



Original Article

**The Analysis of Lead and Cadmium Accumulation in Lettuce
(case study: Varamin)**

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ABSTRACT

The accumulation of metals and the contamination of agricultural soils, which is mostly the result of humans' activities, are among the most important environmental issues throughout the world. Due to the use of chemical fertilizers, pesticide, and municipal and industrial wastewaters, heavy metals accumulate in plants. Vegetables have high abilities to absorb and stock heavy metals, and regarding the high use of lettuce, the control of amounts of heavy metals in it can be essential for consumers' health. In this research, nine samples of lettuce were chosen randomly from three farms located in Varamin City in the spring of 2014, and after sampling and preparation by atomic absorption instrument, lead and cadmium concentration in it was measured. The average lead concentration in Jafarabad, Pakdasht, and Asgarabad Varamin is 0.23, 0.45, and 0.50, respectively. The average cadmium concentration in Jafarabad, Pakdasht, and Asgarabad Varamin is 0.06, 0.06, and 0.07, in the order mentioned. The average lead and cadmium concentration in Asgarabade Varamin is higher than other areas. Based on the achieved results, the concentration of cadmium and lead in all the area is acceptable for human use.

KEYWORDS: Heavy Metals, Agricultural Products, Contamination, Fertilizer, Varamin.

INTRODUCTION

Chemical fertilizers have major influences on the quantity and quality of products. As for chemical fertilizers, nitrogen fertilizers have the most use. Normally, for each hectare of lettuce, approximately 80 kg of nitrogen, 80 kg of phosphate, 50 kg of calcium oxide, and 15 kg of magnesium is considered regarding the sources of nutrients in the soil. The entrance and accumulation of heavy metals in agricultural lands is mostly the result of animal manure, pesticides, and chemical fertilizers (Boamponsem, 2012). Some of the heavy metals like copper and zinc are essential for the majority of biological systems like human beings. However, some other heavy metals like lead, arsenic, cadmium, and mercury are highly poisonous for humans, animals, and plants. Among various types of fertilizers, Phosphate fertilizers contain the highest heavy metals concentration. Nitrogen fertilizers, compared to phosphate and potassium fertilizers, have the least heavy metals concentration. The amount of heavy metal which enters the earth by the fertilizer depends on factors such as the amount of used fertilizer, the metal concentration in the fertilizer, the combination of the fertilizer, and the status of supplying it to the roots of the plant (Thomas et.al:2010). Increased essential and inessential heavy metals' concentration in the soil usually deprives plants of their growth and causes a decrease in their breath.

Heavy metals concentration is mostly in the leaves of the plant (Smical et al; 2008). In edible vegetables like radishes, cabbages, tomatoes, and carrots, heavy metals concentration is higher. The highest heavy metals concentration is in the roots and leaves, and the least is in flower buds and the fruit of plants (Ana Erinasmica, 2008). One of the heavy metals in fertilizers is cadmium. The absorption of cadmium by the plant from the soil depends on the total amount of cadmium entering the soil, soil moisture, soil salinity, plant species and varieties, and other rare elements. Cadmium is easily absorbed by the root bark and then enters the wood tissue. In most species, cadmium is accumulated in the roots and a small amount is transmitted to the leaves. Other research suggests that cadmium causes a decrease in the reproduction of mammals and also causes kidney risks, high blood sugar, anemia, and increased mortality in the young population of mammals and birds. Vegetables like lettuce, spinach, celery, potatoes, and cabbages have great powers of cadmium accumulation whereas beans, corn, and peas have little amounts of cadmium. In Oats, soybeans, alfalfa, the amount of cadmium in the roots is higher than that of the shoots; however, tobacco, potatoes, and carrots have the highest amount of cadmium in their leaves. analyzed the amount of heavy metals in vegetables from Shiraz. The results reveal that the least cadmium concentration is in

coriander and the highest lead concentration is in dill. The achieved results with standards represent the two metals' concentration is more than the limit analyzed the ability of three plants (cress, lettuce, and tomatoes) to absorb the element cadmium in Esfahan. The results suggested the highest amount was that of tomatoes and the least for lettuce was observed the levels of heavy metals in agricultural products in Tabriz. The concentration of metals being studied in leek, tomatoes, and onions samples is higher compared to some studies and less compared to some others carried out a research on the cultivated vegetables of the suburbs of Shahrood. The results suggested that the average concentration of chromium, cadmium, and lead is more than the World Health Organization's limit for plants, but it is not the case for zinc and arsenic analyzed the amount of lead in Kerman's lettuce. And the results revealed that the average lead concentration in the samples from used lettuce in all cities is less than the World Health Organization's limit analyzed lead and cadmium concentration in vegetable farms of Gorgan. The highest cadmium concentration belonged to radish and the highest lead concentration belonged to radish, spinach, and garden cress, respectively. The amount of lead and cadmium was less than the limit in the vegetables. (Sandra Radic et al 2013) analyzed the effect of surface water near the fertilizer factory using plants. The results showed surface water contaminated with fertilizer caused the inhibition of plant growth and reduction of photosynthetic pigments content. Studied shown the effect of using phosphate fertilizers on cadmium concentration in potatoes. It was shown that cadmium had increased in the edible part of the potato. (Er Mankara, 2004) analyzed the distribution of heavy metals in Turkey's potato cultivation areas, and it was revealed cadmium and lead are markedly high in all the cultivated area. (Sang young et al, 2002) analyzed the effect of added fertilizer on the solubility of cadmium and nickel in plants and understood the highest

