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Study on heavy metal contamination of vegetables from the Moldova region

Amelia Buculei, Gabriela Constantinescu, Ioana Rebenciuc*

Ştefan cel Mare University of Suceava, Food Engineering Faculty, 13th University Street, 720229, Suceava - Romania

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Abstract

The aim of this study was to determine the accumulation level of heavy metals (Pb, Cd, Zn, Cu) in the tissues of some vegetable species taken from industrially polluted areas.
The presence of heavy metals in vegetable and fruit products, with all the economic implications, regarding especially the health ones, is currently dealt with by the specialists in the area and the control authorities.
The polluting sources by heavy metals of food products are: the use of irrigation, residual polluted water, treatments by pesticides, insecticides, fertilizers; pollution of atmosphere (in industrial areas, non-ferrous metal processing areas, intense traffic areas (tetraethyl lead from gasoline released into the atmosphere), mining areas and non-ferrous metals processing areas as well as accidental sources (releases of chemical substances into air, water, soil).

The vegetables were cropped from polluted and unpolluted areas in Romania. Vegetable species largely used in preparing ranges of cans, either industrially or homemade, have been analyzed: tomatoes and leafy vegetables (spinach, orach) in order to study the changes occurring in heavy metal content of these raw materials during the processing operations.
The accumulation potential of heavy metals (lead, cadmium, copper, zinc) in species of leafy vegetables varies as follows: spinach > orach.
It is obvious that the accumulation potential of heavy metals (lead, cadmium, copper, and zinc) of vegetable species varies in their different anatomic parts as follows: leaves > petiole > stem > root > fruit.

The increase of heavy metals level has the following effects:

- decrease of nitrogen monoxide level, a compound known under the name of "endothelial relaxing factor" in the walls of coronial arteries, without this substance the blood normal circulation is braked, increasing the risk of vascular blockage;
- reduction of hormones quantity produced by adrenal glands, leading to precocious ageing, the stress decreases sexual energy and aggravates the menopause symptoms;
- lack of any reaction of diabetics' to medication;
- appearance of neurological diseases, such as depression and decrease of intellectual capacity; aggravation of osteoporosis and hypothyroidism.

Keywords: contamination, vegetables, metals, food

Corresponding author: *e-mail:* ameliab@usv.ro

1. Introduction

Saline soil is a very important soil resource for agriculture, representing about 3.4108 ha of the cultivated lands in the world. But some of the saline soils are polluted by heavy metals [1]. Metals of toxic potential (Pb, Cd, Zn, Cu) are very stable elements, do not damage thermally or chemically, but depending on their bonding way in the vegetable tissue they can migrate.

The bad effects of heavy metals include growth retardation changes in the activity of several enzymes [2], disturbed photosynthesis within the plant system. The heavy metal uptake by different species of crops differs significantly based on their genetic; therefore, the toxic effects of heavy metals in different crops may also differ significantly. The metal contents of food are gaining importance because of toxicological as well as their nutritional viewpoints.

Dietary intake is considered to be the major supplier of these elements for the body [3].

Environment contamination and exposure to heavy metals, such as mercury, cadmium and lead are a serious issue whose importance is getting higher and higher all over the world. The exposure of human body to heavy metals has significantly increased over the last fifty years, as a consequence of exponential increase in using heavy metals in industrial processes and products [4] .

Polluting sources by heavy metals (Cu, Cd, Pb, Zn) of food products are numerous. Some of them are hereby mentioned. Copper occurs in food products:

- as a result of phytosanitary treatments by pesticides containing copper;
- as a result of corrosion processes of the equipment made from copper and alloys;
- of accidental sources.

Cadmium occurs in significant concentrations in food products because of:

- the use in irrigation of residual waters polluted by Cd;
- the use of fertilizers containing Cd (superphosphate contains 15-21 μg Cd/kg);
- the atmosphere (in industrial, mining and non-ferrous metal processing areas
- the use of containers, packages made from plastic materials having Cd salts as stabilizers or of varnished containers colored by Cd-based pigments;
- accidental sources (leakages of chemical substances containing Cd in the air, water, soil) [5]

The contamination sources by lead of food products are:

- treatments by insecticides (fruit farming, viticulture);
- atmosphere (industrial areas, areas where non-ferrous metals are being processed, intense rush traffic areas (tetraethyl lead from gasoline);
- use of lead and tin or lead/tin-covered containers and pipes;
- accidental sources [6].

