JAP&T
TPA-Timişoara

Available online at http://journal-of-agroalimentary.ro

Journal of Agroalimentary Processes and Technologies 2013, 19(2), 160-166

Journal of Agroalimentary Processes and Technologies

The comparisons about macro elements content in vegetables collected from the Gotlob locality of Timis county

Gabriel Heghedűş-Mîndru[1*], Ramona Cristina Heghedűş-Mîndru[1], Petru Negrea[2], Radu Şumălan[1], Teodor Traşcă[1], Adina Negrea[2], Adrian Riviş[1], Ducu Ştef[1]

[1]Banat's University of Agricultural Sciences and Veterinary Medicine Timisoara, Faculty of Food Processing Technologies, 119, Calea Aradului, 300645, Timisoara, Romania,
[2]Politehnica University Timisoara, Faculty of Industrial Chemistry and Environmental Engineering, No.2 P-ta Victoriei, 300006, Timisoara, Romania

Received: 17 April 2013; Accepted: 19 May 2013

Abstract

The researches carried in this paper aimed at evaluating samples of vegetables from locality Gotlob, Timis county, in terms of content the macro elements sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg). The samples of vegetables Bell Peppers (*Capsicum annum*), Tomatoes (*Lycopersicon esculentum*), Potatoes (*Solanum tuberosum*), Onions (*Allium cepa*), Carrots (*Daucus carota subsp. Sativus*), Eggplants (*Solanum melongena*) were collected from three different points of the locality Gotlob. The solutions obtained were analyzed using an Atomic Absorption Spectrometer - Varian 280 FS SpectrAAVariant. The highest content was recorded in sample Bell Peppers source 3 (12.585 g/Kg d.w.) for potassium element, in sample Carrots source 1 (1.690 g/Kg d.w.) for sodium element, 0.562 g/Kg d.w. for magnesium element in sample Carrots source 2, and 0.915 g/Kg d.w. for calcium element in sample Onions source 3.

Keywords: sodium, potassium, calcium, magnesium, atomic absorption, vegetables

1. Introduction

Vegetables are important constituents of human diet across the world both in terms of quantities consumed and nutritional value, especially so in the Indian subcontinent where a majority of the population is vegetarian [1-2].

Mineral nutrient status and accumulation of especially Ca, K and Mg in various fruit types have been closely associated with postharvest disorders, although not necessarily as the underlying mechanism, in tomato (*Solanum lycopersicum Mill.*) [3]. Adequate K, Mg and Ca supply is important to develop well-structured and functional cell walls and membranes in fruit and vegetables, and insufficient levels or imbalances of these minerals are known to be involved in various post harvest disorders. [4]. Minerals are necessary for human life and play important roles in metabolic functions [5] such as, maintenance of pH, osmotic pressure, nerve conductance, muscle contraction, energy production, and in almost all other aspects of life. Depending on the amounts needed, minerals can be divided into macro (g or mg/day) and microminerals (few mg or lg/day). Physiologically, the most important macrominerals are Ca, K, Na and Mg, and the same for Fe, Cu and Zn as microminerals [6]. Bioavailability of minerals is affected by several factors. Host factors can be defined as any attribute that can influence the amount of metal exposure, uptake, absorption, biokinetics and susceptibility of an individual. Such factors include age, gender, size and weight, nutritional status, genetics and some behaviours [7-8]. The aim of this paper is evaluating samples of vegetables from locality Gotlob, Timis county, in terms of content the macro elements sodium (Na), potassium (K), calcium (Ca) and magnesium (Mg). The samples of

Corresponding author: *e-mail:* gabone2003@yahoo.com

vegetables Bell Peppers (*Capsicum annum*), Tomatoes (*Lycopersicon esculentum*), Potatoes (*Solanum tuberosum*), Onions (*Allium cepa*), Carrots (*Daucus carota subsp. Sativus*), Eggplants (*Solanum melongena*) were collected from three different points of the locality Gotlob. The solutions obtained were analyzed using an Atomic Absorption Spectrometer - Varian 280 FS SpectrAAVariant

2. Materials and Methods

The chemicals used were: HCl (Merk - Germany). HNO3 (Merk - Germany). C2H2 (Linde Gaz Romania). The type of apparatus was: Atomic Absorption Spectrometer - Varian 280 FS SpectrAA; Flame type: air/acetylene. Sodium and potassium was determination by atomic emission method. Calcium and potassium elements was determination by atomic adsorption method.

