M. Harmanescu, et all. Journal of Agroalimentary Processes and Technologies, Volume XIII, No.1 (2007), 169-174
Full Paper – Food Science

METALS CONTENTS OF TOMATOES CULTIVATED IN DIFFERENT CONDITIONS

Monica Harmanescu, Diana Moigradean, I. Gergen
Banat's University of Agricultural Sciences and Veterinary Medicine, Timişoara, Faculty of Food Technology, Calea Aradului nr. 119, Timisoara, RO-300645, Romania, E-mail: monicaharmanescu@yahoo.com

Abstract

It were analyzed the total metals contents for tomatoes cultivated in protected conditions and in field. Ten metals concentrations were quantified for each sample. The analysed minerals are: Na, K, Ca, Mg, Cu, Zn, Mn, Fe, Ni and Pb. Mineral contents were determinated by flame atomic absorption spectrometry (F-AAS) with high-resolution continuum source ContrAA 300 spectrometer. The results were statistically interpreted using multivariate analyses.
***Keywords**: metals, flame atomic absorption spectrometry, multivariate analyses, tomatoes.*

Introduction

Essential metal macroelements presents in vegetables are: *Na, K, Ca* and *Mg*. The microelements are: *Fe, Mn, Cu* and *Zn*. The microelements can be toxic in high quantities. Other metal microelements like *Ni* and *Pb* are very toxic. Metal microelements can affect the biological and biochemical processes: nutrition, photosynthesis and respiration (Gergen, 2006).

Epidemiological studies have shown that the consumption of tomatoes (*Solanum lycopersicum*) and tomatoes products can help to prevent various forms of cancers, especially prostate cancer, and heart diseases. Tomatoes are often a significant part of the human diet and are also abundant sources of antoxidants (Toor, 2006). Vegetables like tomatoes are very important sources of microelements for human nutrition.

In this paper we analyzed the total metals contents for tomatoes cultivated in protected conditions and in field and the results were statistically interpreted using multivariate analyses**.**

Experimental

Samples preparation: The metals from tomatoes samples were analyzed after dry burning of 10 g in the quartz capsules at 650^{o}C for 4 hours. After complete burning a nitric acid 0.5 N solution was added up to 50 mL. The solutions obtained were used for total metals contents determination by flame atomic absorption spectrometry (F-AAS) with high-resolution continuum source.

Reagents: The standard solutions (1000 mg/L) were analytical grade from Riedel de Haen (Germany). The nitric acid 65% solution used was of ultra pure grade (Merck, Germany). All solutions were prepared using deionized water.

Metals determination: Analysis of metals was made with ContrAA-300, Analytik-Jena device, by flame atomic absorption spectrometry (FASS) in air/acetylene flame. The device working parameters (air, acetylene, optics and electronics) were adjusted for maximum absorption for each element. Acetylene was of 99.99 % purity. Under the optimum established parameters, standard calibration curves for metals were constructed by plotting absorbency against concentration (Gergen, 2006). In a definite range for each metal a good linearity was observed. The correlation coefficient for the calibration curves (r^2) ranged between 0.9745 - 0.9891. All analyses were made in triplicate and the mean values were reported. All the values obtained for metals contents in tomatoes samples were calculated in mg/kg tomatoes. Statistical interpretation of data obtained using multivariate analyses was performed with Statistica-6 software.

Results and Discussion

The results obtained for the contents in *Na, K, Ca* and *Mg* for analyzed tomatoes samples are presented in Table 1. In analyzed tomatoes samples the highest content was obtained for *Potassium*, followed by *Calcium*, *Magnesium* and *Sodium*. Potassium contents varied in analyzed tomatoes between 1020 – 1247 ppm. The highest contents in *Calcium* were determinate for *Ace Royal* cultivated in solar (130 ppm) and for *Ace Royal* cultivated in field (124 ppm). For *Magnesium* the highest values were obtained also for *Ace Royal*

cultivated in solar (87 ppm) and for *Ace Royal* cultivated in field (80 ppm). For *Sodium* the highest contents were determinate for Campbell cultivated in solar (46 ppm) and in field (45 ppm).