Foods can contain high amounts of zinc from the following sources:

- treatments by pesticides containing Zn;
- atmosphere (industrial, non-ferrous metal processing areas);
- pipes, containers or equipment made from galvanized tin;
- accidental sources [7].

2. Materials and method

Samples from industrially polluted areas were taken in order to determine the accumulation level of heavy metals (Pb, Cd, Zn, and Cu) in the tissues of some vegetable species used in the preparation of industrial or homemade cans: leafy vegetables (spinach, orach), where the study on the changes occurring in the content of heavy metals of these raw materials is opportune.

Fresh young leaves (0.2 g) were selected from each plant at the last day of the experiment, and washed with deionized water. The leaves were cut into small pieces. 1.0 g of each vegetable fresh leaf was cleaned and washed. The vegetables were chopped and homogenized with phosphate buffer in a blender, then centrifuged at 4000 rpm min1 for 15 min. The supernatant was stored at 4 1C.

The determination of heavy metal content (lead, cadmium, copper and zinc) was made by atomic

absorption spectrophotometry, using AAnalyst 400 with flame-absorption and AAnalyst 600 with graphite oven spectrophotometers respectively. The samples were mineralized according to STAS 5954/1-86 (calcination at 450 – 500 ^{0}C sand ash dissolution by diluted hydrochloric acid).

3. Results and Discussion

One can notice that the highest accumulation level of the four metals is found in the leaves of the vegetables studied. In the case of leafy vegetables the concentration of heavy metals is higher in "mature" leaves than in "young" ones. The accumulation level of heavy metals in the anatomic parts shows the following variation: leaves>petiole> stalk>root>fruit.

The average content of heavy metals in different polluted areas of some vegetable species is shown in figure 2.

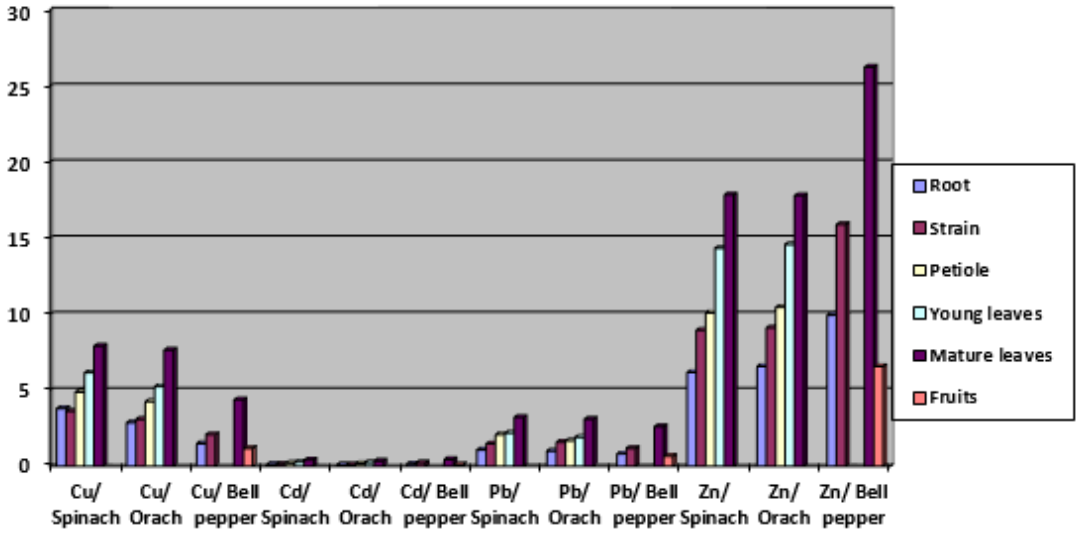

Figure 1. Heavy metals content in different parts of some vegetables species: 1.Spinach 2. Orach and 3.Bell peppers

