

Evaluation of the Heavy Metal levels in Common Herbs and Spices Available on the Tripoli market by Atomic Absorption Spectrometer

Suad A. Alshiteewi

Department of chemistry, Faculty of Education, University of Zawia, libya

s.alshiteewi@zu.edu.ly

تاريخ الاستلام: 2026/01/07 تاريخ المراجعة 16 / 2 / 2026 تاريخ القبول: 2026/03/09 - تاريخ النشر: 2026 /03/16

Abstract:

Herbs and spives are sources of many bioactive compounds that can improve the taste of food well as affect the digestion metabolism. Along with that they may also contain some substances as pesticides, heavy metals and which have harmful effect on the body. In this work 14 of the most popularly spices and herb used in libya cuisine. were studied to determine Co, Cd, Pb, Zn, Se, Cu, As content in them. This was determied using atomic absorption spectrophotometry (AAS). Metals were found to be present in varied concentrations in the samples ,The results were compered with the safety standards of World health organization (WHO) and the Food Agricultural organization (FAO). The average concentration of heavy metals as **Cd** detected ranged from 0.01 ppm – 1.04 ppm, **Pb** ranged from 0.59 – 4.63 ppm, **Co** in a range 0.05ppm – 0.2.20ppm, **Zn** ranged from 0.42ppm – 17.2ppm, concentration of **Se** was from 0.53ppm – 2.00ppm, **Cu** ranged from 2.02ppm – 14.3ppm, and **As** in a range 0.04ppm – 2.60 ppm The results obtained in this study indicate that spices and herbs used for food and meals seasoning may contain relatively high levels of toxic metals. therefore, like other food products they should be under continuous monitoring.

Keyword Heavy metals, Herbs, Spices, Atomic absorption.

Introductions

Spices and herbs are widely used worldwide since ancient in most region of the world for the several purpose due to their medicinal and culinary properties. they are aromatic substances, often derived from various parts of plants such as seeds, fruits, buds, rhizomes, roots, barks, and

others parts of plant. Most of these are fragrant, aromatic and pungent. The bulk of the dry material of spices contains carbohydrates, and organic compounds having different functional group ^[1-4]. that are used to flavor, color, or preserve food. Which most common spices used in Libyan cuisines. They not enhance the taste of food but they can also have been recognized to have medical properties due to antioxidant and antimicrobial. antidiabetic, anti- inflammatory, and antihypertensive action. However, increasing pollution and industrial activities have led to the contamination of these plants with heavy metals, contamination of spices and herbs with heavy metals in last two decades has increased markedly and scientific interest due to their dangerous effect on human health, that we consume. Which can enter the food chain from different environment and human sources. Mostly caused through various pathways, including: contaminated soil and water used for irrigation can lead to the accumulation of heavy metals such as lead, arsenic, cadmium, and mercury in plants. By fertilizers and pesticides which some agricultural inputs may contain heavy metals ^[2-3]. which can be absorbed by plants. by air pollution from automotive exhaust, agricultural waste such as pharmaceutical waste, industrial waste, fertilizers, the effect of the long term intake of spices contamination with heavy metals can be significant. Heavy metals are referred to as metallic chemical elements that have a relatively high density greater than 5g/cm, and found at different concentration in the earth's crust. and toxic or poisonous as low concentration. Heavy metals that are released to the environment at various concentration become contaminated, Heavy metals are among the largest contamination of food products. Heavy metals in food or water can cause serious health effects including organ damage, developmental issue and cancer. Most heavy metals are nonbiodegradable, and their bioaccumulation is due to their biological availability and extended biological half-life. Food is the primary nonoccupational source of heavy metal exposure for humans ^[5,6]. Foods of various types, including spices, The trace metals found in spices and medicinal herbs are vital for the functioning of some cells in humans. A various of these metals in the form of trace elements are essential for many function in the human body, high levels of these metals become hazardous because of their deleterious effects on human health. This is imperative that we understand the level of these metals in our food ^[7]. The aim of this study was to determine the safety of the most popular species and herbs used in Libya cuisine and medicinal purpose, as determined by levels of heavy metals (Zn, Cu, Fe, Cd, Pb, Ni, Ca, Cr) residue. The most herbs and spices were evaluated by atomic absorption spectrophotometry (AAS) The levels of investigated heavy metals were

compared with recommended levels by the purchased from the International organization as WHO and FAO.

Material and Methods

All samples were collected from local market (souliman khater market) in capital tripoli-libya, they were classified according to their scientific name and the used part of the plant (table1). Samples washed by distilled water and dried in the oven at a temperature of 105°C for 3 hours to a constant weight. And ground to powder in an electric grinder and the powder kept dry for metal analysis. All glassware and digestion apparatuses were soaked in 30% nitric acid and rinsed with distilled water.

Sample digestion and heavy metals analysis

Samples extracted using hot block digestion method. 1 g of each sample was weighed in a 100 mL beaker. Followed by addition of 10 mL mixtures of 30 % (m/m) H₂O₂ and 65 % (m/m) HNO₃ in the ratio (3:1 v/v) solution. The solution was digested on a hot plate at 120°C in a fume cupboard for 120 minutes. The digested samples were allowed to cool to room temperature and final extracts were filtered into 25 ml volumetric flasks through 45 µm filters and then diluted to the mark with 1% HNO₃ solution. Heavy metals concentrations were measured by atomic absorption spectroscopy AAS

