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Evaluation of concentration of heavy metals and microbial contamination in parsley (*Petroselinum crispum*) vegetable

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ABSTRACT

Heavy metals can be considered one of the most important pollutants in the environment because besides being toxic, they have stability and high accumulation properties, and these metals are easily transferred to arable lands. In this study, due to the high use of parsley (*Petroselinum crispum*) by the local people (north of Iran) in their meals, its contamination level has been investigated. Hence, heavy metals including arsenic (As), cadmium (Cd), lead (Pb), and mercury (Hg) were evaluated in parsley obtained from local farms in the Tamchal region (Astaneh-ye Ashrafiyeh city, Iran). Also, the samples were evaluated for microbial contamination (Coliform, total microbial count). For this purpose, three local farms were identified in the Tamchal region and parsley was obtained from each farm and the amount of heavy metals and microbial contamination was evaluated. The results showed that only the parsley of one farm had heavy metals and microbial contamination beyond the standard.

1. Introduction

Industrialization and rapid urbanization often have irreparable consequences for natural ecosystems and human health, the most important of which is soil, water, and air pollution [1]. The presence of toxic metals in sewage, road dust, and urban waste is one of the consequences of rapid urbanization [2]. These toxic metals are easily transferred to arable lands and finally to crops [3]. This transfer can be through dust, contaminated water, pesticides, and even excessive use of fertilizers [4]. Although the presence of many metals is important because they play a major role in many biological and molecular processes, but elements such as As, Pb, Cd, and Hg do have not any known functionality in the human body and are very harmful to health more than certain levels [5,6]. These toxic metals are easily accumulated in plants and the human body, in fact, accumulation is one of their most important characteristics [7]. Industrial discharges, agricultural chemicals, plastics, automobiles, coal mines, and thermal power plants are the main sources of toxic metal pollution in the environment [8-42]. These metals can cause major health problems, for example, Cd poisoning can cause cardiotoxicity and hypertension, or Hg can cause coronary heart disease [43-45]. Also, diseases transmitted from food groups have negative effects on public health. These diseases can be caused by ingesting pathogens or consuming toxins produced by them in food products [46]. Various sources can cause the contamination of products with pathogens, such as the use of land application of raw manure, contaminated irrigation water, contaminated soil, fecal contamination, and contamination of cutting and packing rooms [47].

Herein, parsley (see Figure 1) was obtained from three local farms and microbial contamination (*Coliform*, total microbial count) as well as heavy metal

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concentrations such as Pb, As, Hg, and Cd were investigated.

2. Experimental

2.1. Materials

The samples were obtained from the Tamchal region in Astaneh-ye Ashrafiyeh (north of Iran).

Figure 1. Parsley (*Petroselinum crispum*).

A total of three samples of parsley were gathered from local farms. The chemicals were obtained from Dr. Mojallali Co. (Iran).

2.2. The measurements and characterization

Digestion, analysis, and microbial contamination of the samples were performed according to the method described in the literature [2,5,6]. Also, the content of heavy metals was evaluated on a flame atomic absorption spectrometer (SavantAA, GBC).

3. Results and discussion

In this study, one region was selected (see Figure 2) and samples were prepared from three local farms (see Figure 3). As mentioned, parsley was chosen for the study because it is widely used by local people (in northern Iran) in their meals.

