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ECOLOGICAL ASSESSMENT OF HEAVY METAL POLLUTION OF VEGETABLE IN YEREVAN (ARMENIA)

Abstract

The article provides a review of results for 1995-2007 on ecological assessment of heavy metal pollution of vegetables growing on private home-gardens in the city of Yerevan and on sampling done in 2011 from the main markets of the city. The analysis of monitoring data indicated nickel and lead accumulation in vegetable produce emphasizing basil and pepper in concentrations which were manifold excessive vs. MAC values. The ecological expertise of vegetables in the city's markets supported a necessity of improving the control over farm produce exhibited in Yerevan's markets.

Key words: *heavy metals, pollution, vegetables, ecological assessment.*

INTRODUCTION

Presently, the issue of food product and raw food stuff safety is becoming increasingly essential due to steadily increasing levels of environmental pollution with diverse chemical contaminants, a hazard of their accumulation in food and transfer into the human organism. Especially hazardous are heavy metals due to their property to accumulate and deposit for a long period of time in compartments of natural landscapes, whereas their accumulation in farm crops and transfer via food chains into the human organism may induce diverse diseases [1, 2].

Assessing a risk of heavy metal pollution of products of plant origin is topical to Armenia owing to high contents of the noted elements in diverse compartments of urban environment (soil, water, vegetation) [6]. A social and economic crisis the

country experienced in the 1990s, heavily affected Yerevan's population and to survive people had to develop private home gardens on urban landscapes. A major part of such home gardens is located close to highways or on ecologically unfavorable sites. Main crops cultivated in such plots are vegetable and fruit species which are widely used by a considerable part of the population [3, 8].

In 1996-2007 we studied the contents of heavy metals in basic species of vegetables and herbs cultivated by local people on the territory of the city [4, 5].

This work covers the analysis of monitoring data for the noted years as well as the results of a control purchase of vegetables from Yerevan's major markets in 2011 for a purpose of assessing ecological risk of heavy metal pollution of vegetable species.

MATERIAL AND METHODS

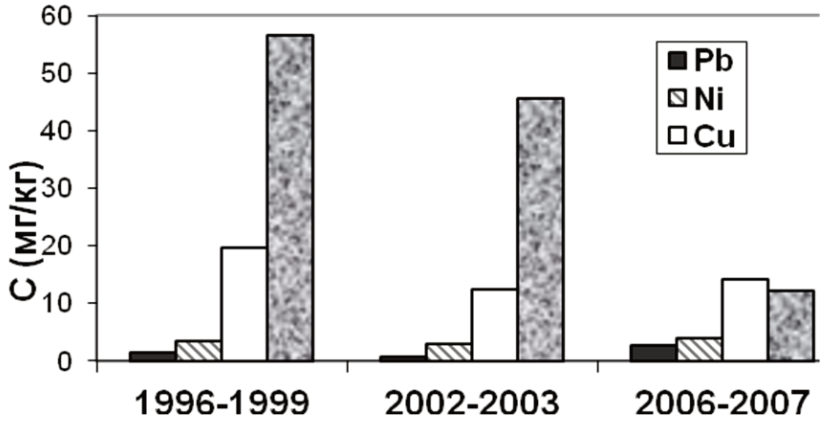
The research objects in 1995-2007 were ripe specimens of over 10 vegetable and herb species gathered from 50 private home gardens scattered all over Yerevan. The collected samples were analyzed for 10 heavy metals. This paper deals with a comparative analysis of mean contents of Cu, Pb and Ni in tomatoes, pepper, beans, parsley and basil.

In 2011 we made a control purchase (sampling) of vegetables from 6 most attended markets located in different parts of Yerevan. The studied species included pepper, tomatoes, carrot and herbs: parsley, basil and coriander. After transportation to the lab, we treated (grinding and mixing) fresh/raw material of each species and then took several samples to analyze them for heavy metals (Hg, As, Cd, Cu, Pb, Ni) and some pesticides (DDT, DDD, DDE, PCB). The contents of heavy metals were measured by a graphite atomization on Aanalyst 800 AAS (Perkin Elmer, USA) and flame atomization methods applying Method & AAS Extraction ISO-8288, ISO-5666, and ISO-11696. The obtained results were then collated with the accepted MAC values for vegetables [7] and setting maximum levels for certain contaminants in food according EC Commission Regulation № 1881/2006 and № 629/2008.

RESULTS AND DISCUSSION

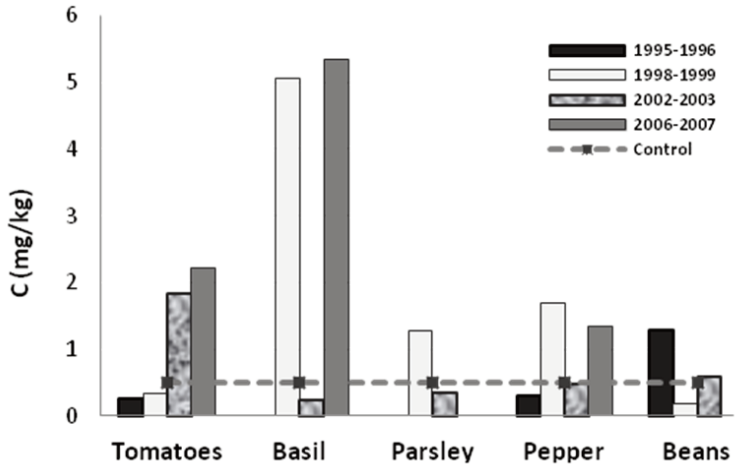
The obtained monitoring data for 1995-2007 indicated that the vegetable and herb species contained high concentrations of almost all studied elements, whereas those of Pb, Ni and Cu increased in 2006-2007 (Fig.1).