The vegetable samples were analyzed immediately after harvesting, were removed the impurities mechanical (ground, vegetation, debris, etc.), by washing, followed by removal of adherent water with filter paper to full drying.

The primary samples thus obtained were mixed together, and the material obtained - medium samples were obtained after the quartering method. To determine dry matter for trace elements content of each variety were selected 100 ± 0.001 g edible part.

Dividing vegetables with plastic utensils are made by cutting into small pieces after removing the shell.

Divided vegetables are introduced in the oven to 105 ºC until a constant weight (when the loss of mass is the same one hour after the last weighing).

The porcelain capsules cleaned and brought to constant weight by drying at 105 °C, were weighed approximately 100 g (with an accuracy of ± 0.001 g) plant products.

Place in oven proof capsules at 50 - 60 °C where they remain 6 hours. It then raises the temperature at 105 °C and held for 6 hours. After this time, samples are removed from the oven capsules and allowed to cool in a desiccators provided with desiccant agent.

After cooling, weigh evidence capsules and inserted back into the oven. The operation is repeated until the differences between two successive weighings does not exceed ± 0.001 g.

All samples was realized in triplicate

*2.1. Dry mineralization.*Vegetable organic matter is oxidized by oxygen in the air in a calcinations furnace, heated gradually to 550°C temperature, which is maintained for 6-8 hours. The method used was that described in STAS 5954 -1986, [9] adapted to the specific analysis of plant products.

Weigh 2g of plant products, obtained after drying and place in a roasting oven thermoregulation, cold. Temperature gradually rises to 200 - 250°C and maintained until complete charring. Oven temperature is then raised to 550 ° C and burning for 6-8 hours until a white ash.

2.2. Wet mineralization. The volume of acid depends on the amount of ash sample. Mineralization of samples is performed as follows: 1 - 2 g sample with 10 ml HCl and 5 mL HNO_3, or 3 - 4 g sample with 21 ml HCl and 7 mL HNO3. Boil until almost dry sample, then filtered and the filtrate washed so as to not exceed the volume of 100 mL (volume of the filter flask).

The operation was repeated for all 18 samples analyzed. Filtrates obtained were collected in glass bottles (100 mL) for analysis by atomic absorption trace elements.

Determination of trace elements by atomic absorption spectrometry is based on measurement by atomic absorption spectrometry, the concentration of trace elements in the acid extract obtained from the ashes of the plant product sample. Analytical process includes two steps: digestion, dry route and dosage, by atomic absorption spectrometry.

3. Results and discussion

Table 1 illustrates the results obtained by atomic absorption analysis of samples of vegetable from three sources, Gotlob locality.

In Figure 1 are represented the values of macro elements (Na, K, Ca and Mg) content from vegetable samples analyzed, from source 1, Gotlob.

Table 1. Macro elements content of Na, K, Ca and Mg in the samples of vegetable analysis (dry weight) of the three sources from Gotlob locality.

