases saturation was calculated using the exchangeable bases sum values (carried out by Kappen method) and hydrolytic acidity values (carried out by titration of the extract realized with CH_3COONa 1n solution, with NaOH 0.05n). The total content of heavy metals (Cd, Cu, Pb and Zn) was measured with flame atomic absorption spectrometer in hydrochloric solution resulted by digestion of soil samples in $HClO_4$-HNO_3 mixture. The mobile forms of these chemical elements were been extracted with EDTA-CH_3COONH_4 solution at pH=7.0 (Lăcătuşu et al., 1987). The heavy metals fractions bounded by soil components determination were made through successive extractions (Lăcătuşu & Kovacsovics method, 1994). The heavy metals content in edible parts of vegetables (lettuce, dill, parsley, orach, onion, tomatoes, cucumber, carrots, radish, and potatoes) carried out in hydrochloric solution resulted by plant ash solubilization. The vegetables and fruits sampled from the investigated zones inhabitant's gardens were washed before being placed in analytical cycle. The leafy vegetables (lettuce, parsley, dill, orach and onion) were analyzed in the dry samples, and the tomatoes, cucumber, root vegetables (carrots, radish, potatoes) and fruits samples in the fresh state. The fruits (cherry, apples and pears) were collected and analyzed in the first part of the summer, when cherries were only at maturity.

Analytical data were statistical processed, computing the values of the grouping centre (arithmetic mean, geometric mean, median) and the spreading parameters (minimum, maximum, standard deviation and variation coefficient). According to the contamination/pollution index (Lăcătuşu, 1998), the interpretation of soil contamination or pollution with heavy metals level has been carried out.

3. RESULTS AND DISCUSSIONS

3.1. The main physical and chemical soils properties

The soil cover of the three areas investigated is relatively different (Tab. 1). If the Baia Mare zone acid soils predominate, with pH values varying between 4.36 and 6.30, the other two zones, Copşa Mică and Zlatna, besides acid soils appearing soils with neutral reaction, even slight alkaline. The maximum value of pH value recorded was for a Eutric Regosols located in Copşa Mică. The few higher values of pH may be due to soil amendment and limestone applying into the soil by landowner.

Contrasting values recorded for the organic carbon, respectively humus, and the total nitrogen. They are due both to natural level content, and to the anthropic inputs, as consequence of the organic and mineral fertilization of the soils of the vegetable gardens.

In terms of textures as variable, from sandy-loam to loam clay, practically humus and total nitrogen contents vary in a wide range, from the very low content at very high. Instead, the mobile phosphorus and potassium contents vary only in small content domain, the highest values touching only the medium supply level.

The same turnover values are met for the degree of base saturation. These are characterize the oligobasic soils (V<40%), up to the eubasic soils (V=91-100%), the prevalent being the oligo-mezo-basic soils (V=40-70%).

Therefore, in the areas investigated are predominantly acidic soils, with smaller surfaces neutral or alkaline, heterogeneous supplied with humus and total nitrogen, low medium supplied with phosphorus and potassium, predominantly oligo-mezo-basic. The prevalent texture is loamy in the Copşa Mică and Zlatna zones, and silty loam up to medium loam in the Baia Mare zone (Tab 1).

Table 1. Main physical and chemical properties of soil (A horizon) in the vegetable gardens within areas influenced by emissions from metallurgical factories in the Copşa Mică, Zlatna and Baia Mare cities

Soil type (FAO/ UNESCO)	pH_{H_2O}	Corg. x1.72	N total	P (AL)	K (AL)	V	Textural class*
		(%)		$mg_x kg^{-1}$		(%)	
Copşa Mica							
Eutric Regosol	7.62-8.10	1.83-3.20	0.10-0.16	3-20	126-218	43-70	ML
Luvic Phaeozem	5.27-6.03	1.94-3.27	0.09-3.27	5-16	95-170	40-63	CSL
Zlatna							
Luvic Phaeozem	4.53-5.87	2.21-3.60	0.10-0.20	7-20	90-125	30-71	ML
Eutric Cambisol	5.17-7.07	1.70-2.83	0.10-0.18	8-21	110-213	53-87	MSL-CSL
Eutric Fluvisol	5.80-7.80	2.65-4.16	0.16-0.27	11-24	106-140	70-100	MSL-LC
Baia Mare							
Albic Luvisol	4.36-6.30	4.36-6.30	0.08-0.13	5-17	70-159	30-60	SSL-ML
Haplic Luvisol	4.53-4.92	1.50-4.30	0.09-0.19	6-15	76-170	40-52	SL
Luvic Phaeozem	4.70-5.69	1.70-3.69	0.10-0.21	10-27	110-187	19-49	SSL-SL

