

Heavy metals concentrations in parsley (*Petroselinum crispum*) vegetable

Maydanoz (*Petroselinum crispum*) Sebzesinde Ağır Metal Konsantrasyonları

ABSTRACT

With the increase of pollutants in recent years, the environment has been exposed to serious pollution. Heavy metals (HMs) can be considered a potential risk to human health. Furthermore, soil contamination with HMs leads to their transfer to plants and animals and ultimately to humans. Due to their toxic nature, very trace amounts of them can cause serious problems. HMs are one of the important pollutants that are released from various sources. They are very harmful to the environment and health due to their toxicity, stability, and accumulation properties. In this research, the content of HMs in parsley (*Petroselinum crispum*) has been investigated. For this purpose, HMs such as arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) were investigated in samples collected from local farms in the Tustan region (Lahijan city, Guilan province, Iran). According to the results, all the samples contain HMs above the standard. HMs can cause serious health problems, therefore monitoring food products is very important.

Keywords: Human health, Accumulation, Environmental pollutants, *Petroselinum crispum*, Heavy metals

Öz

Son yıllarda kirletici maddelerin artışıyla birlikte çevre ciddi düzeyde kirliliğe maruz kalmıştır. Ağır metaller (AM'ler), insan sağlığı açısından potansiyel bir risk oluşturmaktadır. Ayrıca, toprağın ağır metaller ile kontaminasyonu, bu elementlerin bitkilere ve hayvanlara, dolayısıyla insanlara taşınmasına neden olmaktadır. Toksik özellikleri nedeniyle çok düşük konsantrasyonlarda dahi ciddi sağlık sorunlarına yol açabilmektedirler. Çeşitli kaynaklardan çevreye salınan AM'ler, toksisite, kararlılıkları ve birikim özellikleri nedeniyle hem çevre hem de insan sağlığı üzerinde önemli olumsuz etkiler yaratmaktadır. Bu çalışmada, maydanoz (*Petroselinum crispum*) bitkisinde ağır metal konsantrasyonları incelenmiştir. Bu amaçla, İran'ın Gilan eyaletine bağlı Lahijan şehrinin Tustan bölgesindeki yerel çiftliklerden toplanan örneklerde Arsenik (As), Kadmiyum (Cd), Kurşun (Pb) ve Cıva (Hg) seviyeleri analiz edilmiştir. Elde edilen bulgulara göre, incelenen tüm örneklerde ağır metal seviyeleri belirlenen standart değerlerin üzerinde bulunmuştur. Ağır metallerin ciddi sağlık sorunlarına yol açma potansiyeli göz önünde bulundurulduğunda, gıda ürünlerindeki ağır metal kontaminasyonunun düzenli olarak izlenmesi büyük önem arz etmektedir.

Anahtar Kelimeler: İnsan sağlığı, Birikim, Çevresel Kirleticiler, Maydanoz, Ağır Metaller

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Introduction

Industrialization has brought amazing progress to the world, but at the same time, it has also created many challenges, such as diseases and climate change (Nargis et al., 2022; Nayeem et al., 2023). The impact of many of these problems will be much greater in the future, such as the increase in the rising of the earth's temperature (Guan et al., 2021; Sheydaei et al., 2023). It can be said that economic growth is related to natural resources, therefore, lack of proper management and excessive exploitation cause serious environmental problems (Liu et al., 2023). Among these, the most important issue is human health. It can be said that HMs are a great threat to human health and the environment, and over time, their destructive effects will appear much more (Kolesnikova et al., 2023). Each of them affects the environment differently, but perhaps the most important issue is their bioaccumulation capacity and sustainability (Raj & Maiti, 2019). Figure 1 shows the different ways of absorption by humans and some of their harms. Many things cause the release of HMs, such as coal combustion, steelmaking activity, fertilizers, pesticides, tire wear, brake wear, and fossil fuel combustion (Sheydaei, 2024b).

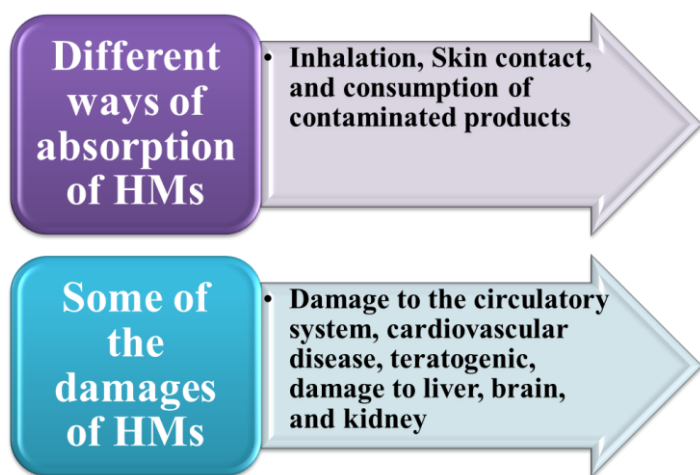


Figure 1.

