

Evaluation of Heavy Metals in *Matricaria chamomilla* and *Lavandula angustifolia*

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Abstract

Today soil and environmental pollution by heavy metals, has become a serious problem for human health. This pollution can be absorbed by agricultural products and enter the body. The purpose of this research is to investigate the contamination of 2 medicinal plants by 4 heavy metals in Shiraz city. To achieve this, 2 kinds of medicinal plants *Matricaria chamomilla* and *Lavandula angustifolia* were chosen and bought from 6 different herbalists in Shiraz and then were registered in medicinal plants herbarium of the school of Pharmacy, Shiraz University of Medical Sciences. Plarograph was used for measuring the concentration of copper, zinc, cadmium, and lead in this study; and according to the achieved results, in *Matricaria chamomilla* and *Lavandula angustifolia* samples the concentration of zinc was 2.66 ± 0.76 mg/kg and 1.46 ± 0.74 mg/kg, the concentration of lead was 0.092 ± 0.069 mg/kg and 0.11 ± 0.05 mg/kg, the concentration of copper was 0.237 ± 0.080 mg/kg and 0.41 ± 0.17 mg/kg and the concentration of Cadmium was 0.017 ± 0.009 mg/kg and 0.019 ± 0.004 mg/kg, respectively. Based on these results, it can be found that the concentration of heavy metals in these two medicinal plants wasn't more than the standard concentration that was reported for similar plants.

Keywords: Copper, Zinc, Cadmium, Lead, *Matricaria chamomilla*, *Lavandula angustifolia*, Plarograph.

1. Introduction

Today, food health is important as much as food preparation in all countries. The American continent has 138000 species of herbs, including the richest sources of plants in the world, while Asia continent has 123000 plant species. Among Asian countries, the largest number and variety of species belong to China, Indonesia, India, Burma, Thailand, Malaysia, and Iran. The effect of medicinal herbs on the treatment of diseases is not overlooked by anyone, but the fact that the plants are free from side effects due to their natural origin, and their use doesn't cause any problems for

the body, is a mistake that is harmful to many of us (1, 2). Today, many scientists, researchers, factories, and pharmaceutical companies research on medicinal plants as their top of agenda (3). Considering the attention to increase use of medicinal plants in Iran, unfortunately, studies are done about chemical contamination of these products are not enough.

One source of chemical contamination of these drugs is heavy metals. Many of these metals will eventually cause poisoning after entering the body due to accumulative properties (4). Growth and generalization of the usage of the medicinal plants increase the risk of poisoning (5). Several reports have been made regarding the pollution of Chinese plant products with heavy metals such as

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lead, mercury, cadmium, arsenic or thallium. A review of 58 cases of heavy metals found in Chinese composite plant products in Singapore between 40-47 $\mu\text{g}/\text{kg}$ has been made reports of acute, systemic, congenital, and clinical poisoning (6-11).

One of the most important issues about heavy metals is their lack of metabolism in the body. In fact, after entering the body, heavy metals do not excrete from the body but precipitate and accumulate in tissues such as fat, muscles, bones, and joints, which also causes many diseases and complications in the body (12). Heavy metals with the highest toxicity on human health include arsenic, barium, cadmium, lead, mercury, and chromium. The excessive intake of these metals into the body causes complications and injuries such as neurological disorders, digestion, bone, enzyme disorders, kidney, testicular, and haematopoietic organs, mental retardation, cancer, etc. (13).

According to the importance of heavy metals and their effect on health, this research was done to measure the concentration of heavy metals, including copper, zinc, cadmium, and lead, in two medicinal plants that were more in demand in Shiraz, Iran.

2. Materials and methods

Matricaria chamomilla and *Lavandula angustifolia* were bought and collected from six groceries in six different districts of Shiraz, Iran. Then a homogeneous solution of HNO_3 and H_2O_2 by the ratio of 1:2 was prepared. One gram of plant powders was added to this solution, and then it was heated in a heater at 105°C for 45 min. After cool-

ing, it was placed in the centrifuge machine and passed through the filter. Then it was poured into a balloon and the volume was reached to 100 ml by using and adding distilled water. In this research, a polarograph was used to measure the concentration of heavy metals. The readings with a polarographic device are such that the potential which was applied to the working electrode (mercury droplet electrode) is measured against a reference electrode.

