ARSENIC UPTAKE IN TOMATO AND CABBAGE IRRIGATED WITH ARSENIC-CONTAMINATED WATER

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Abstract
Arsenic uptake by tomato (*Solanum lycopersicum* L.) and cabbage (*Brassica oleraceae* L. var. capitata L.) plants was studied by cultivating the plants in different soil types and irrigating them with water containing arsenic at concentrations of 0.05 and 0.2 mg As L^{-1}.

Introduction
The presence of arsenic in the agricultural soil or in groundwater used for irrigation causes abiotic stress to the plants cultivated in them. It leads to decrease in biomass production, yield, changes nutritional quality of the food, and alters the soil quality. The transfer of arsenic in soil–plant systems is a major pathway for human exposure to arsenic. As uptake by vegetables depends on the type of vegetable and the available arsenic species (Huang et al., 2006). Ground water in Hungary has naturally occurring arsenic in the range of 1-174 μg L^{-1} (Varsanyi et al., 2006), which is greater than the recommended 10 μg L^{-1} WHO standard, and this water is utilized for irrigation purpose.

Experimental
Arsenic uptake by tomato and cabbage was studied in sand, sandy silt, and silt soil by applying irrigation water containing As at concentrations 0.05 and 0.2 mg L^{-1}. Arsenic was supplied in the form of sodium arsenate. Pre-geminated seeds were grown in a pot-soil system in open greenhouse, supplied with Hoagland's nutrient solution and irrigated weekly. Arsenic accumulation in root, shoot, and fruit was analyzed at the fruiting or mature stage. The pseudo-total As concentration was determined in aqua-regia extract and the plant-available As concentration was determined by ammonium acetate-EDTA method (Lakanen and Ervio, 1971).
Upon harvest plant samples were thoroughly washed and dried at 40°C for 48hrs. The dry homogenized samples were digested in a microwave-assisted acidic digestion system using 7 cm^3 67 % nitric acid and 3 cm^3 30 % hydrogen-peroxide. The resultant solutions were diluted with deionized water up to 25 cm^3. Concentration of As was determined by inductively coupled plasma mass spectrometer.

Results and discussion
- The As content of the sand, sandy silt, and silt soil was 4.32, 6.15, and 9.02 mg kg^{-1}, respectively.
- The As concentration in plant is dependent on the plant-available As and not on the total soil As.

- Increase in As concentration of the irrigation water caused an increase in the As accumulation in the plant, and in both plants maximum As concentration was found in the roots and minimum in the leaf or fruit.
- Vegetables grown in sandy soil had the maximum As concentration and minimum biomass productivity.
- As accumulation in edible part was higher in cabbage.

Conclusion

The FAO-WHO recommended maximum tolerable daily intake limit of As is 2 μg kg^{-1} body weight. Considering this both plants grown in irrigation water containing up to 0.2 mg As L^{-1} are safe for consumption, but cabbage contributes a high amount of As in the diet. It is advised to cultivate plants at 0.05 mg As L^{-1} treatment and in silt soil to maintain an ideal biomass production and minimize As in the edible part.

Acknowledgements

This work was supported by the Hungarian Scientific Research Foundation (NVKP_16-1-2016-0044) granted to GZ and the Stipendium Hungaricum scholarship to SS.

References

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