Samples	Na, g/Kg	K, g/Kg	Ca, g/Kg	Mg, g/Kg
Source 1				
Bell Peppers (*Capsicum annum*)	0.620	12.297	0.074	0.475
Tomatoes (*Lycopersicon esculentum*)	1.017	7.894	0.056	0.347
Potatoes (*Solanum tuberosum*)	0.344	6.638	0.023	0.232
Onions (*Allium cepa*)	0.353	4.906	0.050	0.246
Carrots (*Daucus carota subsp. Sativus*)	1.690	9.150	0.089	0.461
Eggplants (*Solanum melongena*)	0.764	2.626	0.031	0.334
Source 2				
Bell Peppers (*Capsicum annum*)	0.392	7.880	0.036	0.340
Tomatoes (*Lycopersicon esculentum*)	0.497	4.387	0.066	0.268
Potatoes (*Solanum tuberosum*)	0.582	10.793	0.115	0.335
Onions (*Allium cepa*)	0.798	2.454	0.087	0.244
Carrots (*Daucus carota subsp. Sativus*)	0.677	4.879	0.116	0.562
Eggplants (*Solanum melongena*)	0.472	4.243	0.018	0.281
Source 3				
Bell Peppers (*Capsicum annum*)	0.342	12.585	0.074	0.355
Tomatoes (*Lycopersicon esculentum*)	0.354	7.331	0.035	0.206
Potatoes (*Solanum tuberosum*)	0.300	9.901	0.002	0.277
Onions (*Allium cepa*)	0.391	1.991	0.915	0.309
Carrots (*Daucus carota subsp. Sativus*)	1.382	5.888	0.101	0.364
Eggplants (*Solanum melongena*)	0.461	1.877	0.002	0.284

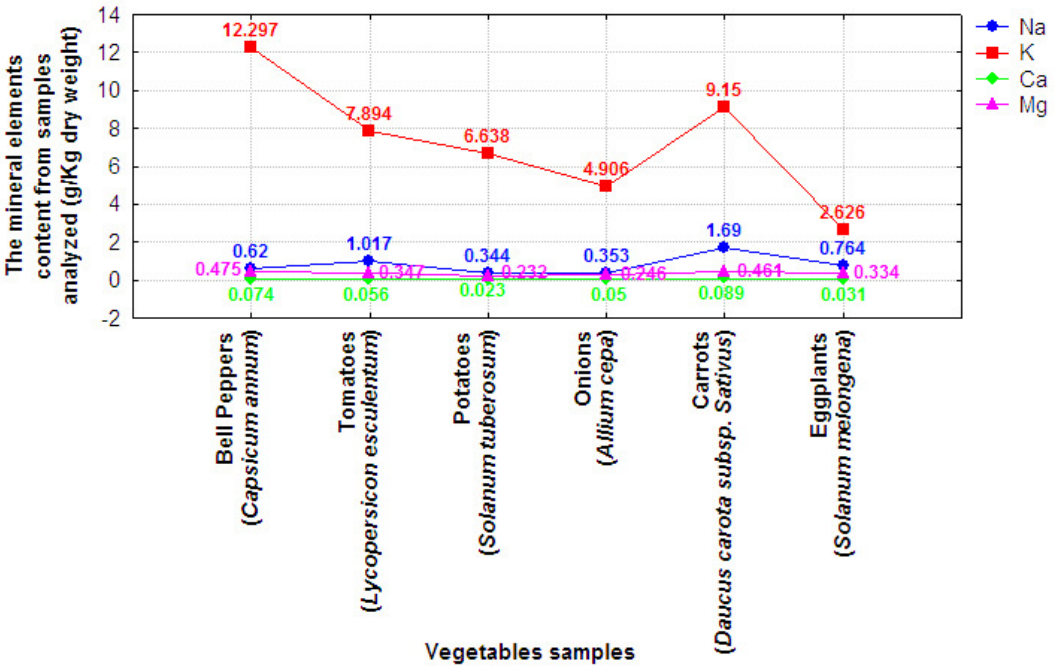

Figure 1. The macro elements content of the vegetable samples collected from Gotlob locality, source 1

