ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Investigation of Lettuce Pollution with Cadmium and Lead in Varamin Region in Iran

Arash Borzou[a*] and Fariborz Azizinezhad[b]

[a]Department of Agronomy, Varamin – Pishva Branch, Islamic Azad University, Varamin, Iran
[b]Department of Chemistry, Varamin – Pishva Branch, Islamic Azad University, Varamin, Iran

ABSTRACT

Soil and water contamination with heavy metals such as cadmium and lead in human societies is one of the major environmental problems. That cause to decrease crop production quality and yield. It's also endangers public health. Heavy metals, especially lead, absorb by lettuce from various ways like as polluted soils and air. On the other hand, many researchers believe that lettuce has the highest capacity to accumulate cadmium. Due to the high consumption of vegetables like lettuce by human amount of heavy metal must be controlled in produced lettuce. After reviewing the necessary hotspots in season 2011-2012 under the lettuce grown in spring and winter, and rector Varamin as one of the important areas of cultivated lettuce in Tehran province were selected. At the time of harvest three plants were taken randomly from each farm. Fresh and dry weight of plants - were measured. Then the dried samples by the electric mill and the powder were used for measurements of cadmium and lead. For this purpose, the samples were digested using the acid solution of cadmium and lead concentrations in the extract was read by atomic absorption spectroscopy apparat. Average cadmium levels in accordance with the results of the sampling unit dry weight of lettuce grown in spring 43/0 mg kg with a maximum rate of 0.95 mg kg, respectively. The fresh plant of 0.022 kg with a maximum 0.044 mg/ kg was observed. While the cadmium concentration in winter planting 0.032 mg kg dry weight and the maximum concentration of 0.80 mg kg dry weight was observed. Cadmium concentrations in plant fresh weight as well as the average concentration of 0.020 g kg with a maximum of 0.051 mg kg fresh weight, respectively. Therefore, none of the specimens in cultivation in spring and winter crops had cadmium contamination. Also because of lead concentration in all samples was below that detection limit its effect on plant dry weight in all cases less than 0.05 mg kg is. Lead pollution is no samples, and therefore these are acceptable for human consumption.

Keywords: Pollution, cadmium, lead, Varamin

Corresponding author

INTRODUCTION

On environmental topics; metals such as lead, mercury, cadmium, nickel and chromium are heavy metals and their effects and compounds are damaging to human health and the environment. These toxins are available in the air, water, building materials, kitchen appliances and even clothing [1-4].

Cadmium is used in the paint and plastics industries, pesticides, fungicides, batteries and photography [5,6]. This heavy metal also is found in fertilizers. The concentration of cadmium in phosphate fertilizers varies from 0 to 170 mg / kg [13]. Cadmium concentrations in normal agricultural soils are close to 1 mg / kg and originating mainly from sewage, phosphate fertilizers, and Zinc sulfate. Cadmium accumulates in surface soils and the plants are not toxic at concentrations found in soil, it also accumulates in plants without showing toxicity effects. However, this is a very dangerous element in the human food chain and in humans can cause kidney problems and other inconveniences [4, 7, 12]. Limit of cadmium in the human diet is very low and is only 1 mg / kg of dry matter.

Lead is a heavy metal that is also present with other metals, and in agriculture has found many applications (used in pesticides). The source of Lead is mainly from the fuel of gasoline-powered vehicles. In addition, the lead content of chemical fertilizers and white iron pipe corrosion in water pipes, or the dissolution of glazed earthenware can enter in the food chain of animal and human. Transfer of lead in soil and plant tissues is very low. The Limit intake of lead in human solid food is about 600 micrograms per day [7-9, 16,17]. Lettuce, spinach, celery, cabbage and potatoes are highly vulnerable for accumulation of Cd. According to many researchers, the edible lettuce plant has the highest capacity for Cd accumulation. However, vegetables like lettuce because of containing the essential components of a diet mainly consisting of minerals, protein, cellulose, vitamins, iron and calcium are important components of human health products. Lettuce with a scientific name (*Lactuca Sativa*) is one of the oldest vegetables known in the world and its origin is in India and Central Asia. Lettuce is an annual plant with broad and long, bright green leaves. Its taste is slightly sweet, and belongs to the group of products that contain the high concentration of cadmium and lead. So one of the important factors in determining the health of this product is the determination of heavy metals in it. World Health Organization has been suggested the o.3 mg / kg as the limit of lead [6, 10, 11, 14 and 15].