*SSL-silty loam; SL-silty loam; CSL-clay sandy loam; MSL-medium sandy loam; ML-medium loam; LC-loam clay

3.2. The heavy metals abundance in the investigated soils

Statistical parameters of the total and mobile heavy metals contents in the A horizon of the vegetable cultivated soils, in three investigated zones are shown in Table 2. If comparing the medium values of analyzed parameters with the maximum allowable limits values we could observe that these limits are exceeding for Cd only in the Copşa

Mică zone, for Cu only in the Zlatna soils, and for Pb and Zn in all three zones. These exceeding are reaching 2.3 times for Cd, 1.7 times for Cu, 2.6 times for Pb and 2.1 times for Zn. In almost all investigated soils, for the heavy metals mobile forms case, are recorded values that exceed the maximum allowable limits. These are reaching maximum of 4.2 times for Cd (Copşa Mică), 1.5 times for Cu (Zlatna), 7.2 times for Pb (Copşa Mică) and 4.5 times for Zn (Zlatna). If the values of Baia Mare have never reached the reminded limits, they, without exception, are the high values of content (Tab. 2).

Table 2. Statistical parameters of total (t) and mobile (m) contents of heavy metals (Cd, Cu, Pb, Zn; mg kg^{-1}) in A horizon of soil under vegetables within the areas affected by emissions from the metallurgical factories in the Copşa Mică (1), Zlatna (2) and Baia Mare (3) cities

Parameter	**Cd**						**Cu**					
	1		**2**		**3**		**1**		**2**		**3**	
	t	**m**	**t**	**m**	**t**	**m**	**t**	**m**	**t**	**m**	**t**	**m**
Xmin	4.50	2.02	0.51	0.24	0.30	0.14	25	10	50	12	21	14
Xmax	12.00	6.14	14.20	6.75	4.10	2.85	140	44	1100	189	120	72
X	6.95	4.19	1.90	0.72	1.96	1.11	74	27	173	84	59	47
σ	2.51	1.00	1.54	0.50	1.01	0.90	40	10	150	32	24	23
Xg	5.36	3.07	1.47	0.78	1.54	1.30	53	20	110	73	51	31
Me	5.29	4.04	1.31	0.69	1.40	1.27	44	16	105	61	42	26
MAL*	3.00	1.00					100	8				
NC**	0.00						20					
Parameter	**Pb**						**Zn**					
	1		**2**		**3**		**1**		**2**		**3**	
	t	**m**	**t**	**m**	**t**	**m**	**t**	**m**	**t**	**m**	**t**	**m**
Xmin	40	21	37	19	44	16	207	39	149	27	74	19
Xmax	493	303	450	285	277	129	1931	436	2210	412	727	219
X	194	129	261	114	150	89	623	194	374	132	293	111
σ	123	112	194	73	93	61	480	136	211	110	149	73
Xg	154	107	220	98	131	78	529	180	195	119	238	97
Me	120	93	193	92	120	73	497	165	183	107	221	91
MAL*	100	18					300	43				
NC**	15						50					

*Maximum allowable limits for total content (Kloke, 1980), for mobile form (Davidescu et al., 1988); **Normal content (Fiedler & Rösler 1988)

3.3. The fractions of Cd and Pb total content

The percentage repartition of the total Cd content fractions recorded in A horizons of the investigated soils (Fig. 1) shows that most part of the total cadmium content belongs to soil solution and to potential soluble fraction linked to colloidal complex and organic matter. These percentages represent 64% (Copşa Mică), 59% (Zlatna) and 66% (Baia

Mare). On average, for all soils, 21% is related to cadmium bounded by ferric and manganese oxides, and 16% the residual cadmium, from the crystalline structure of soil minerals.