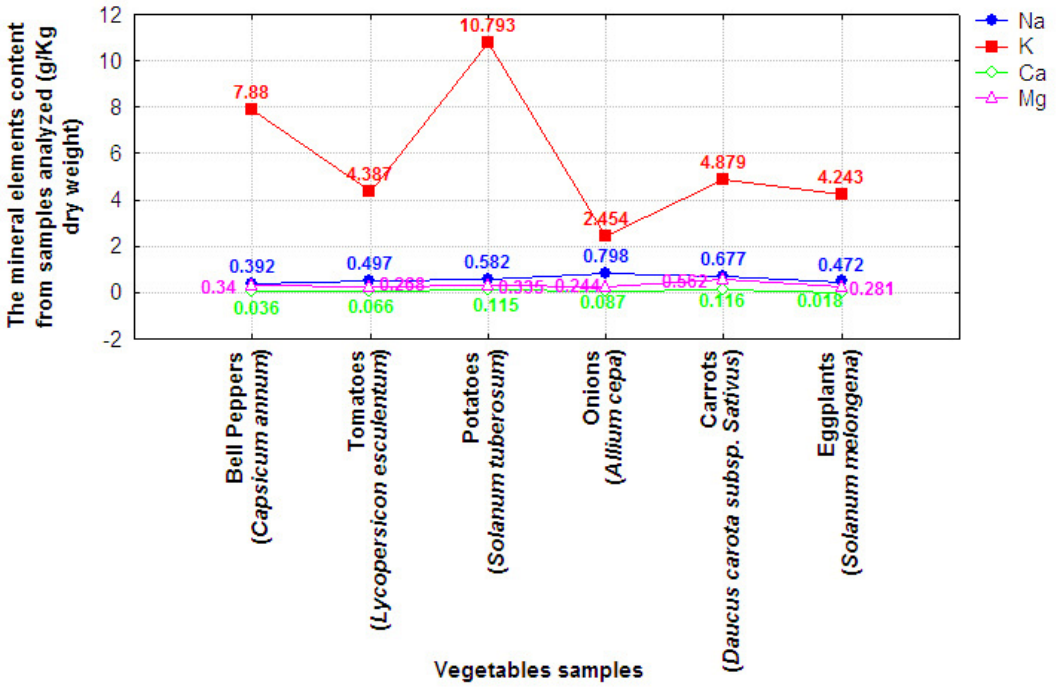

Figure 2. The macro elements content of the vegetable samples collected from Gotlob locality, source 2