Contaminated areas around the cities of Iran including Tehran, Isfahan, Shiraz and other metropolises made it essential to investigate the adverse effects of Cd accumulation in plants and its subsequent accumulation in the human body. The aim of this study was to investigate the contamination of lettuce product to cadmium and lead in the Varamin and Pishva region as one of the major lettuce production areas in the Tehran province.

MATERIALS AND METHODS

For the necessity of this study ,and in order to coverage hotspots of spring and winter lettuce planted; farms of Varamin; Askar Abad; Ghale Sin; Kalate, Joseph Reza.; Shoeib Abad, Palang Dareh, Darbala; Senardak; Muhammad Abad; Zavareh band; Khaveh; Hesar Koochak; Salman Abad, Jalil Abad and Shooran were selected. In the next step on May/o4/2011 (at harvest), three plants were taken from each farms, randomly.

The nylon bags were used for the sample transfer in to the laboratory. Fresh weights of the tested organs were measured and then (the samples) were washed with tap and distilled water. After that the samples were dried in air for 48 hours and then dried in an oven at 75 ° C and then the dry weight was determined. An Electrical mill was used to powder the samples and the powdered samples were used for measuring cadmium and lead levels. For this purpose, 2 g of dried powdered lettuce plants were passed through the sieve 60 in a 100 ml Erlenmeyer flask and 2 ml concentrated sulfuric acid, 4 ml concentrated per choleric acid and 20 ml concentrated nitric acid were added, respectively.

The solution was carefully boiled under the hood to reduce the volume. Then the 20 ml doubly distilled water was added to dissolve deposits. After that, the samples were heated to reduce their volume. With cooling of balloon; with 42 Watt man filter paper, extracts were filtered and with doubly distilled water the volume of solution was brought to 100 ml. With the use of the AAS (GBC932 AA) instrument at a wavelength of 228.8 and 217 nm, Lead and Cadmium concentrations in the extracts, was measured, respectively.

RESULTS AND DISCUSSION

Lead and cadmium concentrations obtained by atomic adsorption are presented in Tables 1 and 2. After determining the concentrations in order to determine and compare the results with the permissible standards; numbers of extracted heavy metal concentration in plant fresh weight were converted. The results are presented in Tables 3 and 4. As can be seen, in spring planted lettuce, cadmium levels was less than 0/95 mg / kg of dry weight., the maximum amount of cadmium in fresh plants was 0/055 mg kg. While in winter crop Cd concentrations were lower than 0/85 mg / kg of dry weight but in fresh herbs the maximum of 0/054 mg kg was gained.

In the case of lead, as in all the samples had lead concentrations less than detection limit of the device, so its concentration in plant dry weight in all samples was less than 0/05 mg / kg. But in figures 1 and 2, the comparison between the amount of cadmium per unit of dry weight of spring and winter samples collected in the same area shows that the cadmium concentration was higher in samples of spring planting. This can be due to higher temperature and thus increasing evapo-transpiration rate in spring crops and mobility of mineral elements in soil and their uptake by the plant.

The ANOVA tables 5 to 10 show that; between cadmium concentrations in the extract obtained in samples from different areas, concentration per unit of dry weight and fresh herbs in spring and winter there were statistically significant differences in the 1% level.

