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Assessment of heavy metal and nitrate contamination in canned products from local markets in Baghdad

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ABSTRACT

This study aimed to determine the concentrations of heavy and trace elements in commonly consumed canned foods using atomic absorption spectrophotometry, the study of specific types of request cans and applications in the local markets and the estimation of some heavy elements and trace elements using an atomic absorption device are discussed, three local markets in Baghdad Atomic absorption spectrophotometer where the value of the lead in the vegetables was the Lebanese origin 0.60 mg/100g and at least 0.20 mg/100g in UAE-grown beans and cadmium with a maximum value of 0.05mg/100g in UAE beans and at least pineapple, While the Cobalt component of the highest value in the mushroom whole Chinese 0.18 mg/100g and at least in pineapple slices, fruit and peaches, where the value of zero and finally the highest nitrate value in the mushroom whole grain Chinese 174.8 mg/100g and less in the fruit problem Malaysian 28.3 mg/100g. As for the rare elements, the highest manganese element in the Chinese pineapple was 2.37 mg/100g and the lowest 0.12 mg/100g in Thai peaches, and the highest iron component was concentrated in Homs in the Jordanian tahini 9.42 mg/100g and the lowest Chinese pine, 34 mg/100 g and the zinc component was the highest in the Jordanian beans 11.27 mg/100 g and the lowest in the Thai peaches 0.23 mg / 100 g and finally the copper component of the highest value in the mushrooms Chinese pieces 2,11 mg / Saudi corn grain 0.01 mg/100g.

Keywords: Canned, Atomic, Local markets, Heavy elements, Baghdad.

Introduction

The development of food technology and industry, the increasing sources of pollution and the potential contamination of food and beverages with organic and organic substances harmful to humans has led to an increase in awareness among specialists regarding the damage caused by these pollutants. Researchers were interested in the study and analysis of food contaminants and their quantities. The most important food pollutants are heavy metals including mercury, arsenic, cadmium, cobalt, selenium, lead, nitrate and nitrite (Mohamed *et al*., 2012; FAO/WHO, 1984). These contaminants may reach canned foods, particularly vegetables and fruits, through air, water, soil, or manufacturing. The source of Cd contamination of the cadmium element is the types of fertilizers containing this element, which leads to some of its effects in the crop and can also be found in the meat of cattle that feed on feed contaminated with Cd (Kennish, 1992).

Lead is a natural component of Earth's crust. Pb is used in many industries, including the food industry. For example, canned foods tend to contain the highest levels of Pb if Pb solder alloys are used in the manufacture of cans (Faez Mohamed *et al*,2020) and the method of conservation. Many fresh vegetables, grains and fruits contain small amounts of Pb as a result of absorption from the soil and deposition of air from the surface of the plant (WHO,1989). While nitrates are highly concentrated in soil and in most

water, plants and vegetables. Their use as a basis in the form of fertilizer and in manufacturing as oxidizing agents in the chemical industry food preservatives (Environmental Health Criteria/WHO, 1979).

Nitrate and nitrite are present in canned foods at higher levels than those by international organizations leading to serious diseases. Nitrates can be converted into nitrite by reduction, which in turn oxidizes hemoglobin to produces a substance (Samir Mohammed *et al*., 2024). Others are unable to carry oxygen. Nitrite can also react in conditions Especially in the human body with the secretary group and the source of food and other sources forming substances, some cause cancer (Environmental Health Criteria / WHO, 1979).

This research studies several types of canned food from vegetables and fruits offered in the local market's terms of their heavy metals and nitrates contents and suitability to health standards (Ayub Ebadi Fathabad *et al*., 2018).

Materials and Methods

Sample source: Food canisters were taken from vegetables and fruits according to the demand in the three local markets in Baghdad on september14th and classified according to their origin. Various canned mixed vegetables, mushrooms, chickpeas, corn grains, canned fruits, pineapple, mixed fruits, and peaches.

Chemical analysis: Samples of vegetables, fruits from different countries were analyzed with an atomic absorption spectrophotometer

Preparation of samples: The samples were heterogeneous because the cans contained solid pieces of vegetables or fruits preserved in saline or sugar. according to the type of product. Therefore, the samples were mixed with a food mixer so that the sample became homogenous and emulsified. The samples were then dried at 75°C in an electric oven. The percentage of moisture in the sample was estimated on a dry weight basis, after manual grinding was performed using dry mortar samples of porcelain.

Determination of metallic elements: According to Kennish (1992):

Digestion Process Digestion: Mix 2 g of dry sample in a 200 ml glass flask and add 10 ml of nitric acid. The sample was added the following day overnight and covered with a bottle. The beaker and its contents were gradually heated in a digestion chamber at 250 °C for 1 h. subsequently. 5 ml of concentrated acid was added to the sample and returned to the surface. Heating, this process was repeated several times until the sample solution became clear. After cooling the beaker to room temperature, the contents were transferred quantitatively to a volume flask with a capacity of 0 25 ml, repeat the action. Deionizer water and complete the size to the mark by re-watering without adding a sample of control.