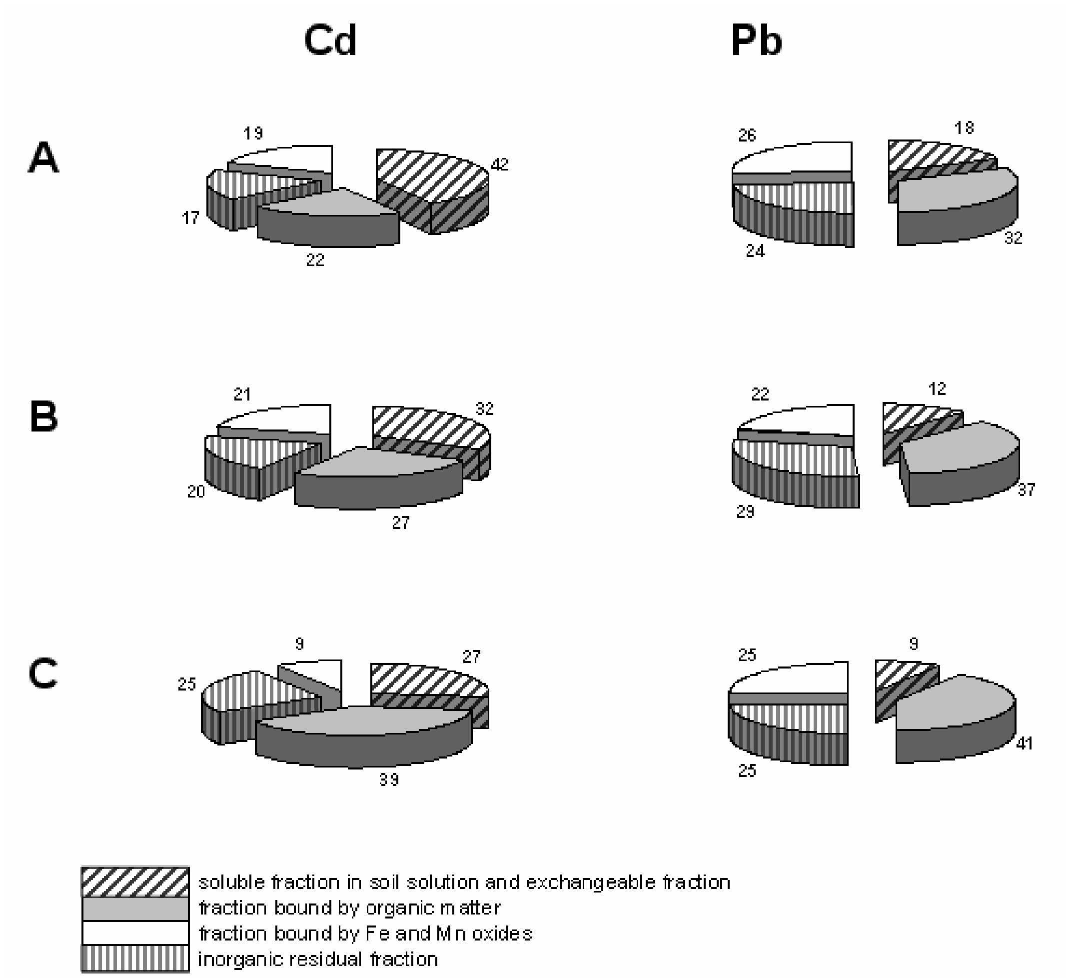

Figure 1. Separated Cd and Pb fractions in soils polluted with heavy metals within the Copşa Mică (A), Zlatna (B) and Baia Mare (C)

In the case of lead picture is a little different, in the sense that lead content in the soil solution and exchangeable fraction is lower than in the case of cadmium. Thus, in soils from Baia Mare only 9% from total cadmium belongs to the soil solution and exchangeable fraction. Instead, the maximum total Pb content from Copşa Mică soils, 18%, belongs to this first fraction. As matter of fact, the lead is bounding by organic matter, much more than cadmium. Actually, the lead is preferential bounding by ferric and manganese oxides and minerals crystalline lattice (Fig. 1). But, if consider the absolute values, we could observe that Pb abundance is superior than those of Cd. Above all of these, we have to taking count of higher mobility and toxicity of cadmium as compare with lead.

The data presented in table 3 clearly reveal the prevalence of cadmium to the lead in the soluble fraction, in soils solution and in the exchangeable fraction, and vice-versa, the prevalence of lead in the other fractions: organic matter, ferric and manganese oxides, and the inorganic residual fraction.

Table 3. Medium percentage repartition of the total Cd and Pb content fractions in the investigated zones soils; Cd : Pb ratio

Fraction nature	**Cd**	**Pb**	**Cd : Pb**
Soluble fraction in soil solution and exchangeable fraction	34	13	2.61
Organic matter bounded fraction	29	37	0.78
Ferric and manganese oxides bounded fraction	21	26	0.81
Inorganic residual fraction	16	24	0.66

But, if consider the absolute values, we could observe that Pb abundance is superior than those of Cd. Above all of these, we have to taking count of higher mobility and toxicity of cadmium as compare with lead.