In order to do so, 10 ml of the diluted sample was added to acetate buffer and injected into the polarograph machine. After that, standards of all four metals (zinc, cadmium, copper, and lead) were added to the machine, then a pH adjustment was done (4.6 ± 0.2) and was left 300 seconds for deoxygenating. Then needed, 100 μm of each elements standard were added using a sampler and started again. After 90 sec, the process was finished, and the polarograph machine showed the results.

The concentrations of the metals were analyzed by Graph Pad Prism-6 T-test.

3. Results

The results showed that the contamination of heavy metals was not that much. In *Matricaria chamomilla* and *Lavandula angustifolia*, the concentration of heavy metals were as follows, respectively: zinc: 2.66 ± 0.76 mg/kg and 1.46 ± 0.74 mg/kg, (Figure 1), lead concentration 0.092 ± 0.069 mg/kg and 0.11 ± 0.05 mg/kg (Figure 2), 0.237 ± 0.080 mg/kg and 0.41 ± 0.17 mg/kg (Figure 3), and Cadmium 0.017 ± 0.009 mg/kg and 0.019 ± 0.004

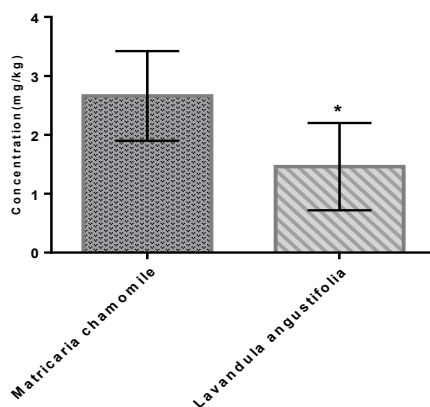


Figure 1. Comparing the concentrations of zinc in *Matricaria chamomilla* and *Lavandula angustifolia* samples (mean \pm SD, N=6, $P<0.05$).

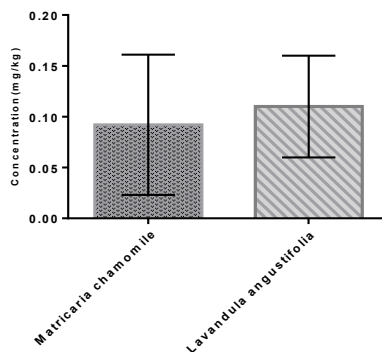


Figure 2. Comparing the concentrations of lead in *Matricaria chamomilla* and *Lavandula angustifolia* samples (mean \pm SD, N=6, $P<0.05$).

mg/kg (Figure 4).

4. Discussion and conclusion

The concentrations of heavy metals copper, zinc, cadmium, and lead in *Matricaria chamomilla* and *Lavandula angustifolia* of different groceries were compared with each other (mean \pm SD, N=6, $P<0.05$).

Heavy metal contamination in the environment is increasing, and these heavy metals are indigestible (14). Therefore, heavy metals absorption by plants that are growing in contaminated soils can be so dangerous (15).

There wasn't any report about the concentration of heavy metals in *Matricaria chamomilla* and *Lavandula angustifolia*, and we could not find any information about the standard concentration limit of heavy metals in these two medicinal plants.

According to the standard No. 10768 of National Institute of Standards, the limit of lead, copper, and cadmium are 1, 150, and 0.1 mg/kg in

green tea, respectively. Hence, since the amount and the way of using green tea is almost similar to *Matricaria chamomilla* and *Lavandula angustifolia*, we used the national standard of green tea for comparison.

A research was done about the concentration of arsenic, copper, cadmium, and chromium in green tea, and the result showed that the maximum limits of elements were as follows: 0.34 ± 0.54 $\mu\text{g}/\text{kg}$ in imported green tea samples, lead 577 ± 608 $\mu\text{g}/\text{kg}$, and cadmium 37 ± 15 $\mu\text{g}/\text{kg}$ in domestic green tea (16).