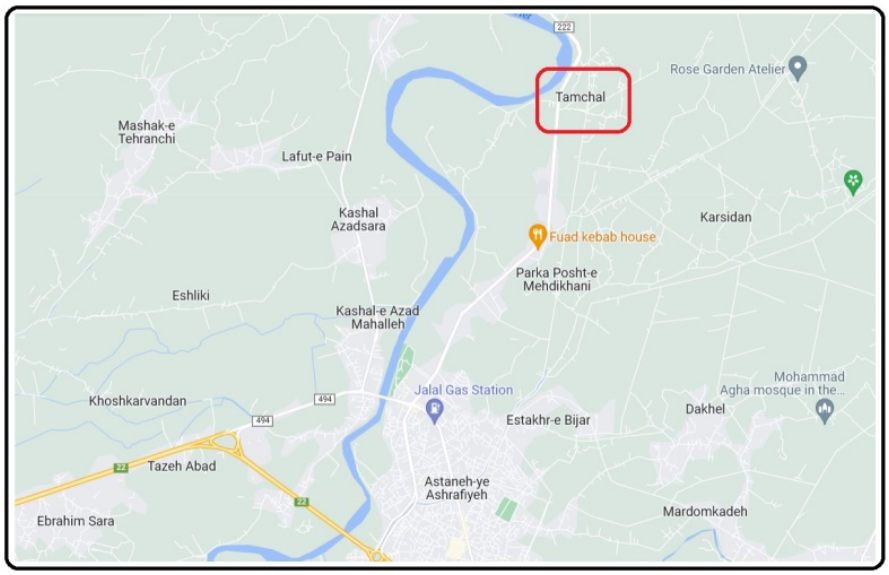

Figure 2. Tamchal region.

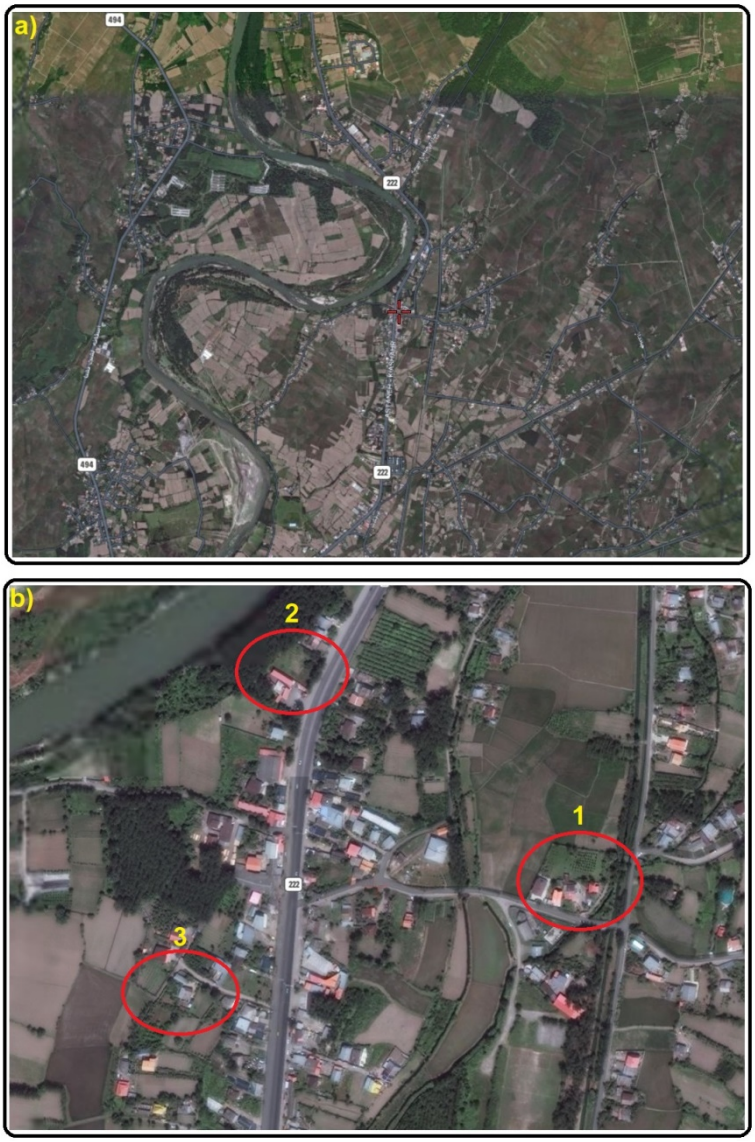

Figure 3. a) Region selected for evaluation b)The location of selected farms in the region for evaluation.