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3.4. The soils pollution level

Computing the values of contamination/pollution index, which takes into account the total heavy metal content in the soil sample, but also two other significant characteristic of the soil: content of organic matter and clay content (Lăcătuşu, 1988), for all three investigated zones we obtained the average levels of soil pollution (Tab. 4).

The cadmium pollution is at medium to high level in Copşa Mică, low in Zlatna and low to medium in Baia Mare. The maximum soil pollution recorded for copper was in Zlatna, for lead in Copşa Mică and Baia Mare, and for zinc in Baia Mare.

Although, all the four chemical elements are present al pollution level in all investigated soils, the cadmium pollution is specific to Copşa Mică zone, the copper pollution to Zlatna zone, and those with zinc to Baia Mare zone.

Table 4. Heavy metals polluted level of soils, established according with contamination pollution index values (Lăcătuşu, 1988)

Investigated area	Cd	Cu	Pb	Zn
COPŞA MICA	m* - l*	l	m – h*	m
ZLATNA	l	m	m	m
BAIA MARE	l - m	l - m	m - h	m - h

*l=low; m=medium; h=high

3.5. The heavy metals accumulation in vegetables and fruits

Heavy metals contents in vegetables and fruits analytical data are presented as medium values in figures 2-9.

3.5.1. Heavy metals absorption in fresh vegetables

Comparison of the medium values of the heavy metals contents in the edible parts of five types of vegetable with the maximum allowable limits for Cd and Pb (Ewers, 1992) reveals the exceeding of these limits in the majority of samples. Exceptions are contents of cadmium in tomatoes and cucumber (Fig. 2, 3). At the root vegetables, especially carrots and radish, maximum allowable limits of Cd was competed by up to 2.5 times. Maximum values were recorded in carrots and radish collected from Baia Mare.

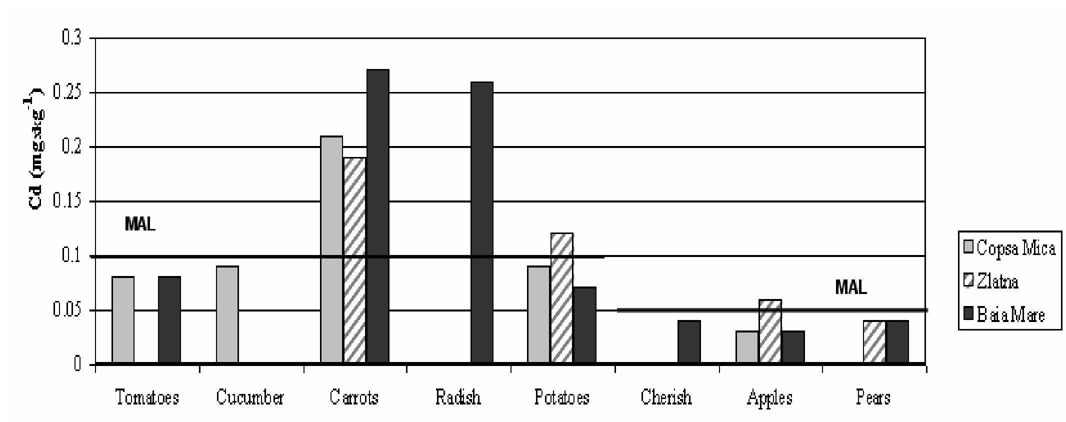

Figure 2. Medium cadmium content in edible parts of some fresh vegetables (n=76) and fruits (n=32) collected from Copşa Mică, Zlatna and Baia Mare areas, as comparing with maximum allowable limits* (MAL)

*Maximum allowable limits: 0,1 $mg \cdot kg^{-1}$ for fresh vegetable, and 0,05 mg kg^{-1} for fruits (Ewers, 1992)

In the case of potatoes was registered a small exceeding, but only to the tubers collected from Zlatna. In contrast with cadmium, in almost all samples the lead content exceeded the maximum allowable limits, except tomatoes (Fig. 3).

