Research Journal of Environmental Sciences

ISSN 1819-3412

Academic
Journals Inc.

www.academicjournals.com

Research Journal of Environmental Sciences 3 (3): 339-344, 2009
ISSN 1819-3412

Determination of Pb, Ni, Hg, Cr, Cd in Edible Vegetables in the West South of Tehran Province with Atomic Absorption

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Abstract: In this research, edible vegetables from Babasalman and Eslamshahr regions were sampled in summer 2007 from farms for which well water was used. The samples were then prepared and concentration of the trace elements were determined by using atomic absorption spectrometry in Iranian Atomic Energy Agency. According to the analysis the minimum and maximum concentration of Pb 0.0050±0.0001 ppm in mint (stem) of Babasalman and 0.0645±0.0010 ppm in radish (leaf) of Eslamshahr, Ni 0.0004±0.0001 ppm in radish (root) of Babasalman and 0.0175±0.0001 ppm in bulbil (root) of Eslamshahr, Cr 0.0903±0.0006 ppm in radish (root) of Babasalman and 0.8801±0.0036 ppm in mint (leaf) of Eslamshahr, respectively. Minimum of Cd concentration was lower than detection limit of spectrometer and maximum was 0.0816±0.0002 ppm in radish (leaf) of Babasalman and concentration of Hg was lower than detection limit of spectrometer in all of the samples and only was 0.1399±0.0002 ppm in cress of Babasalman.

Key words: Vegetables, heavy metals, Eslamshahr, Babasalman

INTRODUCTION

This study provides data on five trace elements in Iranian edible vegetables. Some of these metals such as Cd, Hg, Pb, are being potentially toxic. Nickel is one of the newest trace-elements for which the position as to their essentiality or toxicity is not fully explored. It should be stressed that the actual physiology and metabolism and thus also the toxicity of each of the newer trace elements and others depend on various factors, among others the physico-chemical form of trace element. This physico-chemical form influences absorption, accumulation, release, body distribution and physiological effect of the trace element under consideration (Gharib, 2004a, b). The another one is chromium with three oxidation number is essential trace element (Elmadfa and Leitzman, 2004) but with six oxidation number is toxic. The effects of trace elements in water, plants and animals tissues are very important. It is mentioned that plants can absorbed them from different sources such as: factories activity, workshop, fuels, agriculture activities, sewage, waste and environmental air pollution. Plants absorb them through water, soil or air. The amount of absorption is the function of soil components. In light sandy soils, amount of pollution is less than other kind of soils. This type of soil which has a few amount of clay and humus, can hardly absorb heavy metals, where as absorption increase in soils which have more clay and humus compound (Simeonova and Todorova, 2003). In addition, soil acidification can cause increased risk mobilization of heavy metals. At low pH value in soil the release rates for cadmium and aluminium increase considerably (Barthwal, 2002). By increasing in atomic mass of metal, its absorption by plant is more and the transferring factor will be more. Through this results for elements like, Cd with lower atomic mass the transfer factor is 1-10 and the mobility from earth to plants is very high, for Ni with average mass atomic, transferring factor is 0.1-1 and ion mobility is suitable and for Pb, Hg elements. Because of their high atomic mass, transferring factor becomes 0.01-0.1 and lack of ions mobility is very high (Uchida *et al*., 2007). After entering heavy metals from soil to plants like vegetables these metals will enter people's diet. And according to the amount of people's daily meal, they appear their effects. In Iran, vegetables have special place in people's diet.

