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REVIEW ARTICLE

EVALUATION OF HEAVY METALS IN A SELECTION OF DOMESTIC AND FOREIGN VEGETABLES COLLECTED AT THE ERBIL MARKET

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ABSTRACT

Three varieties of local and imported vegetables—eggplant, pepper, and tomatoes—were gathered in Erbil. The heavy metals in vegetables, such as lead (Pb), manganese (Mn), zinc (Zn), and cadmium (Cd), as well as the health risks they pose in Erbil, were examined using an X-ray fluorescence spectrometer (XRF). The FAO/WHO safe limits for the concentration of heavy metals in vegetables were exceeded by the local and imported vegetables, with mean values mg kg-1 ranging from 40-122, 12-32, 15-55, and 3-8, respectively. The majority of the heavy metals under investigation exceed the FAO/WHO acceptable limit values. Estimates of the daily intake of the four main heavy metals (pb, Mn, Zn, and Cd) showed that imported and locally grown vegetables had high Cd consumption (7 and 8 mg kg-1). This study recommends that the Kurdistan region of Iraq and society as a whole be made aware of this issue and that its effects on the environment and public health be taken into consideration.

KEYWORDS

Heavy metal, local and imported vegetables, XRF instrument.

1. INTRODUCTION

Vegetables that contain harmful metals are a global health concern because they can have detrimental effects on human health and food quality. Although heavy metals are naturally occurring substances, both natural and man-made factors can be responsible for their presence in plants. Vegetables are a quick, inexpensive, and sufficient source of fiber, vitamins, and minerals (Akan et al., 2013). Basic nutrients found in vegetables, such as calcium and proteins, are part of what both humans and animals need to survive (Yang et al., 2011). One of the most significant sources of neutralizing agents for acidic substances produced during digestion is vegetables (Yusuf et al., 2009). Furthermore, the primary advantage of vegetables lies in their ability to combat various toxicants through their anti-oxidative properties (Elbagermi et al., 2012). Many plant species have different dietary needs, such as those for minor and macroelements that support budding and growth (Ihekeronye et al., 1985).

Due to their high vitamin, fiber, and potassium content, vegetables are a healthy part of any diet. Consuming vegetables regularly lowers the chance of developing cardiovascular disease and a number of cancers, particularly tumors of the digestive system (Aysha et al., 2017). But eating greens from soil tainted with heavy metals could be harmful to one's physiological and metabolic systems (Li et al., 2018). Overuse of both organic and inorganic fertilizers in the fields can cause heavy metals to build up in agricultural plants, which can be harmful to consumers. (Meng et al., 2018; Akter et al., 2017). The health consequences of elevated levels of hazardous substances in soil, water, and plants are causing great concern for experts worldwide. These risks could result from these factors' potential for harm. Several cases of heavy metal contamination in products have been documented. (Mahmood et al., 2020; Sayo et al., 2020). Because heavy metals do not biodegrade, they build up in the soil and pose a risk to the local ecosystem, which includes people, animals, and plants. (Tariq et al., 2019). In addition to being toxic, heavy metals can cause cancer and genetic mutations. The two most common ways that humans are exposed to toxic metals are through absorption and ingestion. (Sayo et al., 2020). Humans are primarily exposed to some of these metals through the soil-crop system, which involves ingestion of the metals. (Solidum et al., 2012). There are several kinds of heavy metals that can lead to different cancers, neurotoxicity, dyspnea, teratogenic and mutagenic effects, and other health problems. Cadmium is one such metal. Mahdavi et. al., 2018). The purpose of this research is to ascertain the levels of heavy metals in local and imported vegetables in Erbil's city markets, as well as the health risks associated with eating them.

2. PROCEDURE

2.1 Area of study

The population of Erbil, the capital of Iraqi Kurdistan, exceeds one million. A location was chosen, one of the vegetable markets in Erbil. at Longitude 36.11809 and Latitude 44.0306.