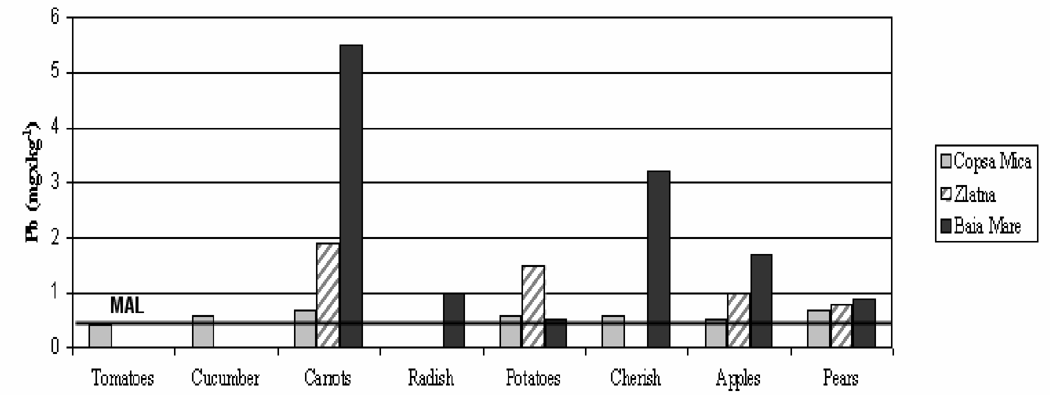

Figure 3. Medium lead content in edible parts of some fresh vegetables (n=76) and fruits (n=32) collected from Copşa Mică, Zlatna and Baia Mare areas, as comparing with maximum allowable limits*(MAL) *see figure 2a

Are remarkable the high Pb contents of carrots roots collected from Baia Mare, 11 times higher than the maximum allowable limits values, and almost 4 times in samples of carrots collected from Zlatna. It remarked the content of Pb in radish cultivated in Baia Mare gardens that exceeding two times the maximum allowable limit. In the case of vegetables collected in the area Copşa Mică, the contents of Pb exceeded the least amount of the maximum allowable limit.

Other two analyzed elements, copper and zinc, could be considering both heavy metals and nutrients, according to their physiological role and content in plant. For these heavy metals, we could not establish certain values for maximum allowable limits (Fig. 4, 5). However, it may notice some variation in the root vegetables, which culminates with the amount of 4, 4 mg kg^{-1} Cu, recorded in the radish collected from Baia Mare. A similar image offering also the case of Zn, in which the maximum value 30 mg kg^{-1} was registered in radish cultivated at Baia Mare.

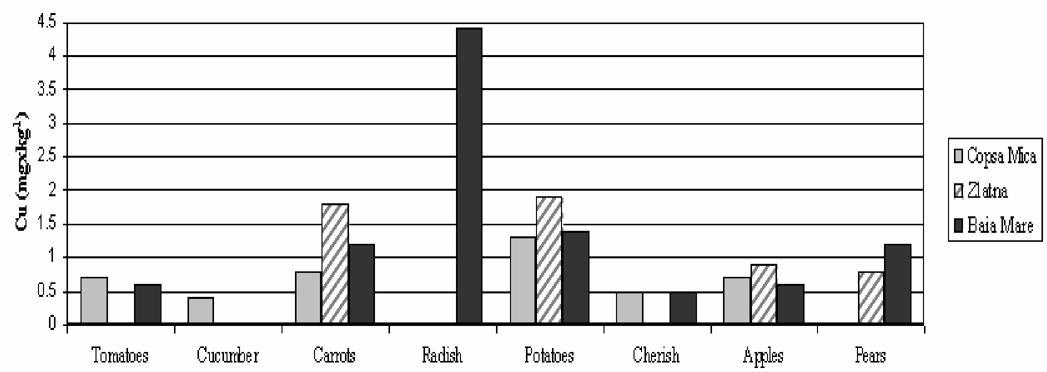

Figure 4. Medium copper content in edible parts of some fresh vegetables (n=76) and fruits (n=32) collected from Copşa Mică, Zlatna and Baia Mare areas