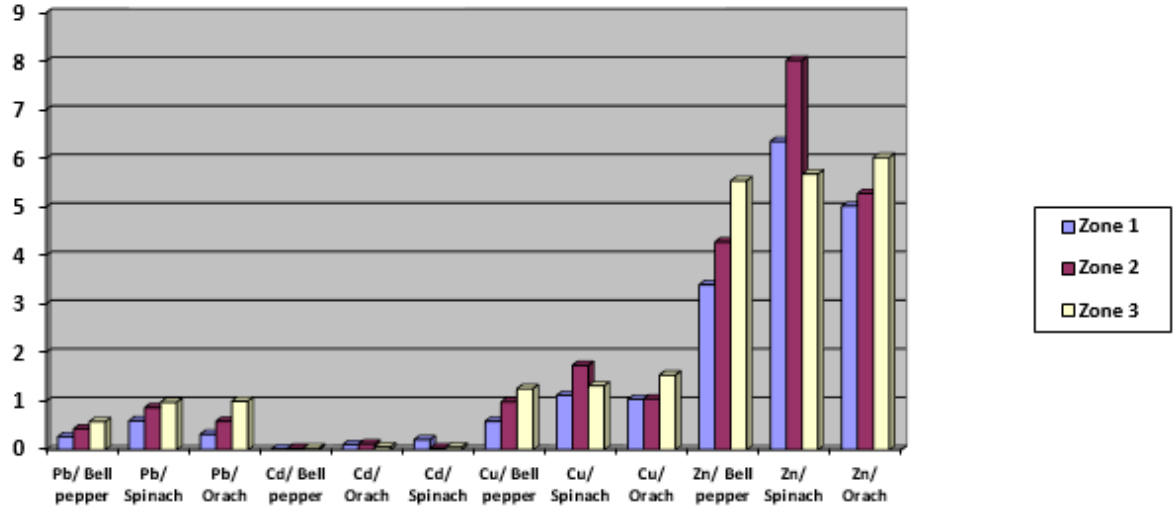

Figure 2. Heavy metals content in different polluted areas of some vegetables species: 1.Spinach 2. Orach and 3.Bell peppers

In the case of spinach and orach, the concentration of heavy metals in leaves is about 2.2 times higher than in that of roots. As the leaves are the eatable parts in the case of these species, a rigorous control of heavy metal content is highly required.

For tomatoes the heavy metal content (Pb, Cd, Zn, Cu) in fruits (the eatable part of this species) is slightly lower than in the other parts of the plant (leaves, stalk and root)

4.Conclusions

This research was done in order to determine the accumulation level of heavy metals (Pb, Cd, Zn, Cu) in the tissues of some vegetable species taken from industrially polluted areas. Heavy metal content of vegetable species used as raw materials in cans' industry (carrots, parsnip, parsley, tomatoes, eggfruits, cucumbers, peppers, bell-peppers etc) is different depending on the areas they are grown in. It is ascertained that the raw materials deriving from industrially polluted areas have a high content of heavy metals, most of the times exceeding of the maximum limits admitted by the legislation in force being registered.

The distribution of heavy metals in different parts of the vegetable species is of special interest both for the study and comprehension of the absorption mechanism of heavy metals and for quality assessment of vegetables.

In this aim the research was directed to determine the distribution of heavy metals in parts of some vegetable species belonging to different plant families and to identify the accumulation area of heavy metals in the parts studied.

Compliance with Ethics Requirements. Authors declare that they respect the journal's ethics requirements. Authors declare that they have no conflict of interest and all procedures involving human / or animal subjects (if exist) respect the specific regulation and standards.

References

1. QuSheng Li et al., Toxic effects of heavy metals and their accumulation in vegetables grown in a saline soil, *Ecotoxicology and Environmental Safety*, **2010**, *73*, 84–88
2. Gopal, R., Rizvi, A.H., Excess lead alters growth, metabolism and transloca- tion of certain nutrients in radish. *Chemosphere*, **2008**, *70*, 1539–1544
3. Yasemin S_ahan et al., ICP-MS analysis of a series of metals (Namely: Mg, Cr, Co, Ni, Fe,Cu, Zn, Sn, Cd and Pb) in black and green olive samples from Bursa, Turkey, *Food Chemistry*, **2007**, *105*, 395–399
4. Alam, M. G. M., Snow, E. T., & Tanaka, A., Arsenic and heavy metal contamination of vegetables grown in Samta Village, Bangladesh. The Science of The Total Environment, **2003**, *308*, 83–96.
5. Angioni, A., Cabitza, M., Russo, M. T., & Caboni, P., Influence of olive cultivars and period of harvest on the contents of Cu, Cd, Pb, and Zn in virgin olive oils. *Food Chemistry*, **2006**, *99*, 525–529.
6. Anonymous (1984). List of contaminants and their maximum levels in foods, Part II., Food and Agricultural Organization of United Nation (Unpublished FAO document, CAC/Vol. X–VII. Ed. 1, Available from FAO or WHO).
7. Anonymous (1994). Proposed draft codex general standard for contaminants and toxins in foods, Food and Agricultural Organization of United Nation (Unpublished FAO document, agenda item 13(b), CX/FAC 95/12, Available from FAO or WHO).