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Measurement and Comparison of Heavy Metals Concentration in Vegetables Used in Mashhad

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Abstract

***Background*:** In This study some vegetables' (mint, leek, radish and scallion) cadmium and lead metals level was investigated in two areas (west, east) of Mashhad from May to October 2011.
***Materials and Methods*:** The amount of heavy metals was determined by graphite atomic absorption after acidic digestion of the samples and the data were analyzed.
***Results*:** The results indicated that maximum and minimum level of lead concentration was found in two areas: scallion of east (42.13mg/kg) and radish of west (17.76 mg/kg) respectively which were Leek (0.89 mg/kg) and scallion (0.22) of east for cadmium.
***Conclusion*:** The survey of heavy metals is needed to assess health hazards, food safety, and security.

Introduction

The uptake and bioaccumulation of heavy metals in vegetables are influenced by many factors such as climate, atmosphere depositions, the concentration of heavy metals in soil, the nature of soil and the degree of maturity of the plants while harvesting [1]. Atmospheric deposition was identified as the dominant pathway for lead (Pb) to penetrate in leafy vegetables [2-3]. The translocation factors showed that metals' accumulation was mostly observed in roots. Compared to other heavy metals, cadmium (Cd) seemed to be much more hazardous [4]. The contamination of vegetables by heavy metals can be due to their irrigation by wastewater [5], fertilizer and pesticide [6]. Consumption of lead or cadmium-contaminated vegetables can pose a significant health risk to humans [7]. The maximum allowable concentration of lead and cadmium in plant for human consumption is 0.1 and 5 mg/kg respectively [8]. According to FAO, the level of allowable entrance cadmium to the human body is 0.4-0.6 mg/person weekly [9].

Heavy metals are persistent and accumulative; therefore the level of these metals is needed to be monitored carefully with the aim of making sure of their concentration and their comparison with standard levels. This study was carried out to investigate the vegetable's (mint, leek, radish, and scallion) cadmium and lead metals' level in two areas (west, east) of Mashhad.

Materials and Methods

This is an analytical-descriptive In this experiment some vegetables' (mint, leek, radish, and scallion) cadmium and lead metals' levels were evaluated in Mashhad's west (Shandiz) and east (across Mashhad power plant) which are the two most important areas of vegetable production from May to October 2011 (the time of vegetables' harvesting in Mashhad). Hence, samples were collected from central square fresh fruit vegetables. From each intended area and type of vegetable, three samples were collected. The samples were washed with tap water, rinsed with distilled water, dried in an oven at 105 ˚C for 24 to 48 h, and then 0.5 g of each sample was weighed and digested (acid digestion) according to the method of AOAC, 1998 [10]. The amounts of heavy metals were determined by graphite atomic absorption Varian model. The data were analyzed by SPSS-16, Version 16. A probability level of $p<0.05$ was considered statistically significant. Statistical tests included post hoc (LSD, Tamhane) and univariate.

Results

The mean heavy metals concentration (lead and cadmium) of mint, leek, radish, and scallion samples during the months of sampling are listed in table 1. The total mean concentration of lead and cadmium of every month sampling of studied vegetables was compared with their standard concentration according to WHO and FAO which is ranges 0.2-0.8 mg/kg for cadmium and 0.1-10 mg/kg for lead. According to the table, the total mean concentration of cadmium in studied vegetables ,except leek, was in determined standard limits for the plants (0.2, 0.8 mg/kg) but concentration of lead was higher than standard (0.1, 10 mg/kg).

Table 1. The mean Pb and Cd Concentration of vegetables in during the months of sampling at 95% confidence intervals

Month Vegetable	May	June	July	August	September	October	Total Mean of Sampled Menthes
				Pb			
Mint	No sample	23.29	25.81	58.63	38.43	23.43	33.92
Leek	36.09	18.79	43.58	53.78	34.16	19.78	34.36
Radish	23.85	13.66	No sample	46.33	25.32	No sample	27.29
Scallion	22.95	21.45	No sample	58.71	No sample	No sample	34.37
				Cd			
Mint	No sample	0.42	0.54	0.54	0.47	0.73	0.54
Leek	0.41	0.56	0.18	2.99	1.27	0.52	0.98
Radish	0.68	0.30	No sample	0.45	0.45	No sample	0.47
Scallion	1.11	0.25	No sample	0.26	No sample	No sample	0.54

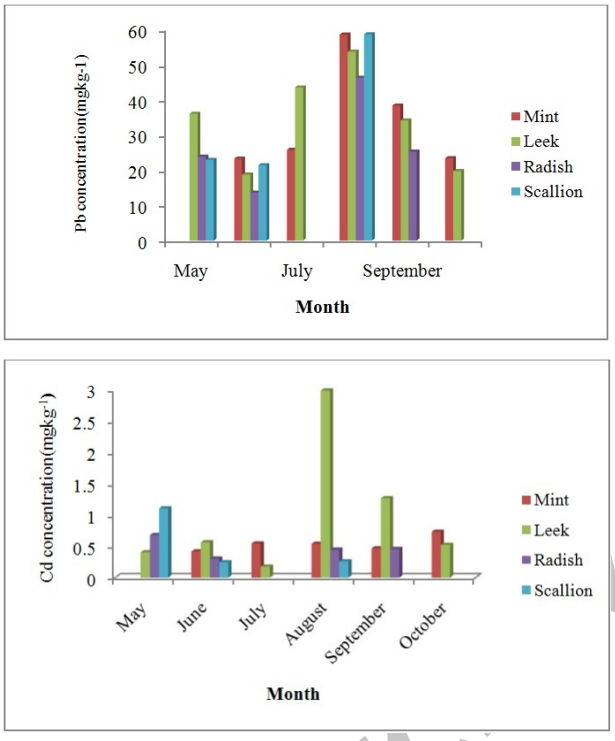

Figure 1. The mean Pb and Cd concentrations of studied vegetables

The graph is designed to compare Pb and Cd concentrations during the months of sampling. Considering the mean lead concentration in different vegetables and months, the maximum and minimum concentration was observed respectively in scallion of August (58.71 mg/kg) and leek of September (19.78 mg/kg) and for cadmium in leek of August (2.99 mg/kg) and scallion of June (0.25 mg/kg) respectively

