**Advances in Bioresearch**
Adv. Biores., Vol 7 (1) January 2016: 13-17

Print ISSN 0976-4585; Online ISSN 2277-1573
Journal's URL:http://www.soeagra.com/abr.html
CODEN: ABRDC3
ICV Value 8.21 [2014]

Advances in Bioresearch

## ORIGINAL ARTICLE

# Investigating the amount of Cadmium and Lead in Edible Vegetables such as; Leek, Parsley, Dill, Coriander and Fenugreek Cultivated in Jiroft Area

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**ABSTRACT**
*The entering and accumulation of heavy metals into agricultural lands are mainly caused by industrial activities, fertilizers, animal manures, municipal sewages, pesticides and composts. To evaluate the contamination levels in some edible vegetables caused by cadmium and lead, the concentrations of these elements were investigated in cultured samples collected from Jiroft city. During January to March, 150 samples (50 samples per month) of leek, coriander, dill, parsley, and fenugreek were selected from vegetable fields. Then the samples were separately washed with distilled water and rinsed, after that they were dried thoroughly. At this point, acid digestion was performed on the samples and the concentrations of soluble heavy metals were measured using atomic absorption machine (Aanalyst-400 made in America).SPSS software version 19 was used for data analysis. It was found in this study that the average concentration of cadmium in vegetables is relatively reasonable and in the standard range, but the average concentration of lead in most vegetables is in the high levels of the standard range.*
***Keywords****: Cadmium, lead, vegetables, Jiroft.*

Received 21/08/2015 Accepted 19/12/2015

**How to cite this article:**
Hossein B, Saleh S, Mohammadreza M S. Investigating the amount of Cadmium and Lead in Edible Vegetables such as; Leek, Parsley, Dill, Coriander and Fenugreek Cultivated in Jiroft Area. Adv. Biores., Vol 7 [1] January 2016: 13-17**.** DOI: 10.15515/abr.0976-4585.7.1.1317

## INTRODUCTION

Due to toxicity, inseparability and accumulation, heavy metals are among the most dangerous contaminants of the natural environment. So the insertion of natural and artificial heavy metals into plants, results in the accumulation of them in tissues and organs. These accumulations of the contaminants in animals 'bodies are more important than their risk of toxicity [1]. Entering and accumulation of heavy metals in agricultural lands are mainly caused by industrial activities, fertilizers, animal manure, municipal waste, compost and pesticides [2]. Due to the potential transfer of heavy metals to humans and animals through agricultural products, the impact of agricultural activities on the accumulation of the elements has been considered particularly in arable lands[3]. Vegetables containing different vitamins and nutrients are among the most valuable foods; due to the high consumption of vegetables by many people, ensuring the safety of them is of utmost importance [4]. The entering of heavy metals into the food chain and their reaching to a critical concentration result in harmful metabolic and physiological effects on living organisms [5]. Cadmium is an element with an atomic weight of 112/4, which can cause kidney damage, high blood pressure, mutagenesis and carcinogenesis [6]. The most known toxic effects of cadmium on humans are Itai-Itai disease. The symptoms of this disease are; severe bone pain and in most cases, death [7]. The normal amount of cadmium that enters the body through food is 10-50 mg per day [8]. The amount of cadmium in plants –for human consumption-shouldn't exceed 0.1mg/kg [9]. Some plants easily absorb cadmium through the roots and maintain it in much higher concentrations as opposed to other plants. The amount of cadmium in plants may vary depending on the

plant species, the root environment and the culture time [10]. The amount of cadmium in contaminated plant is 5-30mg / kg [11, 12]. The atomic number of lead is 82. It enters into the environment through casting and leaded gasoline. If the amount of lead in the blood of children exceeds 400 micrograms per liter, it will cause mental retardation. Lead also results in fatigue, abdominal pain, anemia, impaired respiration and influences nervous system [13]. The maximum permitted concentration of lead inplantsis5mg / kg while the lead levels in contaminated plants are 30-300mg / kg [11]. Gupta *et al.* [14] investigated the concentration amount of lead, zinc and cadmium in spinach and radish in tropical region of India. It was shown in this study that the concentration of these elements is high and this high amount leads to the accumulation of the metals in vegetables. The studies of Cheraghi on the safety risks of heavy metals in parsleys harvested from Hamadan farms showed that the average concentrations of cadmium and lead in this vegetable is above the standards announced by the FAO and WHO. However, the average concentrations of nickel and zinc in the plant are lower than the standards [15]. The results of the researches of Torabian and Mahjoury [16] on the southern lands of Tehran showed that many plants contain excessive chromium and cadmium and the accumulation of cadmium in families of Chenopodiceae and Brassicaceae is more than others [16]. Nazemi and Khosravi conducted a research on the status of heavy metals in soil, water and plants of Shahroud's vegetable farms, they found out that there were some significant differences between the average concentrations of heavy metals in vegetables, water and soil of vegetable farms and standard values; however, there weren't any significant differences between the amount of zinc and the standard values. They also found that the concentrations of lead, chromium, cadmium and arsenic in vegetables are higher than usual [17]. The studies of Nazemi et al. on the amount of heavy metals in the farmed vegetables of Shahroud's suburbs showed that except for zinc and arsenic, the average concentrations of chromium, cadmium and lead were more than the standards proposed by FAO & WHO; in addition, they claimed that the most important cause of contaminated vegetables was urban and industrial wastewater [18]. Mohammadi [19] suggested that the absorption of heavy metals in leafy vegetables was much more than root and tubers vegetables. Some vegetables like parsley possess high capabilities of heavy metals 'absorption such as cadmium, nickel, lead and zinc [20]. Given that Jiroft is one of the poles of producing vegetables in Kerman province, and also because of the importance of safety matters and environmental issues in the amount of heavy metals and their role in human health, the amounts of cadmium and lead in leek, parsley, dill, coriander and fenugreek was determined in this study.