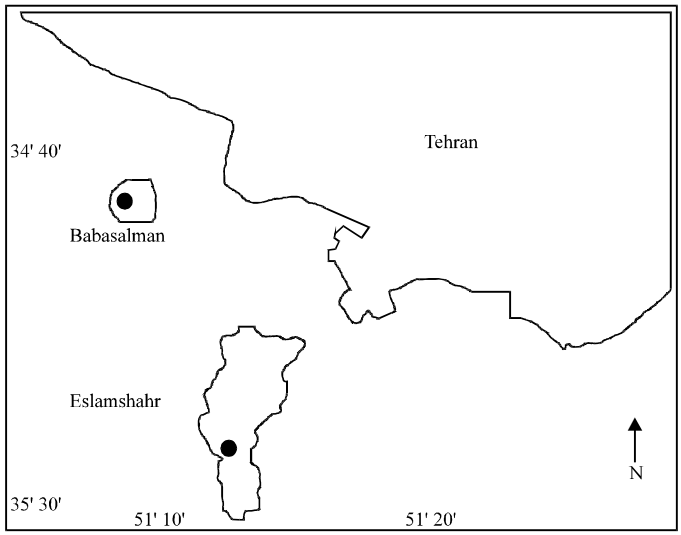

Fig. 1: The sampling points of Babasalman and Eslamshah

The amount of daily receiving is 278 g in Iran (Gharib *et al*., 2003). Which is more than many other countries like Bangladesh with amount of daily receiving 130 g (Alam *et al*., 2003). It is important to measure heavy metals in Tehran as there is the most popular province in Iran; therefore vegetables safeties in this province have been investigated. Offering conclusions to organizations in addition of helping health society and prevent appearing some diseases, will be an introduction for future researches.

MATERIALS AND METHODS

This study have been done of the summer 2007 in Babasalman and Eslamshahr regions from earths sampling that irrigate with dimple water was done. Figure 1 shows the sampling points.

The samples were with stem, leaf and they were with root too and numbers of them were twelve from each plant. All samples have been wet digested in nitric acid 65% and per choleric acid 75% (Nollet-Leo, 2004). Dried weight of each digested vegetables were 1 g and all vegetables were in 90 days age. Metal concentration survey by atomic absorption flame photometric model of Varian A110. In order to statistical calculates in descriptive analysis and illative research from statistic Z (normal distribution) various t-test, ANOVA analysis in have been determined by SPSS soft ware.

RESULTS

According to Table 1 and 2, the minimum and maximum concentration of lead is 0.0050 and 0.0645 ppm, nickel is 0.0004, 0.0175 ppm, mercury is ND (Non Detectable) and 0.1399 ppm, chromium is 0.0903 and 0.8801 ppm, cadmium is ND (Non detectable) and 0.0816 ppm, in vegetables is under study, respectively.

Figure 2a-h show the percentage of metals concentration in vegetables that they were studied. Base on Fig. 2a-d, the maximum percentage of metals concentration are in radish (leaf) among the other vegetables of Babasalman region, but Ni is an exception than other and maximum of concentration of it is in mint (leaf). As Fig. 2b-h show maximum percentage of concentration of metals in Eslamshahr region are different from variety of vegetables in which Pb in radish (leaf), Ni in bulbil (root), Cr in mint (leaf) and Cd in radish (leaf) and bulbil.

Table 1: The average of metals concentration (ppm) in vegetables of Babasalman region

No.	Vegetable variety	Pb	Ni	Hg	Cr	Cd
1	Mint 1 (leaf)	0.0030±0.0002	0.0107±0.0002	ND	0.3263±0.02672	0.0065±0.0001
2	Mint 1 (stem)	0.0050±0.0001	0.0061±0.0002	ND	0.2337±0.0010	0.0021±0.0002
3	Radish 2 (leaf)	0.0145±0.0010	0.0082±0.0001	ND	0.5304±0.0001	0.0816±0.0002
4	Radish 2 (root)	0.0005±0.0002	0.0004±0.0001	ND	0.0903±0.0006	0.0052±0.0001
5	Radish 2 (stem)	0.0045±0.0010	0.0048±0.0001	ND	0.3297±0.0001	0.0317±0.0001
6	Basil 3 (leaf)	0.0096±0.0001	0.0020±0.0010	ND	0.1192±0.0002	0.0189±0.0010
7	Basil 3 (stem)	0.0074±0.0001	0.0026±0.0002	ND	0.1800±0.0045	0.0117±0.0001
8	Cress 4	0.0084±0.0003	0.0047±0.0005	0.1399±0.0002	0.3043±0.0027	0.0665±0.0021
9	Coriander 5	0.0049±0.0004	0.0023±0.0001	ND	0.1924±0.0017	0.0105±0.0004
10	Leek 6	0.0063±0.0001	0.0031±0.0003	ND	0.2378±0.0014	0.0172±0.0011