Table 1- Common name, Scientific name, family, and used parts of studied samples

Common name	Scientific name	family	Used parts
Thyme	Thymus vulgaris	Labiatae	Leaves
Cinnamon	Cinnamomum zylanicum	Lauraceae	Bark
Cloves	Syzygium aromaticum	Myrtaceae	Buds
Nutmeg	Myrisica fragrans	Myrsicaceae	Seeds
Turmeric	Curcuma longa	Zingiberaceae	Leaves
Black pepper	Capsicum nigrum	Piperaceae	Seeds
Cumin	Cuminum Cyminum	Umbelliferae	Seeds

Basil	Ocimum basilicum	Labiatae	Leaves
Coriander	Coriandium sativum	Umbellifeae	Seeds
Hot red baprika	L, Nigella sativa	Ranunculaceae	seeds
Ginger	Zingiber Officinale	Zingiberaceae	Rhizomes
Ment	Mentha verticillata	Lamicaeae	Leaves
Tejpatta	C. tamala	Lauraceae	Leaves
Nigella	Nigell sativa	Umbellifeae	seeds

Table 2- Levels of concentrations in Spices and herbs samples (mg/kg)

Sample	Co	Cd	Pb	Zn	Se	Cu	As
Thyme	0.84	0.15	0.70	13.04	2.00	12.0	2.25
Cinnamon	2.10	0.02	3.23	10.1	1.85	5.05	2.07
Cloves	0.15	0.06	2.50	5.00	1.05	9.00	0.04
Nutmeg	2.20	0.06	3.38	7.30	1.86	5.44	1.86
Turmeric	0.10	0.01	0.59	7.42	0.96	6.25	1.62
Blackpepper	0.89	0.14	4.63	11.70	1.66	2.02	0.12
Cumin	0.08	0.06	0.86	9.64	0.78	11.8	0.16
Basil	1.12	0.14	1.00	15.0	0.98	4.72	2.60
Coriander	0.13	0.02	2.55	5.84	1.34	7.82	0.68
Red baprika	0.66	1.04	0.70	9.28	0.88	5.21	2.04
Ginger	0.48	0.06	0.91	17.2	0.79	4.85	0.07
Ment	0.05	0.19	1.22	8.08	0.65	13.02	0.08
Tejpat	0.98	0.05	2.87	9.56	0.53	14.3	0.82
Nigella	1.29	0.03	3.60	11.32	2.00	2.09	0.32

Table 3- Permissible limits of heavy metals in Spices and herbs (ppm). according to WHO/FAO

Metals	ppm	Metals	ppm
Cobalt (Co)	3.5	Selenium (Se)	2.0
Cadmium (Cd)	0.2	Copper (Cu)	3.0
Lead (Pb)	5.0	Arsenic (As)	1.0
Zink (Zn)	100		

Results and discussion

The heavy metal concentration in all samples of Herbs and Spices determined by Atomic absorption spectrometer (AAS) technique which obtained results are shown in (Table 2) that, The highest concentration of cobalt was (2.20 ppm) in Nutmeg and least was in Ment (0.05 ppm), Red baprika had the highest concentration of Cadmium (1.04 ppm) and least was in Turmeric (0.01ppm), the highest concentration of Lead was (4.63 ppm) in Blackpepper, and least was (0.59ppm) in Turmeic, the highest concentration of Zink (Zn) was (17.2 ppm) in Ginger and least was (5.00ppm) in clove, the highest concentration of Selenium was (2.00 ppm) in Thyme and Nigella and least was (0.53ppm) in Tejpatta, Basil recorded the highest the concentration of Arsenic (As) (2.60ppm) and least was (0.04ppm) in clove

The concentration of some heavy metals is within the permissible limits Cobalt, Lead and Selenium in all samples according to the standard set by the World Health Organization and the food Agriculture Organization, but the concentration of Cadmium, Zink, Copper, and Arsenic in some samples were found in higher than the permissible.

Conclusion

The result in table 2 showed that there is no risk from the daily use of the above mentioned spices if taken in limited quantity. Human needs for spices is very few grams per day and there is no risk of using these spices under study in the food stuff. But some results obtained indicates that spices and herbs used in food may contain some toxic metals in relatively high level. Therefore they should be under continuous monitoring.

References

- [1] Kimberley willis, Viktor Budnik knackCanning, pickling& preserving tools, techniques & Recipes 2010 page 88.
- [2] Alqahtani, N., Abdulsalam, N., Abduljawad, E., Alnemr, T. and Ali, S (2022). Physico- chemical properties, rheological characteristics, and storage stability of cold – break processed tomato paste enriched with rice flour. Food Research 6 (1): 90 -98 Journal homepage: [https:// www. my food research. com](https://www.myfoodresearch.com)
- [2] Savas K.B., Gul Akillioglu H. and Vural G. (2015). Osmatic and Membrane Distillation for the concentration of tomato Juice: Effects on Quality and Safety Characteristics, Innovative food Science and Emerging Technologies, 31:131-138.
- [3] WPTC (world processing tomato council). USA: University of Colorado; 2015.
- [4] Thakur, B. R., Singh, R. K. and Nelson, P. E. (1996). Quality Attributes of Processed Tomato Product: A review. Food Reviews International, 12(3), 375- 401.
- [5] WPTC (world processing tomato council). Portugal: IEEE;2016
- [6] Shatta A.A.B, Youssef K. M., Al Sanabani A. S., EL Samahy S.K. (2017). Impact of Processing Steps on Physicochemical and Rheological Properties of Tomato Paste (Cold- break). MOJ Food Process Technol.5 (2):263-271.
- [7] Veloo, K.V. and Tan, H.I (2024). Comparison of heavy metal residue in selected processed canned tomato paste and bottled tomato sauce using atomic absorption spectrometry. Food Research 8 (3), 7- 13
- [8] European Commission Regulation(EC) No 1881/ 2006. Setting maximum levels for certain contaminants in foodstuffs.