Moreover, the health risk assessment for all of the elements was found to be less than 1 mg/kg and it was not higher than limits of WHO and National Standard Organization of Iran (17).

In a research done in China on the concentration of some heavy metals in tea, the results showed that the health risk assessment of iron, zinc, lead, cadmium, copper, manganese, and nickel was less than 1 mg/kg.

The concentration of zinc in *Matricaria*

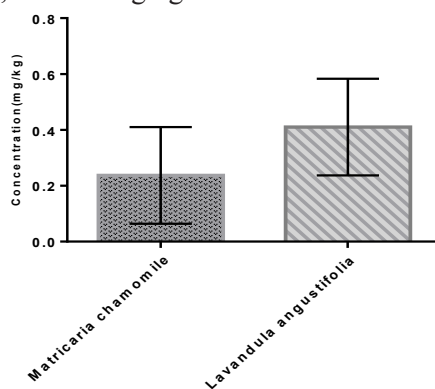


Figure 3. Comparing the concentrations of copper in *Matricaria chamomilla* and *Lavandula angustifolia* samples (mean \pm SD, N=6, $P<0.05$).

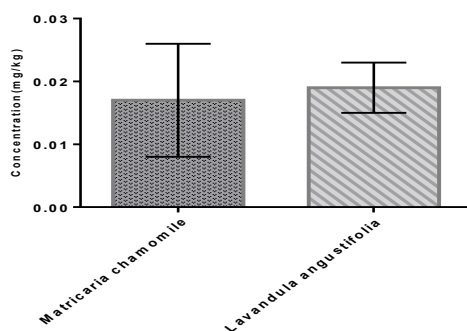


Figure 4. Comparing the concentration of cadmium in *Matricaria chamomilla* and *Lavandula angustifolia* samples (mean \pm SD, N=6, $P<0.05$).

chamomilla was significantly more than that in *Lavandula angustifolia* ($P<0.5$). But, unfortunately in Iran, there is no definite limit or maximum limit for zinc in *Matricaria chamomilla* and *Lavandula angustifolia*; and because of that, we had to compare our results with the results of same studies on tea and sweets because their origin and way of use are almost the same (18) (Table 1).

In addition, the results of another research done in 2012 on the amount of some heavy metals, including nickel, lead, copper, manganese, zinc, cadmium, and vanadium in edible vegetables of south of Tehran refinery, plants had different amounts of metals and from 14 species studied, onion had the highest content of the above-mentioned metals. The mean concentration of zinc in these plants was 70.68, 47.37, 98.11, 85.53, 15.57, 358.03, 91.22, 154.24, 104.50, 63.73, 59.53, 72.92, 86.68, and 74.99 mg/kg, which were more than our results (19).

The concentration of lead in *Matricaria chamomilla* was not significantly different from its concentration in *Lavandula angustifolia* ($P<0.05$). The concentration of lead in *Matricaria chamomilla* and *Lavandula angustifolia* was 0.092 ± 0.069 and 0.11 ± 0.05 mg/kg, respectively, which were less than the results of Cheraghi and

Ghobadi research, on the concentration of heavy metals (calcium, nickel, lead and zinc) in parsley (20). In another research by Hashemi *et al.*, the concentration of heavy metals in 10 medicinal plants were measured, and the results indicated that the levels of heavy metals including chromium, copper, lead, and mercury were less than the allowed limit, which was the same as our result (21). Similarly, in another research by Koh and Woo, they observed that the concentration of lead in some Chinese medicinal plants was less than the allowed limit (7). Moreover, Callas and Machado investigated the concentration of cadmium, mercury, and lead in some Brazilian medicinal plants and the results indicated that lead concentration was very low (7).

Gomes *et al.* also searched about heavy metal contamination in some medicinal plants in Argentina with methods of ETAAS and ICP-AES and the results indicated that the concentration of none of the heavy metals was more than the allowed limit, which was the same as the results in our research (22).

In this study, the concentration of copper in *Matricaria chamomilla* was not significantly different from its concentration in *Lavandula angustifolia* ($P<0.05$).

Table 1. Comparing our results and the results of same studies.