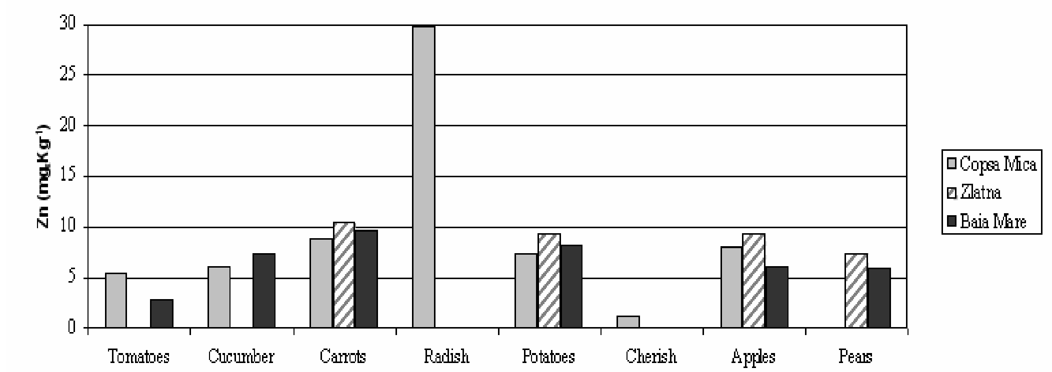

Fig. 5. Medium zinc content in edible parts of some fresh vegetables (n=76) and fruits (n=32) collected from Copşa Mică, Zlatna and Baia Mare areas

3.5.2. Heavy metals absorption in fruits

Unlike vegetables, the accumulation of heavy metals in fruit is low because a large proportion of heavy metals absorbed by trees is stored in other organs, especially in leaves. Air depositions are mostly removed by washing.

Analytical data reveals a heavy metals accumulation in the fruits in some measure (Fig. 2, 4, 5). Not only in the case of lead (Fig. 3) could talking about a heavy metal accumulation in fruits up to levels superior to the maximum allowable limits. This exceeding has no large amplitude, excepting the cherry and apples collected from Baia Mare, where the medium content was by 6.4 times higher for Cd and 3.6 times for Pb as comparing with maximum allowable limit. It is possible that in apples and pears fruits collected and analyzed at maturity to find much higher heavy metals quantities to significant exceed maximum allowable limits for Cd and Pb.

The Cu and Zn content in fruits varies between certain limits, at a location to another, but into a normal content domain according with values published by Voiculescu et al. (2006).

3.5.3. Heavy metals absorption in the leafy vegetables

The average content of heavy metals in leaves of lettuce, parsley, dill, orach and onion were reported to normal contents of these elements in plants (Fig. 6, 7, 8, 9).

With few exceptions, represented by Cu, Pb and Zn in onion leaves whose values are below the limit that marks the normal content, the heavy metals values recorded in all the other investigated plants are superior to levels considered normal concentration.

Lettuce leaves accumulated all four studied heavy metals. Thus, the Cd accumulation in plants collected from Copşa Mică zone, was at more than seven times higher than normal level. Very impressive is lead accumulation in lettuce cultivated at Baia Mare, its content values exceeding up to 50 times the normal level. Cadmium and copper contents recorded in dill leaves collected from Copşa Mică zone, were 10 times, 8 times higher respectively, than normal content level. In parsley leaves collected from Baia Mare, the lead concentration was more than 6 times higher than normal value. The Cd, Pb and Zn are concentrated in the orach collected from Baia Mare with values by 4 times, 6 times, respectively 4 times higher compared to normal content.

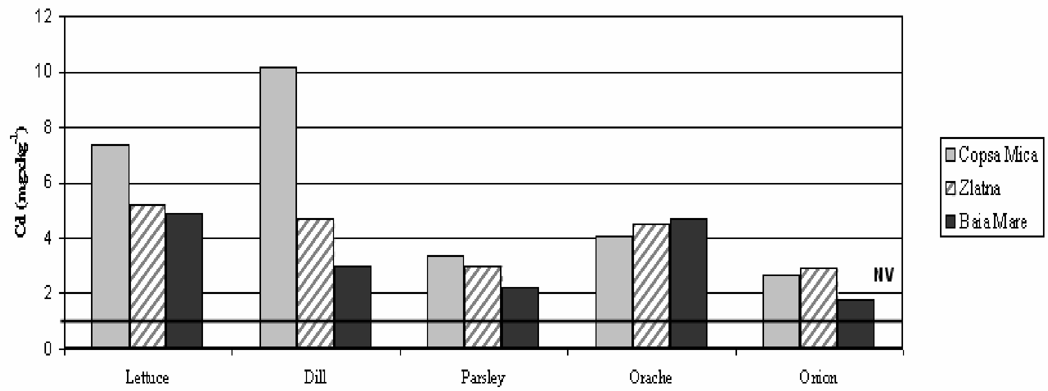

Fig. 6. Medium cadmium content in edible parts of some dry vegetables (n=87) collected from Copşa Mică, Zlatna and Baia Mare areas, as comparing with normal values*(NV)
*Normal values for dry vegetables (leaves) :< 1mg kg^{-1} (Fritz et al., 1977)