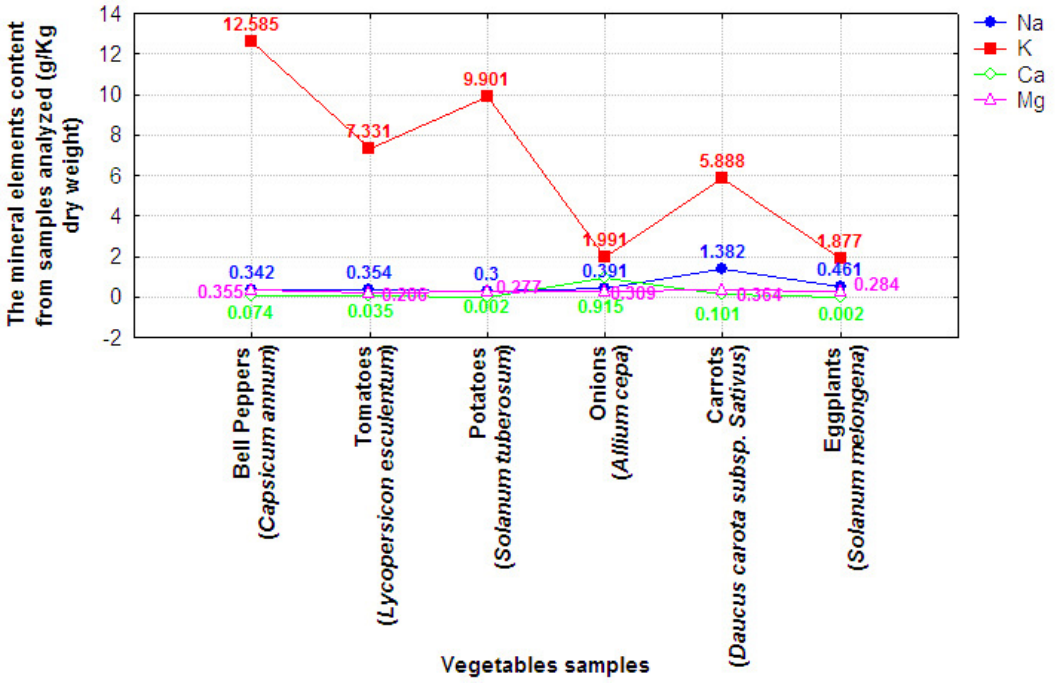

Figure 3. The macro elements content of the vegetable samples collected from Gotlob locality, source 3

Following the analyzes performed the higher sodium content was obtained from samples of Carrots (*Daucus carota subsp. Sativus*) and Tomatoes (*Lycopersicon esculentum*) with values of 1.69 g/Kg d.w. and 1.017 g/Kg d.w. For samples of Eggplants (*Solanum melongena*) and Bell Peppers (*Capsicum annum*) was obtained an average content value of this element with the 0.764 g/Kg d.w. şi 0.62 g/Kg d.w. The highest potassium content was determined in samples of Bell Peppers (*Capsicum annum*) 12.297 g/Kg d.w., and Carrots (*Daucus carota subsp. Sativus*) 9.15 g/Kg dw. The samples of Tomatoes (*Lycopersicon esculentum*) and Potatoes (*Solanum tuberosum*) registered the average values of 7.894 g/Kg dw and 6.638 g/Kg d.w. The lowest sodium content was determined in samples of Onions (*Allium cepa*) 4.906 g/Kg d.w. and Eggplants (*Solanum melongena*) 2.626 g/Kg d.w. The highest calcium content was determined in samples of Carrots (*Daucus carota subsp. Sativus*) and Bell Peppers (*Capsicum annum*) with values of 0.089 g/Kg d.w. and 0.074 g/Kg d.w. The samples of Tomatoes (*Lycopersicon esculentum*), eggplants (*Solanum melongena*) and Potatoes (*Solanum tuberosum*) presented the calcium content in the range (0.056 - 0.023 g/Kg d.w.). The lower content of calcium has been registered to the sample Onions (*Allium cepa*) with the value of 0.05 g/Kg d.w. Olayiwola et. all [10] obtained in dried vegetables analysed the calcium level 71.5 - 87.1 mg/kg, the sodium level 78,5 - 115 mg/kg, and potassium level 80 – 112 mg/kg. The results were similar those obtained by us, in this paper. The samples analyzed for magnesium element content have presented the similar values. The highest content for this element was determined in samples of Bell Peppers (*Capsicum annum*) and Carrots (*Daucus carota subsp. Sativus*) with values of 0.475 g/Kg d.w. and 0.461 g/Kg d.w. The samples of Tomatoes (*Lycopersicon esculentum*), Eggplants (*Solanum melongena*) and Onions (*Allium cepa*) have registered a magnesium content in the range (0.347 - 0246 g/Kg d.w.). The sample Potatoes (*Solanum tuberosum*) presented the lowest content in this element, 0.232 g/Kg d.w.

In Figure 2 is represented graphically, the variation content in macroelements (Na, K, Ca and Mg) of vegetable samples (dry weight) collected from Gotlob locality, Timis County, source 2.