Table 1. lead and cadmium concentrations in spring lettuce extraction

Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No	Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No	Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No
ND	ND	25	ND	0.006	13	*ND	0.015	1
ND	0.005	26	ND	0.007	14	ND	0.014	2
ND	ND	27	ND	0.006	15	ND	0.013	3
ND	0.004	28	ND	ND	6	ND	0.019	4
ND	0.019	29	ND	0.001	17	ND	0.009	5
ND	0.015	30	ND	0.001	18	ND	0.008	6
ND	0.019	31	ND	ND	19	ND	0.006	7
ND	0.016	32	ND	0.001	20	ND	0.007	8
ND	0.014	33	ND	ND	21	ND	0.008	9
ND	ND	34	ND	0.001	22	ND	0.009	10
ND	0.001	35	ND	ND	23	ND	0.009	11
ND	0.001	36	ND	0.007	24	ND	0.010	12

*ND Element concentration was below the detection limit of device.

Table 2- lead and cadmium concentrations in winter lettuce extraction

Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No	Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No	Pb Conc. (mg/lit)	Cd Conc. (mg/lit)	Sample No
ND	0.013	21	ND	0.016	11	*ND	0.004	1
ND	0.002	22	ND	0.013	12	ND	0.004	2
ND	0.015	23	ND	0.012	13	ND	0.013	3
ND	0.017	24	ND	0.010	14	ND	0.013	4
ND	0.015	25	ND	0.001	15	ND	0.014	5
ND	0.001	26	ND	0.002	16	ND	ND	6
ND	0.001	27	ND	0.003	17	ND	0.001	7
ND	0.002	28	ND	ND	18	ND	ND	8
ND	0.001	29	ND	0.003	19	ND	0.015	9
ND	0.001	30	ND	0.015	20	ND	0.017	10

*ND Element concentration was below the detection limit of device.

Table 3- Cadmium concentration in fresh and dry weight in spring lettuce

Cd Conc. Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sample No	Cd Conc. Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sampl e No	Cd Conc . Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sampl e No
0.002	0.05	25	0.013	0.30	13	0.041	0.75	1
0.011	0.25	26	0.020	0.35	14	0.030	0.70	2
0.002	0.05	27	0.012	0.30	15	0.033	0.65	3
0.015	0.20	28	0.003	0.05	16	0.050	0.95	4
0.042	0.95	29	0.003	0.05	17	0.029	0.45	5
0.045	0.75	30	0.003	0.05	18	0.021	0.40	6

0.055	0.95	31	0.003	0.05	19	0.012	0.30	7
0.033	0.80	32	0.002	0.05	20	0.015	0.35	8
0.037	0.70	33	0.003	0.05	21	0.027	0.40	9
0.002	0.05	34	0.002	0.05	22	0.024	0.45	10
0.002	0.75	35	0.003	0.05	23	0.024	0.45	11
0.003	0.75	36	0.019	0.35	24	0.025	0.50	12

Table 4- Cadmium concentration in fresh and dry weight in winter lettuce

Cd Conc. Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sample No	Cd Conc. Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sam ple No	Cd Conc. Fresh weigh (mg/Kg)	Cd Conc. Dry weigh (mg/Kg)	Sampl e No
0.039	0.65	21	0.052	0.80	11	0.008	0.20	1
0.006	0.10	22	0.040	0.65	12	0.015	0.20	2
0.043	0.75	23	0.031	0.60	13	0.037	0.65	3
0.054	0.85	24	0.022	0.50	14	0.032	0.65	4
0.039	0.75	25	0.003	0.05	15	0.043	0.70	5
0.003	0.05	26	0.005	0.10	16	0.003	0.05	6
0.002	0.05	27	0.011	0.15	17	0.003	0.05	7
0.007	0.10	28	0.003	0.05	18	0.002	0.05	8
0.003	0.05	29	0.005	0.15	19	0.052	0.75	9
0.003	0.05	30	0.046	0.75	20	0.049	0.85	10