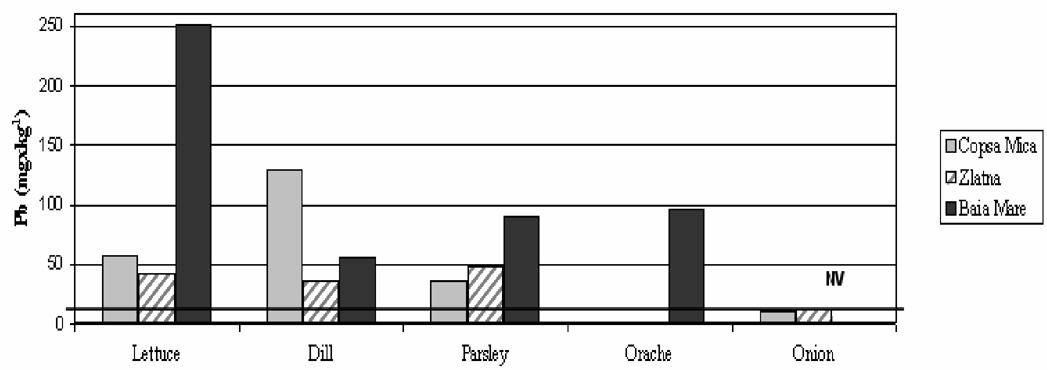

Figure 7. Medium lead content in edible parts of some dry vegetables (n=87) collected from Copşa Mică, Zlatna and Baia Mare areas, as comparing with normal values (NV)*
*Normal values: 5-10 mg kg^{-1} dry matter (Fritz et al., 1977)

3.6. Relationships between soil heavy metals content and the edible part of vegetables

Between the heavy metals mobile forms content from A horizon (0-20cm) of soils used for vegetable cultivation, and the edible part of plants, direct proportionality relationships were set up (Tab. 5).

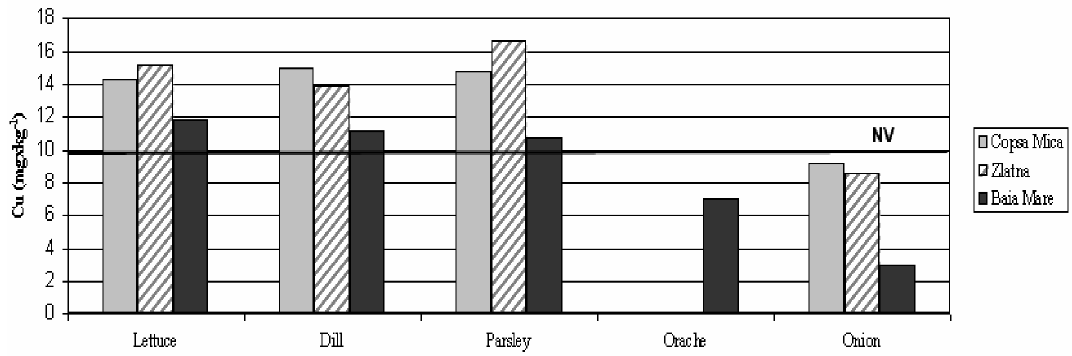

Figure 8. Medium copper content in edible parts of some dry vegetables (n=87) collected from Copşa Mică, Zlatna and Baia Mare areas, as comparing with normal values*(NV)

*Normal values for dry vegetables (leaves) :< 5mg kg^{-1} (Fritz et al., 1977)

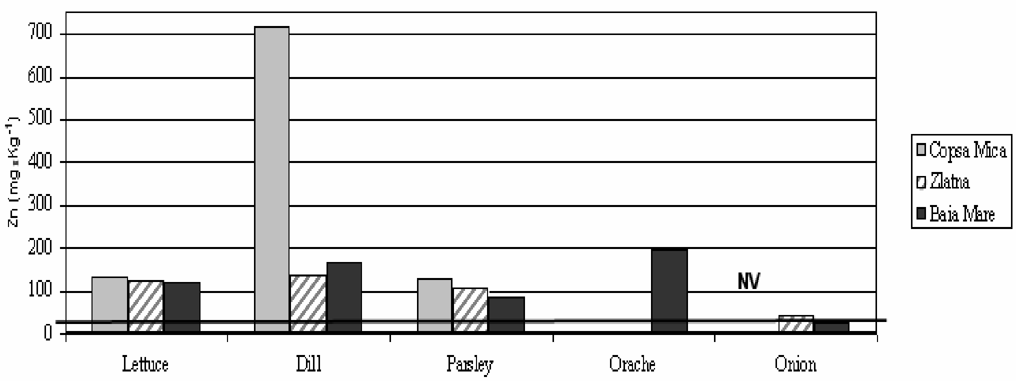

Figure 9. Medium zinc content in edible parts of some dry vegetables (n=87) collected from Copşa Mica, Zlatna and Baia Mare areas, as comparing with normal values*(NV)