Different ways of absorption of HMs and some of their damages (El-Amier et al., 2021; Zhu et al., 2022; Zhang et al., 2021).

Figure 2 shows a diagram of pollution of different sources by HMs. As you can see, they have the ability to contaminate almost all sources and easily enter the food chain. It is very important that vegetables are not contaminated because they have a lot of nutrient elements (due to having fiber, vitamins, and antioxidants) (Bahrami et al, 2021). They are also a cheap source of food, so a large

group of people eat them.

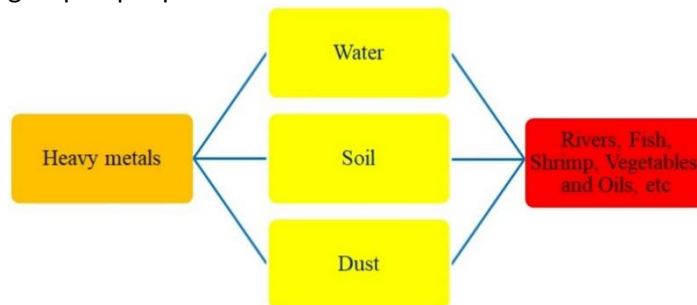


Figure 2.

Contamination of various sources by HMs (Zhu et al., 2022; Zhang et al., 2021).

Among the types of vegetables, parsley (see Figure 3), which belongs to the Apiaceae (Syn. Umbelliferae), the family has been cultivated for more than 2500 years (Marthe 2020). It is mainly used for cooking and garnishing and all parts of the plant can be used (Amein et al., 2006). In northern Iran, local people use parsley extensively in cooking (Ghiasvandnia et al., 2024). Here, parsley was collected from local farms and HMs concentrations were evaluated.



Figure 3.

Parsley (Petroselinum crispum).

Material and Methods

Material

This evaluation focused on local farms in the Tustan region (Guilan province, Iran). Figure 4 shows a map of the area. A total of three farms were sampled. Chemicals were purchased from Ghatran Shimi Tajhiz Co. (Iran).

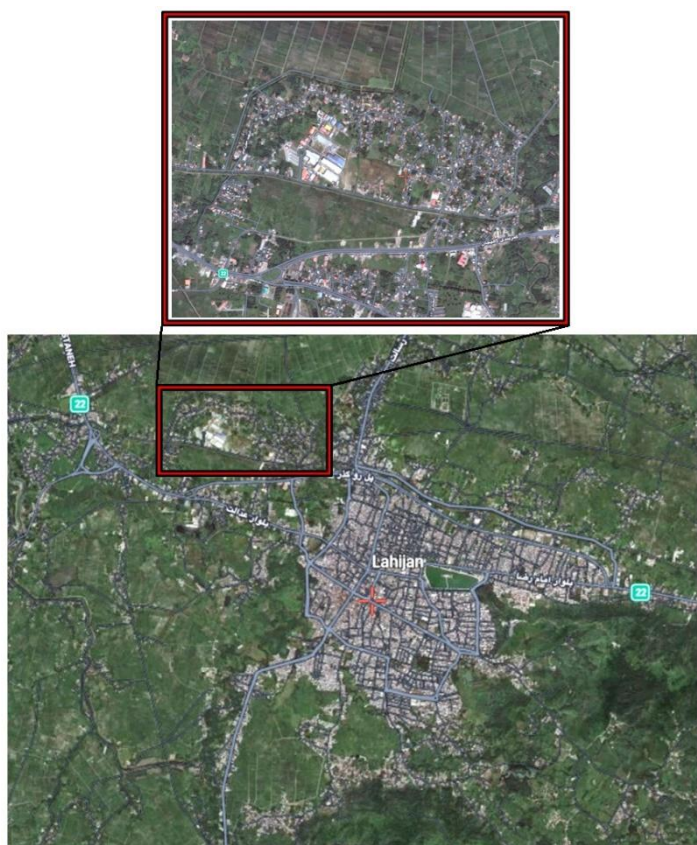


Figure 4.

Tustan region

(https://satellites.pro/iran_map#37.207031,50.004660,14).

Method

The content of HMs was determined on a flame atomic absorption spectrometer (SavantAA, GBC) according to the method described in the literature (Ghiasvandnia et al., 2024; Ghiasvandnia et al., 2023a; Sheydaei et al., 2022; Ghiasvandnia et al., 2023b).

Results and Discussion

Figures 5 and 6 show the region and selected farms of this assessment. The selected area (Tustan) is close to the ring road and the industrial town is also in this area.



Figure 5.

The location of selected farms in the region for investigation
(https://satellites.pro/iran_map#37.224417,49.978995,15).



Figure 6.

The location of the industrial town in the region
(https://satellites.pro/iran_map#37.224373,49.976302,17).