*ND: Non Detectable, 1: *Mentha spicata* L., 2: *Raphanus sativus*, 3: *Ocimum basilicum*, 4: *Lepidium sativum*, 5: *Coriangrum sativum* 6: *Allium ampeloprasum* ssp. *persicum*

Table 2: The average of metals concentration (ppm) in vegetables of Eslamshahr region

No.	Vegetable variety	Pb	Ni	Hg	Cr	Cd
1	Mint 1 (leaf)	0.0086±0.0010	0.0112±0.0002	ND	0.8801±0.0036	ND
2	Mint 1 (stem)	0.0143±0.0002	0.0064±0.0002	ND	0.6302±0.0002	ND
3	Radish 2 (leaf)	0.0645±0.0010	0.0078±0.0007	ND	0.4366±0.0010	0.0530±0.0001
4	Radish 2 (root)	0.0005±0.0002	0.0037±0.0001	ND	0.1676±0.0010	ND
5	Radish 2 (stem)	0.0195±0.0010	0.0064±0.0010	ND	0.3209±0.0010	0.0401±0.0002
6	Basil 3 (leaf)	0.0210±0.0010	0.0043±0.0002	ND	0.2169±0.0002	0.0315±0.0002
7	Basil 3 (stem)	0.0161±0.0002	0.0054±0.0002	ND	0.3372±0.0002	0.0193±0.0001
8	Bulbil 4 (leaf)	0.0084±0.0001	0.0027±0.0010	ND	0.2009±0.0010	0.0032±0.0010
9	Bulbil 4 (root)	0.0263±0.0001	0.0175±0.0001	ND	0.7175±0.0001	0.0525±0.0001

*ND: Non Detectable, 1: *Mentha spicata*, 2: *Raphanus sativus*, 3: *Ocimum basilicum*, 4: *Allium schoenoprasum* L.