Table 1. Results for the contents in Na, K, Ca and Mg for analyzed tomatoes samples (reported to fresh matter)

Tomatoes samples	Na (ppm)	K (ppm)	Ca (ppm)	Mg (ppm)
Campbell, in field	45	1050	95	65
Ace Royal, in field	39	1020	124	80
Campbell, in solar	46	1247	110	71
Ace Royal, in solar	40	1110	130	87

The distribution of *Na, K, Ca* and *Mg* in analyzed samples is presented in Figure 1.

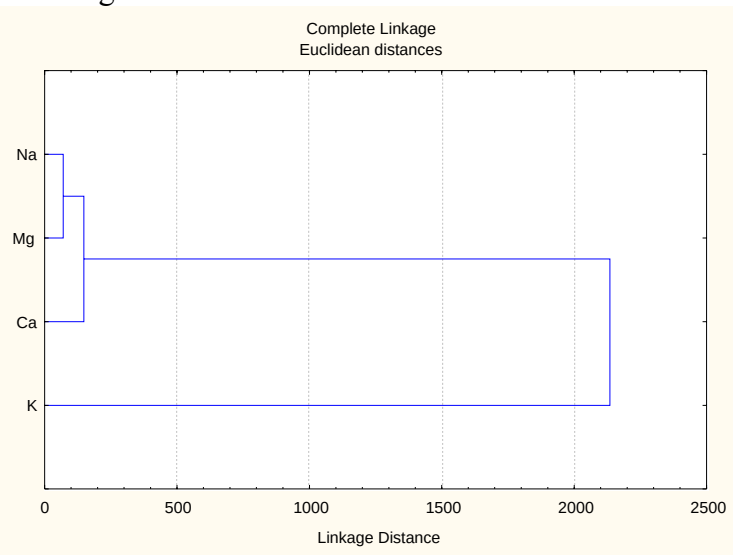

Figure 1. Variables Na, K, Ca and Mg - dendrogram

The coefficients of matrix correlation of variables *Sodium, Potassium, Calcium* and *Magnesium* are presented in Table 2. The results obtained for the contents in *Cooper, Zinc, Manganese, Iron,*

Nickel and *Lead* for analyzed tomatoes samples are presented in Table 3.

Table 2. The coefficients of matrix correlation of variables Sodium, Potassium, Calcium and Magnesium

	Na	K	Ca	Mg
Na	1.00	0.61	-0.83	-0.85
K	0.61	1.00	-0.06	-0.13
Ca	-0.83	-0.06	1.00	0.98
Mg	-0.85	-0.13	0.98	1.00

Table 3. Results for the contents of heavy metals in analyzed tomatoes samples (reported to fresh matter)

Tomatoes samples	Cu (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Ni (ppm)	Pb (ppm)
Campbell, in field	0.59	1.08	0,47	3.58	0.09	0.18
Ace Royal, in field	0.64	1.19	0.52	4.33	0.09	0.17
Campbell, in solar	0.65	1.19	0.66	3.85	0.08	0.22
Ace Royal, in solar	0.84	1.36	0.56	4.98	0.08	0.21
Nat. limit in fresh vegetables, ppm[*]	*5.0*	*15*	-	-	-	*0.5*

* Ordinance *no 975/1998*

The values obtained for *Fe* contents in analyzed tomatoes were in range 3.58 – 4.98 ppm. The highest *Fe* contents were determinated for *Ace Royal* cultivated in solar (4.98 ppm) and in field (4.33 ppm). For *Zn* and *Cu* the highest contents were determinated for *Ace Royal* cultivated in solar (1.36 ppm for *Zn*, respectively 0.84 ppm for *Cu*). *Campbell* tomatoes cultivated in solar have the highest contents in Mn and *Pb* (0.66 ppm for *Mn*, respectively 0.22 ppm for *Pb*). For *Ni* contents the values are 0.08 ppm for tomatoes cultivated in solar and 0.09 ppm for those cultivated in field.