Table 1 shows the evaluation results of HMs in the samples. The results show that all the samples have a high content of HMs, which is higher than the international standards.

Table 1.

HMs concentrations in samples

Metal (mg/kg)	Range	Mean $\pm$ SD ^d
Pb	^a 0.4 - 0.51	^a 0.46 $\pm$ 0.01
	^b 0.37 - 0.48	^b 0.41 $\pm$ 0.01
	^c 0.37 - 0.46	^c 0.43 $\pm$ 0.01
Cd	^a 0.26 - 0.37	^a 0.33 $\pm$ 0.01
	^b 0.26 - 0.32	^b 0.29 $\pm$ 0.01
	^c 0.24 - 0.31	^c 0.28 $\pm$ 0.01
Hg	^a 0.014 - 0.018	^a 0.015 $\pm$ 0.001
	^b 0.01 - 0.013	^b 0.011 $\pm$ 0.001
	^c 0.009 - 0.011	^c 0.0096 $\pm$ 0.001
As	^a 0.13 - 0.16	^a 0.14 $\pm$ 0.01
	^b 0.13 - 0.16	^b 0.14 $\pm$ 0.01
	^c 0.09 - 0.11	^c 0.01 $\pm$ 0.01

Note: * aSample 1, bSample 2, cSample 3, **SD = Standard deviation *** The international standard for Pb, Cd, Hg, and As is 0.3, 0.2, 0.01, and 0.1, respectively (Ghiasvandnia et al., 2024; Ghiasvandnia et al., 2023a; Ghiasvandnia et al., 2023b; Sheydaei et al., 2022).

The main reason for this high content of HMs is certainly the presence of an industrial town (see Figure 6). Although this area is adjacent to the road, this can be considered as a secondary reason. Definitely, due to the presence of the industrial town, there is a lot of traffic in this area. The pollution of the industrial town has been proven and it should not be located near human settlements (Sheydaei, 2024b; Sheydaei et al., 2022; Ghiasvandnia et al., 2023a; Sheydaei et al., 2020; Sheydaei, 2024a). Wrong policies and decisions damage the confidence of society, the environment, and human health (Sheydaei, 2024b). Each HM has the ability to pollute water, dust, and soil, and vegetables grown in contaminated soil or irrigated with contaminated water contain HMs (Sheydaei, 2024b; Ghiasvandnia et al., 2024; Sheydaei, 2024a). There is no doubt that the water and soil in this area are also polluted. On the other hand, pollution of sources by cars and some pesticides has also been reported (Ghiasvandnia et al., 2023a; Ghiasvandnia et al., 2023b; Sheydaei, 2024a; Sheydaei, 2024b). In our previous studies, we examined other areas of Lahijan city, and Table 2 compares their results with this study. According to the results, it can be said that Tustan is the most polluted area after Baz Kia Gorab. In northern Iran, local farms located in the surrounding villages are used to produce vegetables (Ghiasvandnia et al., 2024). Therefore, monitoring at all stages of product preparation is very important. Also, the impact of each HM on human health is briefly reported in Table 3.

Table 2.

Results of other studies in Lahijan city

Region	Metal (mg/kg)	Mean
*Baz Kia Gorab	Pb, Cd, Hg, As	1.66, 0.62, 0.046, 0.13
*Kuh Boneh	Pb, Cd, Hg, As	0.1, 0.08, 0.004, 0.03
*Layalestan	Pb, Cd, Hg, As	0.52, 0.29, 0.03, 0.09
*Kushal	Pb, Cd, Hg, As	0.15, 0.076, 0.005, 0.06
This study	Pb, Cd, Hg, As	0.43, 0.3, 0.012, 0.096

Note: * Data was collected from References (Ghiasvandnia et al., 2024; Ghiasvandnia et al., 2023a; Ghiasvandnia et al., 2023b; Sheydaei et al., 2022). Mean values are reported.

Table 3.

The impact of HMs on humans.

HMs	Symptoms and disease
As	Damage to the circulatory system, anti-immune disorder, chronic bronchitis, and damage to liver and kidney.
Cd	Obstructive lung disease, bone defects, negative effect on enzymes, and kidney damage.
Pb	Damage to the brain, damage to the gastrointestinal tract, damage to red blood cells, damage to the reproductive system, and dysfunctions in the kidneys.
Hg	Damage to the lungs, cardiovascular disease, damage to the nervous, and damage to the skin and eyes.

Note: Data was collected from References (Ghiasvandnia et al., 2024; Ghiasvandnia et al., 2023a; Ghiasvandnia et al., 2023b; Sheydaei, 2024a; Sheydaei 2024b).

Conclusion

In summary, the content of HMs in parsley in the Tustan region was investigated. The results showed that all the samples had more HMs than the standard level. HMs can cause serious problems for human health due to their toxicity and bioaccumulation capacity. This study showed that crop monitoring is very important.

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