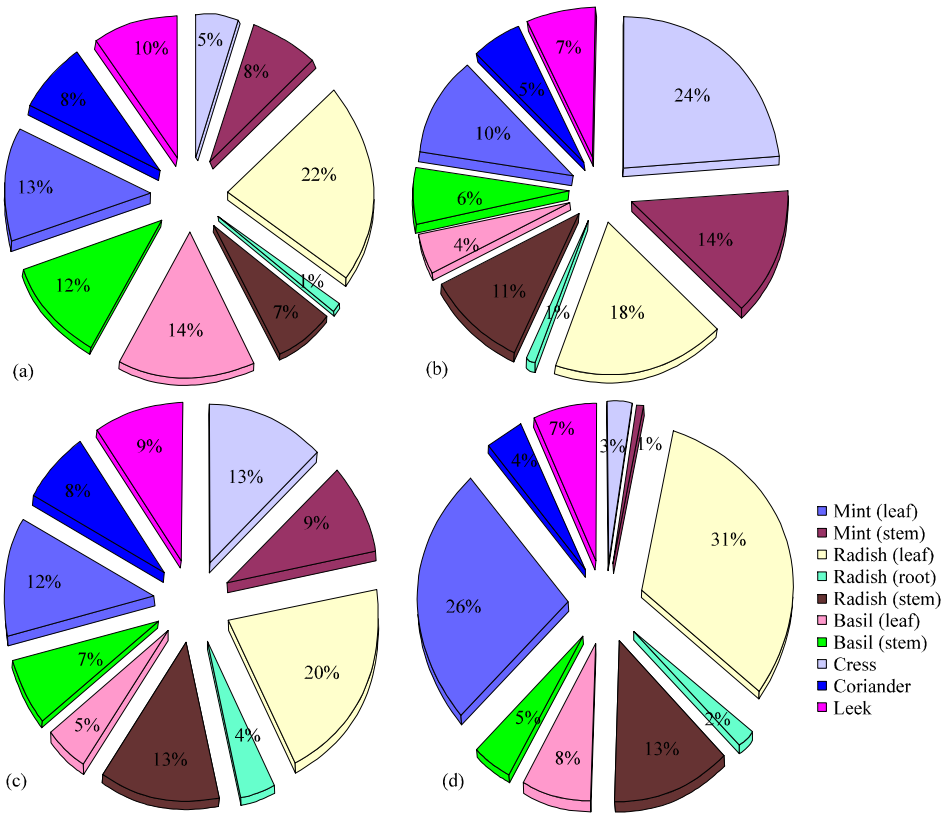

Fig. 2: Continued

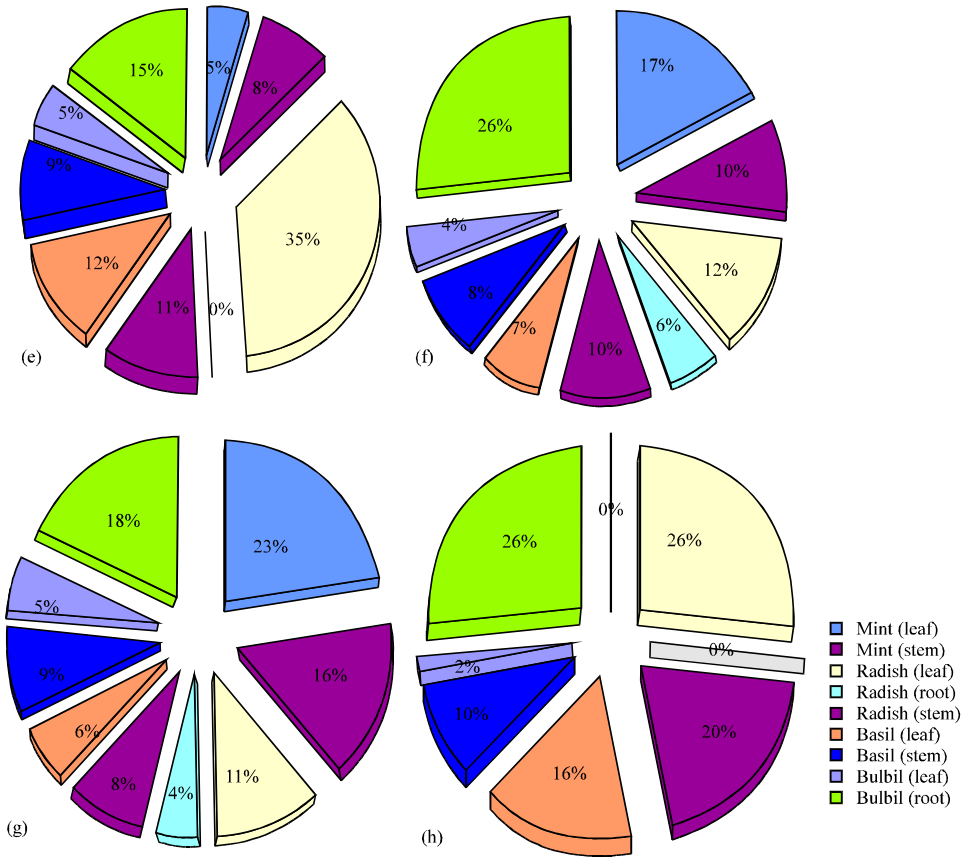

Fig. 2: The maximum percentage of metals concentration (a) Pb% Babasalman vegetables, (b) Ni% Babasalman vegetable, (c) Cr% in Babasalman vegetable, (d) Cd% in Babasalman vegetable, (e) Pb% in Eslamshahr vegetable, (f) Ni% in Eslamshahr vegetable, (g) Cr% Eslamshahr vegetable and (h) Cd% in Eslamshahr vegetable