The coefficients of matrix correlation of variables *Cu, Zn, Mn, Fe, Ni* and *Pb* are presented in Table 4. From matrix correlation of variables *Cu, Zn, Mn, Fe, Ni* and *Pb* presented in Table 4 we observed that *Fe* content are in good correlation with *Cu* (0.92) and *Zn* (0.95). That's way the obtained values for *Cu* and *Zn* were eliminated. *Ni* was

also eliminated because its content is in good correlation with *Pb* (0.97). The distribution of *Mn, Fe* and *Pb* in analyzed samples is presented in Figure 2.

Table 4. The coefficients of matrix correlation of variables Cu, Zn, Mn, Fe, Ni and Pb

	Cu	Zn	Mn	Fe	Ni	Pb
Cu	1.00	0.97	-0.55	0.92	-0.68	0.51
Zn	0.97	1.00	-0.72	0.95	-0.70	0.51
Mn	-0.55	-0.72	1.00	-0.66	0.58	-0.42
Fe	0.92	0.95	-0.66	1.00	-0.43	0.21
Ni	-0.68	-0.70	0.58	-0.43	1.00	-0.97
Pb	0.51	0.51	-0.42	0.21	-0.97	1.00

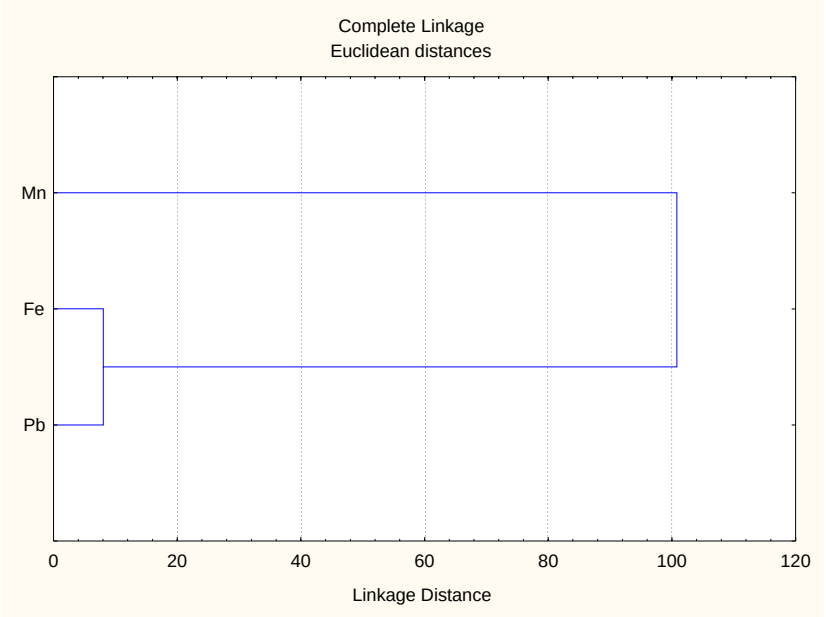

Figure 2. Variables Mn, Fe and Pb - dendrogram

Conclusions

The highest contents in *Na, K, Ca, Mg, Cu, Zn, Mn, Fe* and *Pb* were determinated in tomatoes cultivated in solar. The highest values

between all analyzed metals were obtained for *K*, followed by *Ca, Mg* and *Na*. From microelements the highest values were obtained for *Fe* and *Zn*. All the values obtained for analyzed macro- and microelements contents are under than national accepted limit for these metals in fresh vegetables.

Acknowledgements

The authors would like to thank CNCSIS (Cod 46) for providing financial support.

References

Gergen, I., Gogoaşă, I., Drăgan, S., Moigrădean, D., Hărmănescu, M. (2006). Heavy metal status in fruits and vegetables from a non-poluted area of Romania (Banat County). *Metal Elements in Environment, Medicine and Biology,* Gârban Z., Drăgan P. (Eds. Symp. Series), Tome VII, Publishing House Eurobit, Timişoara, p.149-165.

Toor, K.R., Savage, G.P. (2006). Effect of semi-drying on the antioxidant components of tomatoes. *Food Chemistry*, 94, 90-97.

*** Excerpt from Romanian Ministry of Public Health Ordinance *no 975/1998*. *Maximum limits accepted for heavy metal in foods*