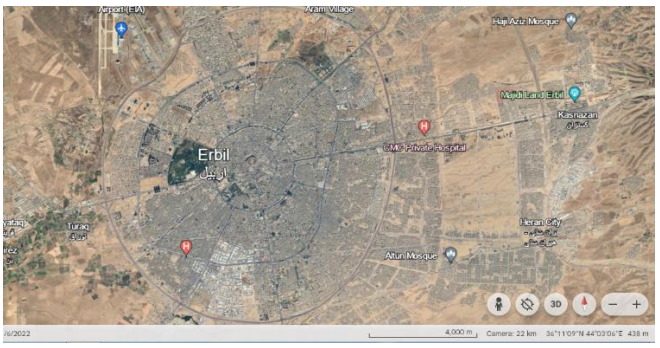

Figure 1: Map indicating the location of the sample on the study area

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2.2 Taking samples

Using a stainless steel knife, roughly 1 kg of edible portions of various imported and local vegetables were obtained. In November, the following vegetables were picked from Plate 1 of the Erbil market: pepper (Capsicum annuum), tomato (Solanum L.), and eggplant (Solanum melongena L.). To get rid of dust and debris, tap and distilled water were used to clean each vegetable sample. The edible parts of the samples were dried in an oven for a full 72 hours. After the materials were dried, they were finely powdered and put in containers to wait for analysis. Luminescence Spectrometer for X-rays XRF was used to examine the different forms of heavy metals, including lead (Pb), manganese (Mn), zinc (Zn), and cadmium (Cd). The mechanism by which XRF operates involves the displacement of electrons from their atomic orbital positions, resulting in the release of an energy burst that is unique to a given element. The XRF instrument's detector then records this energy release and classifies the energies according to their constituent elements.

Plate 1: Nearby Grocery and Convenience Stores, sample location.

3. Results and Discussion

The findings showed that all of the samples contained the heavy metals that were found, albeit in different amounts. Table 1 displays the FAO/WHO standard concentrations of heavy metals in vegetables (mg/kg). Table 2 displays the heavy metal concentrations for local tomatoes, peppers, and eggplants; Table 3 displays the concentrations for imported vegetables. Lead is the metal with the highest concentration found in both imported and local eggplant, according to researchers results (Younis and Darwesh's 2023). The least amount of metals found in both imported and local tomatoes and peppers is cadmium; in eggplant, both local and imported zinc exceeded FAO/WHO acceptable limits; in tomato and pepper, both imported and local zinc fell short of FAO/WHO acceptable limits. The current findings concurred with those of researcher results in 2018, who reported zinc concentrations in tomatoes of 17.3 mg kg-1 (Hasoon; 2018). The manganese content of both imported and local tomatoes was high, and the other metal contents of all vegetables were found to be higher than FAO/WHO acceptable limits in both cases Owing to various factors such as The use of specific fertilizers and pesticides, mining operations, and industrial pollution can all lead to the buildup of heavy metals in the soil. Vegetables may take up these metals and store them in their tissues if they are grown in contaminated soil. In a similar vein, a group of researchers discovered that the concentrations of heavy metals in various plant parts varied (Santamaria et al., 1999). If veggies are kept in heavy metal-containing containers. These metals may be present in the materials used to make the containers, or they may have become contaminated during production or storage. Vegetables stored in areas with high air pollution levels may become contaminated due to the presence of heavy metals in the air. In urban areas or close to industrial facilities, this is more likely to happen. Vegetables can get contaminated by cross-contamination if they are kept close to other products that are contaminated with heavy metals, like batteries or electronic gadgets. Vegetables may get contaminated if they are kept in water that has been tainted by heavy metals.

Table 1: FAO/WHO standard concentrations of heavy metals in vegetables (mg/kg).

Types of vegetables	pb	Mn	Zn	Cd
Tomato	0.1	10	20	0.1
Eggplant	0.3	3.3	30	0.05
Pepper	0.3	2	50	0.1

Table 2: Heavy metal concentration of four local vegetable samples (mg/kg).

Types of vegetables	pb	Mn	Zn	Cd
Tomato	40	15.2	18.3	3
Eggplant	102	30	52	7
Pepper	50.2	12	15	5

Table 3: Heavy metal concentration of four imported vegetable samples (mg/kg).

Types of vegetables	pb	Mn	Zn	Cd
Tomato	55	15	16.2	7
Eggplant	122	30	55	8
Pepper	62.3	32	39.7	7

4. Conclusion

The only heavy metal with concentrations below the limits set by the Food and Agriculture Organization and the World Health Organization was zinc. Zinc concentrations in tomatoes were lower in both imported and local varieties, similar to the lower concentrations in peppers. However, zinc concentrations in both imported and local eggplant were higher. The levels of lead and cadmium found in both domestic and imported vegetables are higher than those allowed by the FAO/WHO. There could be a number of reasons for this, including: Contamination of soil: Heavy metals from industrial processes like smelting and mining can build up in soil. or from using pesticides and fertilizers that have been tainted. If grown in contaminated soil, vegetables may absorb these metals through their roots and store them in their tissues. Water contamination: Heavy metals can also enter the food chain through water pollution. If vegetables are grown in contaminated areas or are irrigated with tainted water, they may absorb these metals and accumulate them in their tissues. Air pollution: Heavy metals such as lead and mercury have the ability to enter the atmosphere and land on crops. This could occur near busy roads or industrial zones. If heavy metals are present in the machinery or packaging materials used during processing and packaging, vegetables may also become contaminated with heavy metals.

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