DISCUSSION

Through this research, the concentration of trace elements is lower than NBS1571 standard. In this case, it is important to notice the amount of daily receiving of trace elements from foods in Iranians diet and their amount of their received of daily vegetables. Results of research (Gharib *et al*., 2003) show that the amount of daily receiving of Cd, Cr, Hg, Ni, Pb in Iranian women are in this order 0.027, 0.05, 0.057, 0.1999, 0.091 mg and in the Iranian men are 0.046, 0.050, 0.017, 0.36, 0.109 mg. Also through the same research, the amount of vegetables that Iranian receives daily is 278 g. This amount has the fourth place in diet of Iranian, after water, corns and bread (Gharib *et al*., 2003).

Selecting the type of vegetables in this examination is not only important because of the usage of them in the part of the Iranian diet, but also because these vegetables except radish are leafy vegetables which can be used as proper new animator of heavy metals. From the results of research (Temmerman and Hoeing, 2004) it can be understood that there is a lot of attention to leafy vegetables due to their heavy metal absorption and absorption and association of metals in the vegetables have relationship with component of metals in the soil and special characteristics of that plant. In Wang *et al*. (2004)

research, the concentration of metals in greenery and rootstalk vegetables like bean, cauliflower, celery, cabbage and eggplant were higher than those in the melon and fruit and also in the study of Xie *et al*. (2006) the heavy metal concentration in vegetables is more than cabbage because of their higher absorption. In this study the amount of Pb, Cd in the radish root is lower than other vegetables which that all of them are leafy vegetables. According to the study of Li *et al*. (2004) the amount of Zn, Pb, Cd in the root vegetables are lower than their concentration in leafy vegetables.

The study of metals concentration in leaf, root and stem of radish in Eslamshahr and Babasalam regions shows that the concentration of Pb, Ni, Cr, Cd in the parts of this plant have this order root <stem <leaf. Statistical study (ANOVA) concluded that the metals concentration in leaf, root and stem of radish in Eslamshahr and Babasalam regions shows the significant difference of metals concentration about $p<0.05$ in the leaf, root and stem. Study of metals concentration in leaf and root of bulbil at Eslamshahr region shows that metals concentration in leaf of bulbil is lower than in its root; also the results of the statistical study of (paired t-test) there is a significant difference of metals concentration in leaf and root of bulbil about $p<0.05$.

Study of metals concentration in leaf and stem of basil shows that the concentration of Ni, Cr, in the stem is more than leaf and the concentration of Cd and Pb in leaves are more than stems. Also statistical study of (paired t-test) shows the significant difference of $p<0.05$ in metals concentration in stem and leaf of this plant in Eslamshahr and Babasalam regions.

Determination of metals concentration in leaf and stem of mint in two Eslamshahr and Babasalam regions shows that the concentration of Ni, Cr in their leaf is more than in their stem and the concentration of Pb in stem is higher than in its leaf. Concentration of Cd in both stem and leaf were reported ND in Eslamshahr and Babasalam and its concentration in leaf is more than stem. Statistical study also shows significant difference of $p<0.05$ about metals concentration in mints stem and leaf. Study and comparing the concentration of metals in vegetables of Babasalam and Eslamshahr regions shows that there is a significant difference of $p<0.05$ between its concentration vegetables in these two regions and usually this concentration is higher in Eslamshahr vegetables. As we know Babasalam is a small region and do not have any industrial center, but Eslamshahr is a wider region that in addition to its residential houses, it has some little industry centers.

From Demirezen and Aksoy (2006) study it would be understood that, there is significant difference between vegetables of cities and villages. It is important to mentioned that this research becomes complete when we study and determine the concentration of metals in the soil of regions; because an important factor that increase the metals concentration in plants is the increasing of metals concentration in soil or chemical fertilizer of that region (Wu-Zhong *et al*., 2002) and this factor needs an essential attention about all metals that examined; because although the average of all metals is lower than NBS1571 standard but in many cases their amount is more than the receiving amount of Iranians men and women that this matter can cause a lot of problems.

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