## MATERIALS AND METHODS

To check the status of the amount of heavy metals in vegetables, the study was carried out for 3 months from January to March, 2014 on vegetable farms of Jiroft city. The samples were collected randomly from vegetable fields of three regions of Jiroft namely; Hossein Abad, Saheb Abad and Jangal Abad. The samples were picked from the beginning, middle and end of the farms. Half a kilogram vegetable was harvested from every type of samples, so that we could investigate the average status of every farm in terms of heavy metal contamination. Thus, 150samples (50 samples per month) of leek, coriander, dill, parsley, and fenugreek were selected from vegetable fields. The sampled vegetables were separately washed with distilled water and rinsed, then they were put into an oven at75°C for48-72 hours to dry thoroughly. 0.5 gram of samples were weighted with accurate scales and put in a furnace eat 500°C for 4 hours, and ash was produced, acid digestion method for each sample was carried out according to standard methods of F3030 and H3030 [21]. The concentrations of soluble heavy metals were measured using atomic absorption machine (Aanalyst-400made in America).SPSS software version 19 was used for data analysis and the results were expressed as ANOVA and Duncan's test.

## RESULTS

The results of measuring the amount of cadmium and lead in farmed vegetables of Jirfot are shown in Table 1. These results are the average concentrations of heavy metals in terms of mg/kg and in the upper and lower limits.

According to Table1 and 2 the average concentration of cadmium in these vegetables is not equal, and this difference is not statistically significant ($p<0/05$); in addition, coriander possesses the highest average concentration of cadmium (0.522mg/kg) and dill possesses the lowest average of concentration (0.289 mg/kg). The highest average concentration of lead can be observed in parsley (10.539 mg/kg) and the lowest average concentration of this heavy metal is observed in dill (9.750 mg/kg); however, according to the statistical analysis there isn't any significant difference between the average concentration of lead in the vegetables ($p <./ 05$). As it is shown in figure 1, Parsley has the most cadmium and lead concentration when comparing with other vegetables. The average concentration of these metals and their absorption

ranges are presented in Table 1. According to this table, except for parsley, the average concentration of lead in vegetables follows the food standard permitted limits through plants (1-10 mg/kg). Also, the average concentration of cadmium in vegetables follows the food standard permitted limits through plants (2 – 8 mg/kg). Therefore, the amount of heavy metals in vegetables is in consistent with WHO and FAO standards.

Table 1: Mean absorption of heavy metals according to vegetables (mg/ kg)

| **Vegetable** | **Cadmium** | **Lead** |
|---|---|---|
| Leek | 0.391<br>0.85 - 0.1 | 9.756<br>12-6.5 |
| Parsley | 0.377<br>0.7 - 0.2 | 10.539<br>13.4-5.8 |
| Dill | 0.289<br>0.35 - 0.2 | 9.75<br>11.3- 6.35 |
| Coriander | 0.522<br>2 - .15 | 9.46<br>12.15-5.6 |
| Fenugreek | 0.4<br>1.45 - 0 | 9.64<br>12-6.25 |
| Significance level (Sig) | 0.205 | 0.436 |

Table2:Analysis of variance analysis to determine the difference between the accumulation of cadmium and lead in vegetables

| Metal | Source changes | S.S (Sum squares) | d.f | S.S (Sum squares) | M.S (Mean square) | F ratio (Analysis of variance) | Significance level (sig) |
|---|---|---|---|---|---|---|---|
| Cadmium (Cd) | Between groups | 0.250 | 4 | 0.250 | 0.062 | 0.536 | 0.710 |
| | In groups | 4.666 | 40 | 4.666 | 0.117 | | |
| | total | 4.916 | 44 | 4.916 | | | |
| Lead (Pb) | Between groups | 5.189 | 4 | 5.189 | 1.297 | 0.285 | 0.886 |
| | In groups | 181.841 | 40 | 181.841 | 4.546 | | |
| | total | 187.030 | 44 | 187.030 | | | |