*Normal values for dry matter: 20-50mg kg^{-1} (Fritz et al., 1977)

The values of correlation coefficients ***(r)*** oscillate in a large range, from 0,395 for Zn at Zlatna to 0,904 for Pb, in the same area. If comparing the ***r*** critical values for the 5% signification level, finding out only three values specific for soil-plant relationships that are insignificant, in case of Cu and Zn at Zlatna, and Cd at Baia Mare. However, even these values are closely to significant level. Are remarkable the high values of specific correlation coefficients, for the lead in soil – plant system at Copşa Mică and Baia Mare, and for cadmium at Zlatna, and even Copşa Mică. Accordingly, in all three investigated zones, the abundance of the heavy metals mobile forms in soils cultivated with vegetables having expression in plants, in the edible part inclusive.

Table 5. Correlation coefficients between heavy metals contents in soil and in edible part of vegetables

Area	Cd	Cu	Pb	Zn
	r	***r***	***r***	***r***
Copşa Mica	0.745	0.542	0.893	0.684
Zlatna	0.812	0.412	0.724	0.395
Baia Mare	0.623	0.619	0.904	0.776
F 5%	***0.653***	***0.509***	***0.693***	***0.660***

4. CONCLUSIONS

In areas polluted by the Copşa Mică, Zlatna and Baia Mare, soils planted with vegetables are predominantly acidic, with small areas neutral or slight alkaline, oligo-mezo-basic. Investigated soils are diverse supplied with humus and total nitrogen, with content from low to medium phosphorus and potassium mobile. Prevalent texture in A horizon is loamy in Copşa Mică and Zlatna zones, and silty loam up to medium loam in the Baia Mare region.

The medium values of total and mobile heavy metals content (Cd, Cu, Pb, Zn), in most samples, exceed the maximum allowable limits. This outruns are up to 2.3 times (Cd), 1.7 times (Cu), 2.6 times (Pb) and 2.1 times (Zn) for the total content, and 4.2 times (Cd), 10.5 times (Cu), 7.2 times (Pb) and 4.5 times (Zn) for the mobile forms content.

The fraction bounded by colloidal complex, organic matter and the cadmium from soil solution represent the largest part of total Cd content (63%). The difference is cadmium bounded by ferric and manganese oxides (21%), and residual cadmium from minerals crystalline structure (16%). In the case of lead, the minimum contribution to the total content is brought by exchangeable fraction, and the fraction of soil solution (13%). Instead, the organic matter and residual fraction represent 37% and 24% respectively, from the total lead content.

The level of cadmium soils pollution is medium to high in Copşa Mica, and low to medium in Baia Mare. The maximum pollution of soil was recorded: for copper in Zlatna zone, for lead in Copşa Mică and Baia Mare zones, and for zinc in Baia Mare.

In fresh vegetables, such as carrots, radish, and potatoes were recorded exceeded the maximum allowable for Pb and Cd. For the root vegetables cultivated in Baia Mare zone, the exceeding reached values up to 2.5 times for Cd, and up to 11 times in a Pb case.

In leafy vegetables (lettuce, parsley, dill and orach) content of heavy metals recorded exceeded, for most samples analyzed, the normal content values. The maximum heavy metals absorption was registered for lettuce, which, accumulated to 7 times more Cd than normal at Copşa Mică, and to 17 times more Pb than normal at Baia Mare.

The heavy metals accumulation in fruits was lower. Only in the cherry and apples collected from Baia Mare, Cd and Pb content exceeded to 6.4 times, respectively 3.6 times the maximum allowable limits.

Between the heavy metals mobile forms content from soils and the edible part of vegetables, direct proportionality relationships, majority statistically assured, were established.

Consumption of fruits or vegetables contaminated with heavy metals by humans, could lead to changes in health of the inhabitants of polluted areas, and can contribute to the emergence of various chronic diseases. The phenomenon has become alarming for people who systematically eating such vegetables and fruits produced in their own gardens located in polluted areas.

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