In case of source 2 the sodium element recorded a higher content in samples Onions (*Allium cepa*) 0.798 g/Kg d.w. or Carrots (*Daucus carota subsp. Sativus*) 0.677 g/Kg d.w. The samples of Potatoes (*Solanum tuberosum*), Tomatoes (*Lycopersicon esculentum*) and Eggplants (*Solanum melongena*) have presented a sodium content in the range 0.582 - 0.472 g/Kg d.w. The lowest content in this element was recorded in sample Bell Peppers (*Capsicum annum*), 0.392 g/Kg d.w. For potassium element the samples Potatoes (*Solanum tuberosum*) and Bell Peppers (*Capsicum annum*) recorded the highest content with values 10.793 g/Kg d.w. and 7.88 g/Kg d.w. The samples of Tomatoes (*Lycopersicon esculentum*), Carrots (*Daucus carota subsp. Sativus*) and Eggplants (*Solanum melongena*) had potassium content with average values in the range (4.243 – 4.387 g/Kg d.w.). The lowest potassium content was recorded to sample Onions (*Allium cepa*) with a value of 2.454 g/Kg d.w. In the case of the calcium element, the higher content was obtained in the samples Carrots (*Daucus carota subsp. Sativus*) and Potatoes (*Solanum tuberosum*) with values of 0.116 g/Kg d.w. and 0.115 g/Kg d.w. The samples of Onions (*Allium cepa*), Tomatoes (*Lycopersicon esculentum*) and Bell Peppers (*Capsicum annum*) presented calcium content in the range (0.087 – 0.036 g/Kg d.w.). The lowest content for this element was recorded to sample Eggplants (*Solanum melongena*) 0.018 g/Kg d.w. The sample of Carrots (*Daucus carota subsp. Sativus*) presented the highest content of magnesium with a value of 0.562 g/Kg d.w. The samples of Potatoes (*Solanum tuberosum*) and Bell Peppers (*Capsicum annum*) recorded values of 0.335 g/Kg d.w. and 0.34 g/Kg d.w. The lowest content for this element was obtained from sample Onions (*Allium cepa*) with a value of 0.244 g/Kg d.w.

Yildirim, et. all [11] obtained in vegetables analyzed (dry weight) the calcium level 0,152 – 0,268 g/kg and the magnesium level 0,030 – 0,112 g/kg. The results were similar those obtained by us, in this paper.

In Figure 3 is represented graphically, the variation content in macroelements (Na, K, Ca and Mg) of vegetable samples (dry weight) collected from Gotlob locality, Timis County, source 3.

In case of source 3 the sodium element recorded a higher content in sample Carrots (*Daucus carota subsp. Sativus*) value of 1.382 g/Kg d.w. The samples of Eggplants (Solanum melongena) recorded a value of 0.461 g/Kg d.w. for this element.

Very similar values were obtained for samples of Bell Peppers (*Capsicum annum*), Tomatoes (*Lycopersicon esculentum*) and Onions (*Allium cepa*) in the range 0.391 – 0.342 g/Kg d.w. The samples of Potatoes (*Solanum tuberosum*) have recorded the lowest content of sodium, 0.3 g/Kg d.w. The high potassium content of the samples was determined to Bell peppers (*Capsicum annum*) and Potatoes (*Solanum tuberosum*) with the values of 12.585 g/Kg d.w. and 9.901 g/Kg d.w. The samples of Tomatoes (*Lycopersicon esculentum*) and Carrots (*Daucus carota subsp. Sativus*) presented potassium content with the values 12.585 g/Kg d.w. and 7.331 g/Kg d.w. The lowest content in this element presented the samples Onions (*Allium cepa*) and Eggplants (*Solanum melongena*) with values of 1.991 g/Kg d.w. or 1.877 g/Kg d.w. Yildirim, et. all [11] obtained in vegetables analyzed (dry weight) the potassium level 0,542 – 1,544 g/kg and the sodium level 0,004 – 0,015 g/kg. The results were much lower than those obtained by us, in this paper. The sample Onions (*Allium cepa*) recorded the highest value for the element calcium 0.915 g/Kg d.w. The sample Carrots (*Daucus carota subsp. Sativus*) presented a calcium content with a value of 0.101 g/Kg d.w. The lowest calcium content was obtained from samples of Potatoes (*Solanum tuberosum*) and Eggplants (*Solanum melongena*) value of 0.002 g/Kg d.w. The results obtained for the magnesium element was very similar, the high content of this element was recorded in the sample Carrots (*Daucus carota subsp. Sativus*), 0.364 g/Kg d.w. The samples of Bell Peppers (*Capsicum annum*), Onions (*Allium cepa*), Eggplants (*Solanum melongena*) and Potatoes (*Solanum tuberosum*) had a magnesium content in the range (0.355 – 0.277 g/Kg d.w.). The lowest magnesium content was recorded in the sample Tomatoes (*Lycopersicon esculentum*), 0.206 g/Kg d.w.