concentration of cadmium is in spinach, radish, and oatmeal. Nickel concentration increased in all plants. Fertilizers with lead have very scarce chance of endangering humans' health, as they are not highly concentrated in agricultural products (Boamponsem. A& Debrah. I, 2012). Lead usually enters humans' body using various ways and in three parts is stored: blood, soft tissue, and bones. It creates lots of poison in the nervous system and kidneys and causes heart and kidney problems. Among the advantages of chemical fertilizers, it can be referred to the low price, short-term income, the easy application. The over use of chemical fertilizers leads to water and soil contamination, the loss of the balance between parallel vital elements in the soil, the solubility and absorption problems of nutrients, eutrophication of lagoons. Regarding the hygienic importance of the existence of heavy metals in vegetables and in humans' health, due to heavy metals accumulation in them, the amount of lead and cadmium in Varamin's lettuce is analyzed in this research.

MATERIALS & METHOD

In this study 9 lettuce samples were harvested from three different farms in varamin. Farms selected randomly. Lettuce leafs & stem were dried at 70° C in oven for 48 hours, and then were grinded in a porcelain mortar.

Then samples weighted. 5gram of Dry lettuce powder digested in 7 ml nitric acid & 1 ml hydrogen peroxide (30%) then placed into microwave instrument ethos plus model (Milestone, Italy). Extract were determined by atomic absorption spectroscopy (spectr AA-200, Varian, Australia).

RESULT AND DISCUSSION

Accumulation of lead and cadmium in Jafarabads were shown in table 1. according to table(1) amount of leads in leaves are higher than stems.

Table 1. the distribution of lead and cadmium levels in Varamin's lettuce (Jaafarabad's Road Entrance)

Sampling Area	Parts Examined	Lead Concentration mg/l		Cadmium Concentration mg/l	
		The stem	The leaf	The stem	The leaf
Jaafarabad's Road Entrance	The Stem of Lettuce	0.27	0.43	0.095	0.084
	The Stem of Lettuce	0.24	0.48	0.055	0.073
	The Stem of Lettuce	0.17	0.41	0.039	0.081

Table 2. the distribution of lead and cadmium levels in Varamin's lettuce (Pakdasht's Road Entrance)

Sampling Area	Lead Concentration mg/l		Cadmium Concentration mg/l	
	The stem	The leaf	The stem	The leaf
Pakdasht Road Entrance	0.49	0.52	0.041	0.056
	0.50	0.43	0.048	0.052
	0.46	0.41	0.044	0.057

Regarding tables (1), (2), and (3), lead concentration in Jaafarabad area is less than Pakdasht and Asgarabad. Cadmium concentration in Pakdasht

Road is less than Jaafarabad and Asgarabad. The amount of lead and cadmium concentration in Asgarabad area is higher than the other two.

Table 3. the distribution of lead and cadmium levels in Varamin's lettuce (Asgarabade Varamin)

Sampling Area	Lead Concentration		Cadmium Concentration	
	mg/l		mg/l	
	The stem	The leaf	The stem	The leaf
Asgarabade Varamin	0.44	0.52	0.062	0.071
	0.52	0.61	0.064	0.069
	0.53	0.59	0.071	0.076

For statistical analysis, the achieved observations related to sampling areas and cadmium and lead concentration in lettuce in Jafarabad, Pakdasht, and

Asgarabad were analyzed by SPSS. The results are as follows:

Table 4. the mean and deviation of lead and cadmium depending on the type of concentration

Concentration Type		Jaafarabad's Road Entrance	Pakdasht's Road Entrance	Asgarabade Varamin
Lead	Mean	0.23	0.45	0.50
	SD	0.051	0.059	0.049
Cadmium	Mean	0.06	0.06	0.07
	SD	0.029	0.003	0.005

Regarding the obtained statistical data, lead concentration mean in Asgarabade Varamin is higher than the other areas. Pakdasht is in the second and Jaafarabad in the last place.

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One of the heaviest elements, which its accumulation in the soil has caused much concern, is cadmium. The major cadmium contamination reason in agricultural soils is the use of phosphate mineral fertilizers. Probably, chemical fertilizers compared to organic fertilizers have been used more in Asgarabad Varamin area, according that we could say that's a reason of higher amount of cadmium in Asgarabad lettuce.

CONCLUSION

According to the results of the tests, the amount of lead and cadmium concentration in lettuce is reasonable for humans' use. The mean of lead concentration in all areas of lettuce cultivation in Varamin is more than the mean of cadmium concentration in the cultivated areas. The reason might be the lettuce farms are located next to roads and the exhaust fumes have lead to an increase in the lead concentration of crops.

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