Determination of concentration of metallic elements: According to AL-Swaidan (1988), using atomic absorption device, the device was set using standard solutions suitable for each item, and the device was adjusted every 10 readings.

Determination of Nitrates and Nitrites: According to Ava Kharazi *et al*. (2021), dried sample (105 g) was added to a 150 ml conical flask. And 50 ml of deionized water was added. Samples were tested using a Shaker for two hours. The samples were then labelled with Whatman filter paper. 1 Nitrate was evaluated in the prepared extract was evaluated using Nitrite - Nitrate selective electrode and its specifications are range from 0.1 to 62000 ppm, pH ranges from 2 to 11, reproducibility 2%. The device is set using the appropriate standard solutions of potassium nitrate and nitrate.

Results and Discussion

1) Vegetable (Mixed chopped): Lead: The amount of lead in vegetables ranged between 0.21 and Saudi origin 0.60 for the Lebanese origin of mg/100g. Cadmium: Cadmium ranged between 0.01 mg/100g for Saudi origin and 0.04 mg/100g for Lebanese. Cobalt: 0.15 mg/100g Saudi origin and 0.03 for Lebanese for mg/100g. Nitrate: Nitrate was 147.2 mg/100g in Saudi product and 158.4 for Lebanese product. Manganese: The quantity ranged between 0.76 for Saudi origin and 0.80 mg/100g for Lebanese for origin. Iron;: Value was 7.05 in the Saudi product and 6.22 for Lebanese mg/100g. Zinc: Its value was 6.83 for Saudi and 1.60 for Lebanese for 100 mg, respectively. Copper: The values of this component ranged between 0.51 and 0.35 for Saudi and Lebanese respectively mg/100g.

2) Mushrooms: The main source of canned mushrooms in the Iraqi market is China. Lead; The amount of lead in the fungus was 0.52 mg/100g and 0.29 mg/100g in whole-grain mushroom. Cadmium; The amount of cadmium in the fungus is 0.01 mg/100g and 0.01 mg/100g in the whole grain mushroom Cobalt: The results showed that the amount of Cobalt element was 0.13 mg/100g of chopped mushrooms and 0.18 mg/100g whole grain mushroom Nitrate: 162.1 for section mushrooms and 174.8 for whole grain fungus. Manganese: The lowest value for this ingredient is 0.39 for whole grain and 0.42 for mg/100g. Iron: values varied between 7.72

for whole grain and 6.84 for mg/100g. Zinc: Values ranged between 4.50 for whole grains and 2.37 for pieces per mg/100g. Copper: Its value was 2.07 for whole grain and 2.11 for mg/100g.

3) Beans (Full grain): Lead: Its value in the product from UAE, Saudi, Jordanian, Kuwaiti 0.20, 0.55, 0.58 and 0.34 mg/100g respectively. Cadmium: Cadmium value was 0.05, 0.02, 0.03 and 0.01 mg/100g respectively. Cobalt: Its values ranged between 0.10, 0.08, 0.06 and 0.09 mg/100g respectively. Nitrates: Nitrate values ranged between 88.9, 93.5, 99.1 and 109.3 mg/100g respectively. Manganese: Its value was 0.77, 0.51, 0.47 and 0.80 for the United Arab Emirates, Saudi, Jordan and Kuwait respectively, respectively. Iron concentrations. ranged from 4.0 to 4.52, 2.86 and 3.50 mg/100g for the UAE, Saudi Arabia, Jordan and Kuwaiti, respectively. Zinc: The values ranged from 3.86, 3.41 and 3.90 for the UAE, Saudi Arabia and Kuwaiti, respectively, to 11.27 mg/100g. The copper: values for the UAE, Saudi Arabia, Jordan, and Kuwaiti were 0.63, 0.96, 1.18, and 1.00 mg/100g.

4) Chickpeas: Samples of canned chickpea, two types of chickpeas whole grain boiled, and the other Homs tahini, as follows: Lead: ranged from 0.22 mg/100g samples of chickpeas whole grain boiled Arabia and 0,22 mg/100g Homs whole grain boiled in Jordan and chickpeas. Tahini 0.39, 0.35 and 0.45 mg/100g for the Saudi, Jordanian and Lebanese products respectively. Cadmium: The value of 0.04 mg/100g samples of chickpeas whole grain boiled In Saudi Arabia and Jordan, chickpeas in tahini (0.2 mg/100g) for the Saudi and Jordanian products, while the Lebanese 0.01 mg/100g. Cobalt: Its value in chickpeas is a whole boiled egg. The value for both Saudi and Jordanian originates was 0.05 mg/100g. The hummus in the tahini was 0.07, 0.09 and 0.08 mg/100g for Saudi, Jordanian, and Lebanese originals, respectively. Nitrate: The value of the whole grain boiled 109.3 mg/100g for the Saudi product and 69.0 mg/100g for the Jordanian product, while the chickpea in the tahini was 90.7, 96.4 and 90.9 mg/100g for the Saudi product Jordanian and Lebanese respectively. Manganese: The values ranged between 1.9 and 2.01 mg/100g for the whole grain of the Saudi and Jordanian products, respectively, and 1.59, 1.35 and 0.85 mg/100g for chickpeas, for Saudi, Jordanian and Lebanese products, respectively. Iron: The values of this component varied from 3.01 to 3.25 mg/100g for the whole grain of the Saudi and Lebanese products respectively to 2.97, 9.42 and 3.88 mg / 100 g for chickpeas in Saudi, Jordanian and Lebanese products respectively. Zinc: This ingredient was valued at 10.54 and 3.07 mg/100g for the whole grains of the Saudi and Lebanese products, respectively, to 0.55, 3.67 and 3.99 mg/100g for chickpeas, for Saudi, Jordanian and Lebanese products respectively. Copper: The anticancer value from 0.65 and 0.53 mg/100g for the whole grain of the Saudi and Lebanese products, respectively, to 0.89, 0.69 and 0.83 mg/100g for chickpeas, for Saudi, Jordanian and Lebanese products respectively.

