16th International Research/Expert Conference
”Trends in the Development of Machinery and Associated Technology”
TMT 2012, Dubai, UAE, 10-12 September 2012

MONITORING OF HEAVY METALS IN TOMATO GROWN IN GREENHOUSE CONDITIONS

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ABSTRACT
Greenhouse production is getting more and more important in the production of food, particularly if it is considered as ecological production. Having it in mind, it is very important to provide continual control of quality such products.
This work is aimed to present the monitoring of the content of heavy metals in tomato, grown in greenhouse conditions. In products grown in greenhouses, heavy metals can be present from different sources such as soil, pesticides, etc.
This paper considers the importance of continual monitoring of presence of heavy metals, such as cadmium, lead, copper, iron, etc. in tomato, taking in consideration their bioavailability to plants in acid and basic soil conditions. Obtained results in this work could be used as the base for establishing the model for continual monitoring of contaminants in food, particularly those that are present in very small concentrations, such as lead, cadmium, etc.
Key words: heavy metals, tomato, monitoring

1. INTRODUCTION
The presence of heavy metals in the food chain and genotypical differences in the critical toxicity levels of heavy metals in plants has been often reported [1]. The most common heavy metal contaminants are Cd, Cu, Pb and Zn, and other. Metals are natural components in soil. Contamination, however, has resulted from industrial activities, such as mining and smelting of metalliferous ores, fertilizer, pesticide application and generation of municipal waste [2]. The level of nutrients, heavy metals present in small ammounts, absorbed by plants is related to thier bioavailiability in the growth medium. Meanwhile, uptake of nutrients increases for some nutrients or decreases for the others depending on antagonistic or synergistic (interactions) effects among plant minerals and other nutrients [3].
Vegetables accumulate heavy metals in their edible and non edible parts. Although some of the heavy metals such as Zn, Mn, Ni and Cu act as micro-nutrients at lower concentrations, they become toxic at higher concentrations. Health risk due to heavy metal contamination of soil has been widely reported [5], [6]. Consumption of these vegetables with elevated levels of heavy metals may lead to high level of body accumulation causing related health disorders. Thus regular monitoring of heavy metal contamination in the vegetables grown at area, such as close to industry, suspicious soils, and of course in greenhouse, is necessary, and of course the consumption of contaminated vegetables should

be avoided in order to reduce the health risk caused by taking the contaminated vegetables [7]. This work is prepared to show the tomato production in greenhouse, where monitoirng is present, and of course result obtained in experimental analysis could be somtime very usuful in order to estimate, is vegetable good or not good for consumption.

2. MATERIAL AD METHODS

Analysis have been performed by Atomic absorption spectrophotometer, type Perkin Elmer, AAnalyst 800. Solid samples were prepared by digestion at 450 °C and transforming, e.g. by diluting them into liquid adding re distillated water. The principle of atomic absorption spectrophotometry is the following:

- Liquid sample is imported with flow of gasses into flame,
- Into flame, samples are dispersed into aerosol – plasma,
- Through plasma, light of specific wavelength is passing, and then it is absorbed by atoms of elements, depending on their spectrum.

The concentration of heavy metals is calculated using the following formule:

$$C_{Me} = \frac{\frac{A_{sample}}{A_{standard}} \cdot C_{standard} \cdot V_{standard}}{m_{sample}} \quad (1)$$

C_{Me} – concentration of metal (mg/kg)
A_{sample} – absorbance of sample (%)
$A_{standard}$ – absorbance of standard (%)
$C_{standard}$ - concentration of standard (mg/L)
$V_{standard}$ – volume of standard (L)
m_{sample} – mass of sample (kg)

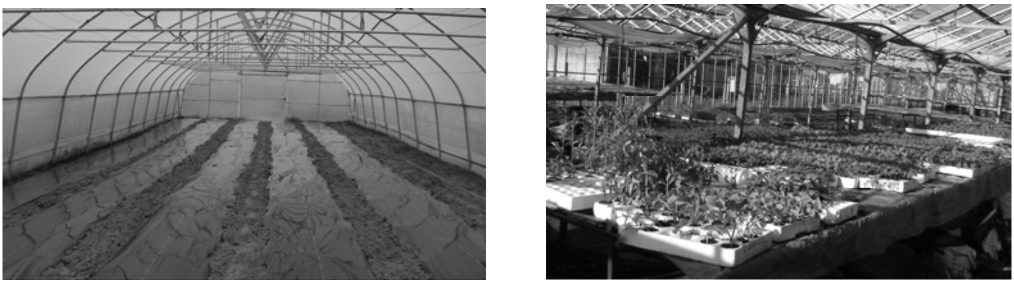
3. RESULTS AND DISCUSSION

Results obtained using AAS technique for determination of heavy metals in soil and in tomato grown in greenhouse.

Table 1. Results of some heavy metals in soil

Metal	Zn	Cd	Pb	Cu
Concentration (mg/kg)	35,25	1,5	2,77	16,25

In table 1, obtained results show that, the highest concentration in soil was for zinc, 35,25 mg/kg, and lowest for cadmium, 1,5 mg/kg.
In Federation of Bosnia and Herzegovina, soil intended for conventional and organic production for vegetables, including greenhouse production, can have maximum limits of some heavy metals, as follows Cu – 50, Pb – 20, Zn – 150, Cd – 1 mg/kg [7].
Comparing results obtained in experimental work, presented in table 1., and maximum allowed concentration for some heavy metals in soil in Federation of Bosnia and Herzegovina, their content is much less than it is predicted by valid regulation for soil.
In order to present how greenhouse for tomato production was, the following pictures show where experiment was performed.



Picture 1. a) greenhouse prepared for tomato production, b) period of flowering of tomato grown in greenhouse

The following pictures show the final product after period of vegetation, when tomato was ready to analyse.

Picture 2. a) tomato during period of vegetation, b) final product of tomato, at the end of vegetation

In the follwoing table, results of presence of heavy metals in tomato, have been shown.

Table 2. Results of heavy metals in tomato grown in greenhouse

Heavy metal	An average concentration (mg/kg)
Cu	13,864
Cd	0,005
Pb	0,005

In table 2., results show that the maximum concentration of heavy metals was determined for iron in tomato, 103,267 mg/kg, and the lowest for cadmium and for lead, 0,005 mg/kg.
According to EU regulation and valid regulation of Bosnia and Herzegovina , maximum allowed content of some heavy metals per kilo of fresh vegetables is presented in table 3.

Table 3. Maximum allowed concentration of some heavy metals in fresh matter by EU and B&H (mg/kg) [8],[9]

Metal	EU	B&H
Lead	0,1	1
Copper	5	5
Cadmium	0,05	0,05

Three above mentioned heavy metals, lead, copper and cadmium, have less content in tomato then it is allowed by valid regulation in EU and B&H. The content of copper was higher more than double concentration allowed by valid regulations, 13,864 mg/kg.

4. CONCLUSIONS

Based on above, the following can be concluded:

- Monitoring of presence of heavy metals in soil and in fresh vegetables is really important;
- Content of copper in tomato was higher than it is allowed by regulations,
- Concentration of copper in soil was not too high, but in tomato, it was, and only the way how it reached in tomato is through protection by adding pesticides from producer,
- Education on adding pesticide and protection of vegetables, has to be performed permanently.

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