Figure1. *Mean monitoring data on elements in vegetables, Yerevan.*



Mean contents of other metals for the same period were low vs. the previous years, whereas those of elements of high level of hazard: Ng, As and Cg did not exceed the maximum acceptable level or were not detected.

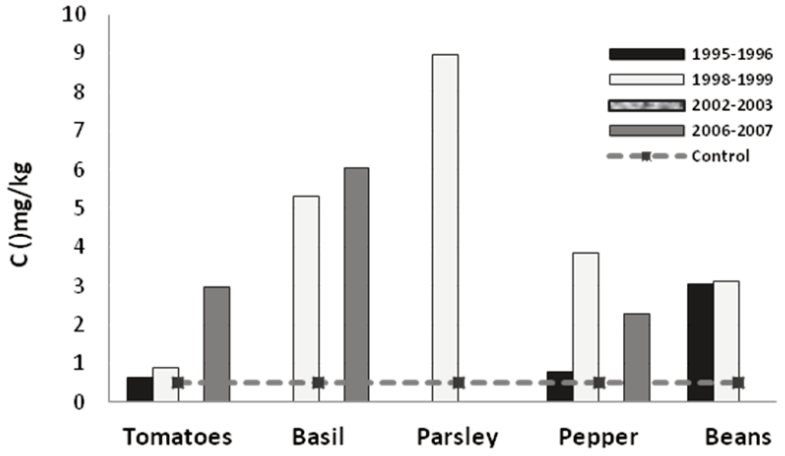
Figure 2*. Lead contents in vegetable in different years.*



Since recent years, researchers have been placing an emphasis on the issue of environmnetal contamination with nickel owing to its disclosed carcinogenic effect on a human organism [9, 11]. Our researches, performed in Yerevan, indicated nickel accumulation both in the leaves of trees and vegetables [10]. MAC value (0,5mg/kg)– exceeding concentrations of nickel were detected in all the studied vegetables and particularly herbs (by over 10 times), in pepper (by 7,7 times) and beans (by 6.3 times) betweeen 1998 and 1999. However, in 2006-2007, too, its contents in vegetables exceeded the standard by 4.5-12.1 times, this evidencing a continuously high risk of

nickel pollution of farm crops cultivatied in the city (Fig. 3).

Figure 3. *Nickel contents in vegetable in different years.*



The analysis of monitoring data on separate vegetable species indicates that herbs (basil and parsley) and pepper have the best property of heavy metal accumulation

As noted above, in 2011 we sampled vegetables in Yerevan's best attended markets with a purpose of revealing level of risks of farmcrop pollution with chemical toxicants.

Presently, Armenia is being integrated with EU norms and standards on setting maximum levels of certain contaminants in food. EU Directives and Regulations, limit only those heavy metals which are especially hazardous to human health: Hg, Cd, Pb and As, though many researchers pinpoint the hazard of high contents of other metals in food, too [11].

When analyzing samples of vegetables collected from Yerevan's main markets in 2011, we studied concentrations of Hg, As, Cd, Cu, Pb and Ni, and as well as residual concentrations of some pesticides (DDT, DDD, DDE and PCB). The results of chemical analyses were then collated with standards accepted in the EU countries.

Wholly, metal contents in the vegetable samples did not exceed the accepted values except nickel which concentrations were 1,5 times excessive vs. MAC in carrot and tomatoes samples collected from one of markets. Especially hazardous were extremely high contents of cadmium in pepper sampled in one of Yerevan's central markets: by 214 times excessive vs. the accepted levels (0.03 mg/kg). The repeated chemical analysis of those samples verified the obtained result. Only the supposed site of cultivation of the noted vegetables is known, whereas the sources of high contents of cadmium have not been disclosed so far.

The herbs displayed no high concentrations of metals. No residual quantities of pesticides in all the vegetable sample were detected either.

CONCLUSION

Thus, the analysis of monitoring data on pollution with chemical contaminants indicated nickel and lead accumulation in vegetables and particularly in basils and pepper, grown on private home gardens in Yerevan, in concentrations which were manifold excessive vs. the accepted standards.

Vegetable sampling in Yerevan's main markets and subsequent chemical analyses of the samples indicated a necessity of improving ecological and sanitary control over farm produce brought to Yerevan's markets from Armenia's regions.

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EKOLOŠKA PROCENA ZAGAĐENjA POVRĆA TEŠKIM METALIMA U JEREVANU (JERMENIJA)

Apstrakt

Ovaj rad daje pregled rezultata, za period 1995-2007. Godine, ekološke ocene zagađenja teškim metalima povrća iz privatnih bašta u gradu Jerevanu i uzoraka uzetih 2011. godine sa glavnih gradskih pijaca. Analiza podataka dobijenih monitoringom pokazala je akumulaciju nikla i olova u biljnim proizvodima, naročito u bosiljku i biberu, u koncentracijama višestruko iznad vrednosti MAC. Ekološke ekspertize povrća na gradskim pijacama potvrdile su neophodnost poboljšanja kontrole poljoprivrednih proizvoda na Jerevanskim pijacama.

Ključne reči: *teški metali, zagađenje, povrće, ekološka procena.*

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