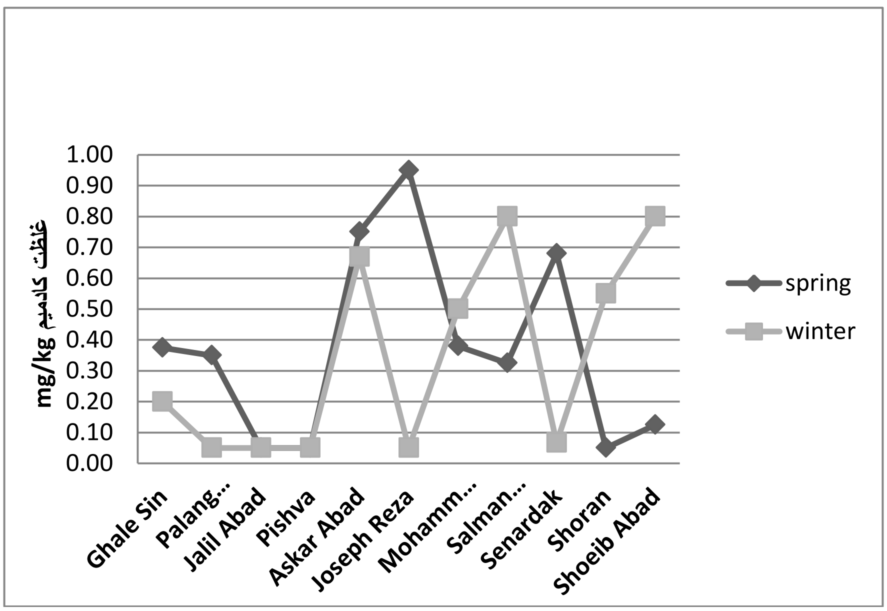

Fig1. Comparison of cadmium concentration in dry weight of spring and winter lettuce

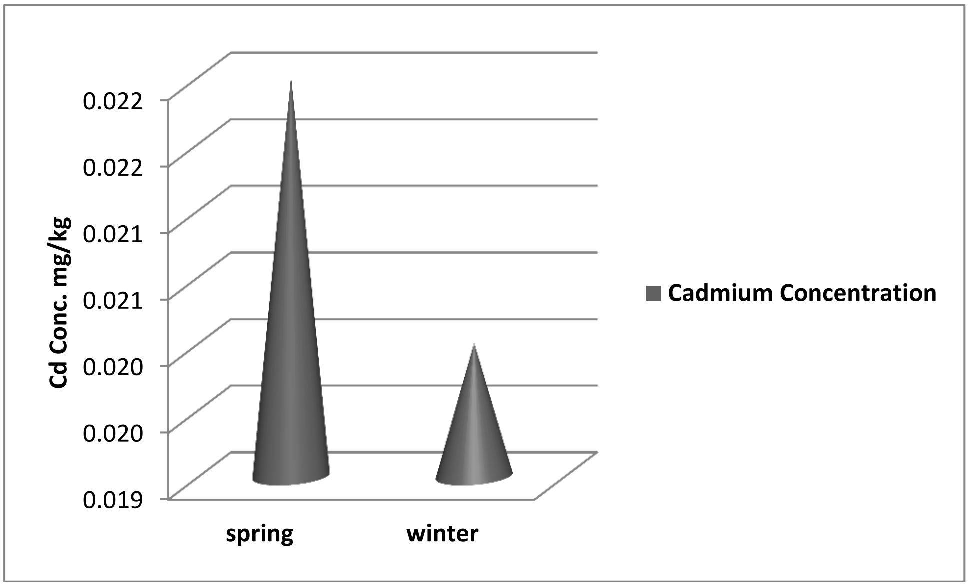

Fig2. Comparison of cadmium concentration in fresh weight of spring and winter lettuce

Table 5- Analysis of cadmium concentration in spring lettuce extraction from different farms

S.O.V	M.S	D.F	F
Different farms	0.00136	15	74.89**
Error	0.000061	32	
Total	0.00142	47	

**The difference was significant at 1%.

Table 6- Analysis of cadmium concentration in dry weight of spring lettuce from different farms

S.O.V	M.S	D.F	F
Different farms	3.86	15	68.53**
Error	0.12	32	
Total	3.98	47	

**The difference was significant at 1%.

Table 7- Analysis of cadmium concentration in fresh weight of spring lettuce from different farms