Country	Product	Zinc (mg/kg)
India	Tea	14.5-25.2
Iran	Sweets	0.02-1.26
This research	<i>Matricaria chamomilla</i>	2.66 ± 0.76
	<i>Lavandula angustifolia</i>	1.46 ± 0.74

Mean concentration of copper in this study was 0.237 ± 0.080 mg/kg in *Matricaria chamomilla* and 0.41 ± 0.17 mg/kg in *Lavandula angustifolia*.

According to a study by Hashemi et al., the concentration of this heavy metal in 10 samples of medicinal plants was 376 ± 1.7 µg/kg in chicory, 428.12 ± 7.08 µg/kg in spearmint, 483.275 ± 11.375 µg/kg in tea, 160.875 ± 87.85 µg/kg in *Glycyrrhiza glabra*, 137.60 ± 61.525 µg/kg in oregano, 254.76 ± 48 µg/kg in savory, 533 ± 20.63 µg/kg in cowslip, 260.025 ± 23.275 µg/kg in senna, 345.7 ± 27.40 µg/kg in hibiscus, and 112.20 ± 0.1 µg/kg in violet (21). A research was done on the concentration of heavy metals petulance's leaves, whose results showed that the concentration of copper in this plant was 0.45 mg/kg, which was more than its conversation in this study (23).

Endear investigated about the concentration of iron, zinc, manganese, and copper in dill and fenugreek and concluded that the concentration of copper was 0.255mg/kg in fenugreek and 0.173 mg/kg in dill, which was less than that in *Matricaria chamomilla* and *Lavandula angustifolia* (24).

In the other hand, since there was no allowed limit for the concentration of heavy metals in *Matricaria chamomilla* and *Lavandula angustifolia* in the National Standard Organization, we compared our results with sweets and tea. Because according to the annual statistics, the way and the amount of usage of tea and sweets are the same as *Matricaria chamomilla* and *Lavandula angustifolia*.

The allowed limit of copper is 150 mg/kg in tea (Standard No. 67.140.10) and 0.4 mg/kg in *Fumaria officinalis* (Standard No 71.100.60; 76.160.20). In the present study, the mean concentration of copper in *Matricaria chamomilla* was 0.237 ± 0.080 and in *Lavandula angustifolia* was 0.41 ± 0.17 mg/kg

The concentration of cadmium in *Matri-*

caria chamomilla was not significantly different from its concentration in *Lavandula angustifolia* ($P > 0.05$).

According to the results of the present study, the concentration of cadmium in *Matricaria chamomilla* was 0.017 ± 0.004 and in *Lavandula angustifolia* was 0.014 ± 0.004 mg/kg. Hashemite et al. investigated the concentration of heavy metals in some medicinal plants and concluded that the concentration of cadmium was 59.65 ± 22.8 mg/kg in chicory, 185.26 ± 7.26 mg/kg in spearmint, 238.15 ± 13.15 in tea, 404.15 ± 34.525 in *Glycyrrhiza glabra*, 173.35 ± 17.375 in *Thymus*, 503 ± 13.56 mg/kg in savory, 136.16 ± 11.60 in cowslip, 232.3 ± 3.3 mg/kg in sienna, 152.6 ± 2.75 mg/kg in hibiscus, and 44.3 ± 6.7 mg/kg in violet, and the concentration of heavy metals in those plants were not more than their standard limits (21).

A study was done about the concentration of heavy metals in leaves of *Portulaca* and concluded that cadmium concentration was 124.74 mg/kg, which was more than what is resulted in the present study (25).

Kazemzadeh khoei investigated the concentration of heavy metals in edible vegetables of the south of Tehran, and the achieved results showed that cadmium concentration was 0.006 mg/kg, which was not more than its limit, the same as results of the present research (19).

Mehdipour researched about the concentration of heavy metals in 10 medicinal plants in Tehran and concluded that concentration of cadmium was less than the standard limit, which was the same as the present research result (26).

In the other hand, the allowed limit of cadmium reported for green tea was 0.1mg/kg (According to standard No. 67.140.10), which is more than what is resulted in this study.

Conflict of Interest

None declared.

5. References

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