The mean lead and cadmium concentration was determined in west and east areas studied vegetables. The mean Cd concentration mint, leek, radish, and scallion was observed in west area, 0.39, 0.71, 0.74, 0.46 mg/kg respectively and 0.59, 0.89, 0.22, 0.52 mg/kg respectively in east area and also, for Pb 17.76, 20.15, 31.12, 21.46 mg/kg and 27.79, 42.13, 35.72, 38.08 mg/kg respectively in west and east areas. Also, the mean Pb concentration in these areas was above standard limits and the mean Cd concentration, except leek of east area, in standard limit. The maximum and minimum concentration of Pb in leek and radish of west area was observed to be 31.12 and 17.76 mg/kg and scallion and radish of east area, 42.13, 27.79 mg/kg. The maximum and minimum concentration of Cd in west and east was 0.39, 0.74 mg/kg for leek and radish and 0.22, 0.89 mg/kg for leek and Scallion.

Maximum and minimum concentration of Pb was respectively observed in scallion of east and radish of west (42.13 and 17.76 mg/kg respectively) which were observed in leek and scallion of east for Cd, (0.22, 0.89 mg/kg, respectively). So, the maximum concentration of Pb and Cd was observed in Mashhad east area. Also, Cd and Pb concentrations are different in studied vegetables. The maximum and minimum concentration of Pb was observed in leek (33.88 mg/kg) and radish (24.45 mg/kg) which were leek (0.83 mg/kg) and Scallion (0.46 mg/kg) for Cd.

Discussion

The results indicated that the average concentration of cadmium in the vegetables studied was in proposed standard limits for plant (0.2, 0.8 mg/kg) but concentration of lead was higher than standard (0.1, 10 mg/kg).

The total mean of Pb concentration in leek, mint, radish, and scallion samples during the sampling months were 34.36, 33.92, 27.29, 34.37 mg/kg. The mean Pb concentrations of the same plants in west area were as follows: 21.46, 31.12, 20.15, and 17.76 which were 38.07, 35.72, 42.13, and 27.79 in east area. Considering the total mean of Cd of leek during the sampling months in both areas, the one related to east area (0.89 mg/kg) was higher than standard. So, time and location influence the mean Pb and Cd concentration. According to analyzed heavy metals concentration, the mean Pb concentration was higher than Cd in studied vegetables.

So, according to this study, the level of accumulation and uptake of Pb and Cd in leek (leafy vegetables) is higher than radish (Glandular vegetables). These results are in accordance with the experiment carried out by Banerjee et al. who reported that lead concentration in all washed samples of cauliflower and spinach exceeds the allowable standard limit but cadmium concentration didn't exceed the safe value. Besides, heavy metals deposition may be due to a wide range of sources such as small scale industries, vehicular emissions, and re-suspended road dust and coal combustion [7].

Gupta et al. showed that the volatile metals such as arsenic, mercury were mostly found in rhizomes of the studied plants and plants absorb Cd from their roots [11] Song et al. showed that the concentrations of As, Cr, Cu, Cd, Pb and Ni (but not Zn) in local-produced vegetables or the ones from open-fields were all higher than those grown in greenhouses or provincial vegetables [12]. Zheng et al .concluded that Transfer factor (TF) of heavy metals from soil to vegetable decreases in the order as follows: Cd>Zn>Cu>Pb>Hg. Furthermore, TF of leaves are higher than other tissues [13]. Nabulo et al. reported that Elevated concentrations of Pb and Cd were found particularly in leafy vegetables. Some other studies show that high level of Pb in roadside soils and leaves of vegetables is related to traffic density. Also, it is recommended that roadside farming activities in the city are safest at a distance of 30 m from the edge of the road, especially along busy highways. It is reported that washing reduces the Pb and Cd concentration in many of the vegetables [3].

Also, Torabian et al. reported that level of accumulation of Pb in leek is higher than radish but in radish is higher than leek for Cd [14], While Nazemi et al. reported that level of accumulation Pb in root of radish is higher than leek and about Cd it is vice versa [15]. Also, Dadban et al. observed that the mean concentration of Pb and Cd in leafy vegetables (Spinach, Penny) is higher than Glandular ones (radish) [8].

In another study, Rad et al. found that leek is more sensitive than Mint and Lettuce for uptake of Cd but none of studied vegetables was affected by Pb concentration in water. Finally, the high levels of lead and cadmium in studied vegetables may be due to their close distance from road, human activities in surrounding areas (factories, power plants), and the use of wastewater for irrigation or overuse of fertilizer. Therefore, survey of heavy metals is critical to assess health hazards, food safety, and security. Moreover, farmers should be trained to provide their agricultural lands in the safest distance from road, factories, power plants and highways, and people must be warned to use vegetables with lower Pb and Cd concentration.

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Authors' Contributions
All authors had equal role in design, work, statistical analysis and manuscript writing.

Conflict of Interest
The authors declare no conflict of interest.

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