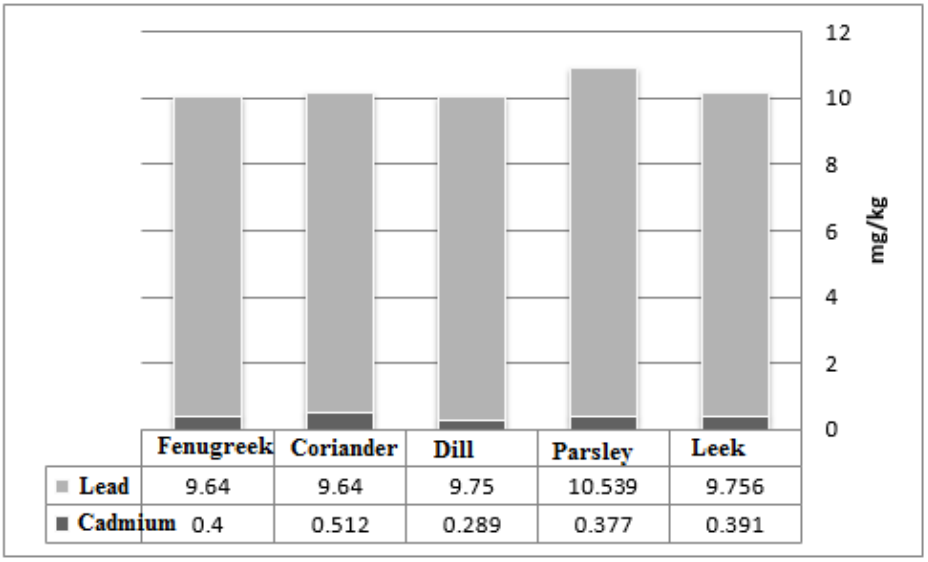


Figure 1: Comparison of vegetables in terms of cadmium and lead

## DISCUSSION AND CONCLUSION

The existence of Heavy metals in today's' industrial world has become a serious problem because these metals are entering the human food chain. According to Table 1, the combination of metal concentrations invegetables, from the least to the greatest amount, is as follows.

Cadmium: dill, parsley, leek, fenugreek and coriander
Lead: fenugreek, coriander, dill, leek and parsley
In all these vegetables, the average absorption of cadmium is in the standard range proposed by FAO and WHO (2-8 mg/ kg), yet the upper limit of absorption in some vegetables like coriander (2 mg/kg), and fenugreek (1.45 mg /kg) are higher than the standards. The average absorption of lead in leek, dill, coriander and fenugreek follows the standard ranges of WHO & FAO, but the average of upper limit for absorption of lead in these vegetables is greater than 10 mg/ kg, this amount is higher than the permitted amount proposed by World Health organization. The average absorption amount of lead in parsley is 10.539 mg/ kg which is greater than the permitted standard. The greatest amount of absorption belonged to parsley; other vegetables have absorbed an equal amount of heavy metals (figure 1). According to Figure 1, the highest bar in the chart belongs to average concentration of lead and the average concentration of cadmium is less than lead's. In a study conducted by Bahemuka and Mubofu [23] the amounts of absorbed cadmium and lead are 0.2 and 35.75 mg/kg, respectively, when comparing the result of the study with that of Bahemuka and Mubofu, we came to realize that the average concentrations of metals are more than the results of Bahemuka. In another study carried out by Rajesh Kumar *et al*. [24] the average range of lead concentration was 1.8-0.3 and The average range of cadmium concentration was 0.5-2.1 mg/kg, as it is seen the average concentration of lead was less than the results of this study but the average concentration of cadmium was more than the results of this study. The concentration of cadmium in the study of Samarghandi *et al*. [25] was about zero, also the maximum amount of lead was 88.3 mg/kg, which is less than the amounts obtained from this study. It was found in this study that the average concentration of cadmium in vegetables is relatively reasonable and in the standard range, but the average concentration of lead in most vegetables is in the high levels of the standard range. Given that in Jiroft city, the urban wastewater is not used for irrigation of vegetables, it is realized that a reason for the high concentration of lead in the vegetables is the locations of fields. Vegetable fields in Jiroft are most likely placed in suburbs and edge of the city.

**ACKNOWLEDGEMENT**
This study was supported by Jiroft University of Medical Sciences, financially and morally. There by the authors appreciate the university authorities' helps.

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