S.O.V	M.S	D.F	F
Different farms	0.0086	15	183.87**
Error	0.000099	32	
Total	0.008649	47	

**The difference was significant at 1%.

Table 8- Analysis of cadmium concentration in winter lettuce extraction from different farms

S.O.V	M.S	D.F	F
Different farms	0.00167	16	57.78**
Error	0.00006	34	
Total	0.00173	50	

**The difference was significant at 1%.

Table 9- Analysis of cadmium concentration in dry weight of winter lettuce from different farms

S.O.V	M.S	D.F	F
Different farms	4.274	16	60.68**
Error	0.15	34	
Total	4.424	50	

**The difference was significant at 1%.

Table 10- Analysis of cadmium concentration in fresh weight of winter lettuce from different farms

S.O.V	M.S	D.F	F
Different farms	0.0152	16	36.54**
Error	0.0009	34	
Total	0.0161	50	

**The difference was significant at 1%.

CONCLUSION

Due to the limit based on cadmium 2001/22/CE are 2.0 in leafy vegetables, soybeans, rice and edible mushrooms and 0.1 mg / kg of fresh weight for the roots and stems vegetables and potato. On the other hand World Health Organization has declared, cadmium shouldn't be used more than o.4 – 0.5 mg per week so the limit of Cd in crops has been declared 12.0 mg / kg. So in none of the samples, whether planted in spring and winter crop, cadmium contamination did not identified and lettuce production of acceptable conditions for the consumer is entitled. In the case of lead, because all samples had lead concentrations below the detection limit, therefore, its concentration in dry weight was less than 0.05 mg / kg due to the World Health Organization, the 0.3 mg / kg has been proposed as the lead limit therefore no lead contamination in the samples was detected and all samples are acceptable for human consumption.

REFERENCES

[1] Adrian DC. Trace elements in the terrestrial environment. Springer – Verlag, New York, 1986.
[2] Albertina Xavier da Rosa Corraa, Leonardo Rubi Ro riga, et al. Science of the Total Environment 2006; 357: 120-127.
[3] Alloyway BJ. Heavy metals in soils. 2nd Edition, Blackie Academic and Professional. London. England, 1995.
[4] Anderson MK, A Refsgaard, KW Raulund-Rasmussem, B Strobel and CBH Hansen. Soil Sci Am J 2002; 66: 1829-1835.
[5] Anderson A, Bingefors S. Acta Agriculture Scandinavia 1985; 35: 339-344.
[6] Audu AA, Lawal AO. Variation in metal contents of plants in vegetable garden sites in Kano metropolis, Kano, Nigeria. 2006.
[7] Barry PSI. British J Ind Med 1981; 38: 61–71.
[8] Bellinger DC, Needleman HL. N Engl J Med 2003; 349: 500-502.
[9] Brady N. The nature and properties of soils. Tenth edition. Mac Milan Publishing Company New York. Coiler Mac Millan Publishes London,1990.

[10] Brown SL, RL Chaney, J Scott Angle and J A Ryan. J Environ Qual 1998; 27: 1071-1078.

[11] Eriksson JE. Factors influencing adsorption and plant uptake of Cd from agricultural soils. Swedish University of Agricultural science, Department of soil science, Reports and Dissertation, 4. ISBN 91-576-4111-0. ISSN 1100-4525. 1990.

[12] Maurice E, Shils James A, Olseon, Moshe Shike. Modern Nutrition in health and Disease 1994; 2184-285,264-267,279-281, 1598-1599.

[13] Nicholson FA, KC Jones and AE Johnson. Sci Technol 1994; 28: 2170-2175.

[14] Radojevec M and Baskin VN. Practical environmental analysis. Royal society of Chemistry, Cornwall UK. 1999.

[15] Stover RC, LE Sommers and DJ Silviera. Water Pollut 1976; 48: 2165-2175.

[16] Tallin D, KS Rossolot. Pollution Prevention for Chemical Processes, John Wiley and sons, inc 1997: 258-227.

[17] Ziegler EE. Pediatric Res 1978: 29-34.