4. Conclusion

Following the analyzes carried from vegetables samples collected from zone 1 Gotlob recorded the highest content of macroelements (Na, K, Ca and Mg) followed by samples from zone 3 Gotlob, respectively samples from zone 2 Gotlob. The vegetable samples collected from three sources Gotlob locality had a high intake for potassium element.

The lowest contribution in the analyzed samples was recorded for the element calcium. The samples which recorded the maximum content for mineral elements analyzed were: sodium element 1.690 g/Kg d.w. - Carrots (*Daucus carota* subsp. Sativus) source 1, potassium element 12.585 g/Kg d.w. - Bell Peppers (Capsicum annum), source 3, calcium element 0.915 g/Kg d.w. - Onions (*Allium cepa*), source 3 and the magnesium element 0.562 g/Kg d.w. - Carrots (*Daucus carota* subsp. Sativus), source 2.

Acknowledgements

This work was carried out during the project "Post-doctoral School of Agriculture and Veterinary Medicine Posdru/89/1.5/S/62371" co-financed by the European Social Fund the Sectorial Operational Programme for the Human Resources Development 2007-2013.

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 and/or animal subjects (if exists) respect the specific regulations and standards.

References

1. FAO, Policy, technical and environmental determinants and implications of the scaling-up of livestock production in four fast-growing developing countries: a synthesis. Final research report of phase II. **2003**
2. Khillare, P.S.; Jyethi, D.S,; Sarkar, S. Health risk assessment of polycyclic aromatic hydrocarbons and heavy metals via dietary intake of vegetables grown in the vicinity of thermal power plants, *Food and Chemical Toxicology* **2012,** 1642-1652
3. Del Amor, F.M.; Marcelis, L.F.M.; Differential effect of transpiration and Ca supply on growth and Ca concentration of tomato plants, *Sciencia Horticulrae* **2006**, *111*, 17–23
4. Cronjea, P.J.R.;, Barrya, G.H,; Huysamerb, M., Fruiting position during development of 'Nules Clementine' mandarin affects the concentration of K, Mg and Ca in the flavedo, *Scientia Horticulturae* **2011**, *130*, 829-837
5. Biziuk, M.; Kuczynska, J., Mineral components in foods *Taylor & Francis* **2007**, Cap 1, 1–31
6. Silvera, S.A.N.; Rohan, T.E., Trace elements and cancer risk: A review of the epidemiologic evidence. *Cancer Causes Control* **2007**, *18*, 7–27
7. Robson, M., Methodologies for assessing exposures to metals: human host factors. *Ecotoxicology and Environmental Safety* **2003**, *56*, 104–109

8. Barroso, M.F,; Silva, A,; Ramos, S,; Oliva-Teles, M.T,; Delerue-Matos, C,; Sales, G.F.M,;. Oliveira M.B.P.P., Flavoured versus natural waters: Macromineral (Ca, Mg, K, Na) and micromineral (Fe, Cu, Zn) contents, *Food Chemistry* **2009**, *116*, 580–589
9. STAS 5954/1-86. Fruit and vegetable products; mineralization samples for determination of metals (In Romanian).
10. Olayiwola, O.A,; Oyeleke, G.O.; Adeoye, M.D., Mineral composition and effect of boiling time on vitamin C in extract of fresh and dried Nigerian vegetables with and without addition of potash :Iree, Nigeria as a case study, *Food Science and Quality Management* **2012,** ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online), 1-12
11. Yildirim, E,; Dursun, A,; Turan M., Determination of the Nutrition Contents of the Wild Plants Used as Vegetables in Upper Coruh Valley, *Turk J. Bot.* **2001,** *25*, 367 - 371