Table 1 shows the contents of toxic metals in the samples. The evaluation results show that sample 2 has the highest and sample 1 has the lowest content of toxic metals. Although in this farm, due to its proximity to the river, its water was used to irrigate crops, while other farms used the well water for irrigation. Unfortunately, in this area, due to the entry of household sewage into the river, it is likely that the content of heavy metals is higher. Comparing samples 1 and 3, the only reason is the distance from the main road, which caused the content of heavy metals to be lower in sample 1. Pollution of resources by heavy metals from automobiles has been proven, in fact, burning fuel, corrosion of batteries, wear of brake linings, wear of tires, and leakage of oil leaks release toxic metals [2,5]. Although some pesticides contain As and Cd and their excessive use causes pollution [2,6]. The results show that investigating heavy metals is very necessary, especially in the studied area, because in the north of Iran, for the production of agricultural products in the cities, local farms located in the surrounding villages are used, which unfortunately, there is no monitoring in all stages of product preparation. Therefore, both the residents of these areas and the nearby cities are exposed to these toxic metals.

Table 1. Toxic elements concentrations in parsley samples from the Tamchal region.

Metal (mg/kg)	Range	Mean ± SD[d]
Pb	[a]0.15 - 0.21 [b]0.70 - 1.51 [c]0.17 - 0.23	[a]0.20 ± 0.10 [b]1.06 ± 0.10 [c]0.20 ± 0.13
Cd	[a]0.10 - 0.84 [b]0.34 - 0.96 [c]0.12 - 0.13	[a]0.52 ± 0.04 [b]0.13 ± 0.03 [c]0.10 ± 0.02
Hg	[a]0.006 - 0.004 [b]0.012 - 0.01 [c]0.006 - 0.004	[a]0.004 ± 0.001 [b]0.011 ± 0.001 [c]0.004 ± 0.001
As	[a]0.03 - 0.06 [b]0.2 - 0.14 [c]0.03 - 0.06	[a]0.05 ± 0.03 [b]0.16 ± 0.005 [c]0.05 ± 0.03

Note: * [a]Sample 1, [b]Sample 2, [c]Sample 3, **SD = Standard deviation *** The international standard for Pb, Cd, Hg, and As is 0.3, 0.2, 0.01, and 0.1, respectively [2,6].

In this study, the samples were also evaluated for microbial contamination (*Coliform*, total microbial count) and the results are summarized in Table 2. The results show that according to Iran's national standards (standards 9263 and 5272, which are related to *coliform* and total microbial count, respectively) [2,6], except for sample 2, the rest of the samples are acceptable. Foods, especially vegetables, can always be a source of bacterial contamination. In fact, many factors contribute to pollution, such as soil, water, feces, pesticides, insects, and animals [6]. Therefore, proper disinfection must be done before any use of vegetables. Although the presence of pathogens inside the plant tissue and the hydrophobicity of the plant surface slightly limits the effectiveness of washing [2,6]. Therefore, prevention of contamination in all activities before, during, and after harvesting is very necessary. As mentioned, the farm (sample 2) is very close to the main road, and river water was also used to prepare crops. In addition, as can be seen in Figure 3, there is an area with a high density of trees next to the farm, where a large number of the Eurasian magpie (*Pica pica*) were present and feeding on the farm products. All these factors can contribute to this microbial contamination.

Table 2. Microbial contamination in parsley (Tamchal region).

Contamination	Maximum
Coliform	[a]1.35×10^2 [b]2.36×10^3 [c]1.65×10^2
Total microbial count	[a]2.04×10^3 [b]1.19×10^5 [c]2.23×10^3

Note: Note: * [a]Sample 1, [b]Sample 2, [c]Sample 3, ** Iran's national standards for coliform and the total microbial count are 10^3 and 10^5, respectively [2,6].

4. Conclusion

In summary, the level of heavy metals in parsley collected from local farms in the Tamchal region was evaluated. The results showed that the sample of a farm had more heavy metals than the standard level. Also, the evaluation of microbial contamination of parsley showed that only one sample was unacceptable. This

study showed that crops should be continuously monitored.

Conflicts of Interest

The authors declare no conflict of interest.

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