

## **Investigation of Chromium and Nickel contamination in Lettuce (*Lactuca sativa* L.) cultivated in Varamin**

**Fariborz Azizinezhad<sup>1\*</sup>, Arash Borzou<sup>2</sup> and Majid Abdouss<sup>3</sup>**

<sup>1</sup>Department of Chemistry, College of Chemistry, Varamin-Pishva Branch, Islamic Azad University, Varamin, Iran

<sup>2</sup>Department of Agronomy, College of Agriculture, Varamin-Pishva Branch, Islamic Azad University, Varamin, Iran

<sup>3</sup>Department of Chemistry, Amir Kabir University of Technology, Tehran, Iran

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### **ABSTRACT**

*Due to the high consumption of lettuce, the examination of its heavy metals content, including Chromium and Nickel is of enormous importance. This study was conducted in 2012-2013, in which 11 important areas under the cultivation of lettuce in Varamin-Pishva located in Tehran were investigated. To do so, at the time of harvest, three samples were randomly taken from each field and then their fresh and dry weights were measured. The dried samples were dissolved in acid by wet digestion method and the concentrations of Chromium and Nickel in the resulted extract were determined by atomic absorption spectrometry (AAS). The mean content of Chromium in spring cultivated lettuce was 0.3493mg/L and 0.9375 of fresh weight and 17.4636 mg/kg of dry weight, while Chromium content in winter cultivated lettuce was 0.3154 mg/L and 0.8917 of fresh weight and 15.7682 mg/kg of dry weight. The concentration of Nickel was less than of 5 mg/kg and 0.4 mg/kg in dry and fresh weight, respectively. The results demonstrated that the lettuce cultivated in these areas is free from Chromium and Nickel contamination for humans.*

**Keywords:** Chromium, Nickel, Lettuce, Pollution

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### **INTRODUCTION**

Considering high consumption of vegetables including lettuce, it is important to ensure their safety and high quality cultivation. One of the most important factors in determining the safety of this product is the content of heavy metals including Chromium( Cr) and Nickel( Ni).[ 1-5 ]Presently, the cultivation areas around big cities such as Tehran, Isfahan, Shiraz, etc are irrigated by canals contaminated with various pollutants including agricultural and industrial sewage. The presence of vegetable planting areas surrounding big cities suggests the importance of studying the adverse effects of heavy metal accumulation in plants.[6-8] Cr, mainly accumulate in soil as the bound form. The most stable forms of Cr are Cr(III) and Cr(VI). Cr(VI) is much more toxic than Cr(III) and is considered a potent carcinogen. The content of Cr in vegetables, were reported from 20-600µg/kg. The usual of Cr uptaken by humans through foods ranges 5-500 µg/day and drinking water has been measured 0.1 mg/L. [9-11] Total Nickel content in soil is 1-200 mg and its toxicity level in soil is 40mg/kg. Toxicity level of Ni in plants has been reported 50mg/kg of dry matter. Maximum permitted Ni concentrations in water and foods are 0.05 mg/L and 5mg/kg of body weight, respectively.[12-15]The objective of this study was to examine Cr and Ni contamination in lettuce cultivated in Varamin as one of the most important lettuce cultivation areas.

## MATERIALS AND METHODS

In this study, the samples were taken from the villages Askar Abad, Ghale Sin, Yousef Reza, Shoeib Abad, Palang Darreh, Senardak, Mohammad Abad, Salman Abad, Jalil Abad, Shooran and Pishva during two successive planting seasons as well as at the time of harvest and then the cations of heavy metals, Cr and Ni were measured. When the spring and winter plants were harvested (05/05/2012 and 25/11/2012), three fields were randomly selected from which three lettuce plants were taken. The samples were transferred to the laboratory in plastic bags. They were washed with tap and distilled water, dried in air and then dried in an oven at 65°C for 48 h and weighed. Then, the samples were powdered by an electric mill to measure Cr and Ni contents. For this aim, 2 g of dried powder sample were passed through the sieve 60 in a 100mL bottom-round erlen to which 4 mL of concentrated perchloric acid, 2 mL of concentrated sulfuric acid and 20 mL of concentrated nitric acid were added. The solution was carefully boiled to reduce in volume. Then, 20 mL of distilled water, was added to dissolve the deposits. The samples were heated to reduce the volume. When the flask was cooled, the extract was filtered by using wattman filter paper no.42. Then, the volume of solution was increased to 150 mL by addition of distilled water.[6, 8,16] The concentrations of Cr and Ni were determined by use of atomic absorption spectrometer (AAS,GBC 932) at 357.9 and 314.4nm, respectively.[17]

## RESULTS AND DISCUSSION

Ni concentration in all extracts was too little to be detected by the instrument. Cr concentration was converted to heavy metal concentration in fresh and dry weight after it was determined in the extract and compared to permitted standard ranges. The results are presented in Tables 1 and 2. Mean Cr concentration in spring cultivated lettuce was 17.46 mg/kg of dry weight with the maximum amount of 41mg/kg and was 0.94 mg/kg fresh weight with the maximum amount of 2.47 mg/kg. In winter cultivated lettuce, Cr concentration was 15.77 mg/kg with the maximum amount of 45 mg/kg. Also, Cr concentration was 0.89 mg/kg of fresh weight with the maximum amount of 2.41 mg/kg.

**Table 1- Chromium concentration in fresh and dry weight in spring lettuce**

Sample	Cr Conc. Fresh weigh (mg/Kg)	Cr Conc. Dry weigh (mg/Kg)	Sample	Cr Conc. Fresh Weigh mg/Kg)	Cr Conc. Dry weigh (mg/Kg)
Ghale Sin	1.01	23.00	Salman Abad	0.33	8.00
Askar Abad	0.25	9.50	Senardak	0.28	5.40
Yousef Reza	0.23	5.35	Palang Darreh	1.74	32.00
Shoeib Abad	1.62	33.5	Mohammad Abad	0.42	8.00
Jalil Abad	1.44	21.00	Shooran	0.24	5.35
Pishva	2.47	41.00	Mean Conc.	0.94	17.46

**Table 2- Chromium concentration in fresh and dry weight in winter lettuce**

Sample	Cr Conc. Fresh weigh (mg/Kg)	Cr Conc. Dry weigh (mg/Kg)	Sample	Cr Conc. Fresh Weigh mg/Kg)	Cr Conc. Dry weigh (mg/Kg)
Ghale Sin	0.46	6.00	Salman Abad	0.32	5.05
Askar Abad	2.24	45.00	Senardak	0.97	19.50
Yousef Reza	0.31	6.50	Palang Darreh	1.51	23.00
Shoeib Abad	0.39	6.75	Mohammad Abad	0.30	5.10
Jalil Abad	0.63	12.00	Shooran	0.26	5.05
Pishva	2.41	39.50	Mean Conc.	0.89	15.77

## CONCLUSION

The results of this study identified, in most samples, spring cultivated lettuce showed higher Cr content than winter plants. This may be due to higher temperature, increasing of movement and mobility of minerals contained in soil, faster growth, root respiration, permeability of plant cell wall and accelerated chemical reactions in soil. Considering the obtained result, it could be concluded that the cultivated lettuce is acceptable for human consumption.[8,17,18]

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