5) Corn (Grain): Lead: Its concentration is between 0.12 mg/100g for the Thai product and 0.18 mg / 100g for the Saudi product. Cadmium: Concentrate was 0.03 mg/100g for the Thai product and 0.02 mg / 100g for the Saudi product respectively. Cobalt: Its concentration is between 0.08 mg/100g for Thai product and 0.09 mg/100g for the Saudi product, respectively. Nitrate: Its concentration ranged from 85.04 to 73.1 mg/100g in the Thai and Saudi products, respectively. Manganese: Its concentration ranged from 0.42 to 0.38 mg/100g for the Thai and Saudi products, respectively. Iron: Its concentration ranged between 0.78 and 2.01 mg/100g for the Thai and Saudi products, respectively Zinc: Its concentration ranged between 5.32 and 2.56 mg/100g for the Thai and Saudi products, respectively. Copper: Its concentration ranged between 0.65 and 0.01 mg/100g for the Thai and Saudi products, respectively

6) Pineapple: Lead: Its concentration was 0.21 and 0.30 mg/100g for the Thai and Chinese products, respectively. Cadmium: There is no presence in both originators Cobalt: Its concentration in the Thai product is 0.01 mg/100g, while the Chinese product does not have the ingredient Nitrates: Values for nitrate ranged from 39.8 to 44.6 mg/100g for the product from Thailand and China, respectively. Manganese: Its value ranged from 1.01 to 2.37 mg/100g for the Thai and Chinese products, respectively. Iron: Its value was 12.5 and 0.34 mg/100g for the Thai and Chinese products respectively. Zinc: ranged between 7.67 and 2.62 mg/100g in the Thai and Chinese products, respectively. Copper: Values ranged between 2.08 and 0.25 mg/100g for the Thai and Chinese products, respectively.

7) Fruit (Cocktail**):** Lead: Its concentration is 0.12 and 0.28 mg/100g for the Malaysian and Thai products, respectively. Cadmium: Its concentration is zero mg / 100g in both of the products Cobalt: Its concentration is zero mg/100g in both products. Nitrate: Its concentration is 28.3 and 38.6 mg/100g respectively for the Malaysian and Thai products, respectively. Manganese: The concentration of this component ranged from 0.54 to 0.24 mg/100g for the Malaysian

and Thai products respectively. Iron: between 0.56 and 0.77 mg/100g for Malaysian and Thai products, respectively. Zinc: Between 1.83 and 0.95 mg/100g for Malaysian and Thai products, respectively. Copper: between 0.66 and 0.23 mg/100g for the Malaysian and Thai products, respectively.

8) Peach (Halves): Lead: Its concentration is 0.42 and 0.22 mg/100g for the Thai and Malaysian products, respectively. Cadmium: Its concentration is zero mg/100g in both of the products. Cobalt: Its concentration is zero mg/100g in the Thai product and 0.01 mg/100g for the Malaysian product. Nitrate: Its concentration is 60.5 and 58.9 mg/100g respectively for the Thai and Malaysian products, respectively. Manganese: The concentration of this component ranged from 0.12 to 0.09 mg/100g for the Thai and Malaysian products, respectively. Iron: ranges from 1.28 to 1.42 mg/100g for Thai and Malaysian products, respectively. Zinc: ranges from 0.23 to 0.41 mg/100g for the Thai and Malaysian products, respectively. Copper: between 1.70 and 0.58 mg/100g for Thai and Malaysian products.

The type of can and the nature of the preserved food have a significant impact on the contamination of the food with the metal of the can, so care must be taken to choose metal cans coated from the inside with more than one layer or resort to the use of paper cans. The results of the Monte Carlo Simulation showed that the intake rate was the most efficient parameter for the target hazard quotient and cancer risk (Amin Mohammadpour *et al*., 2022). Hina Abbasi *et al*. (2020) examined several samples of canned fruits and vegetables in their study to assess heavy metals (HMs) concentrations and associated health risks in processed fruit products sold in the local markets of North Pakistan. In our study, we found the presence of a number of metals in the samples of canned foods under study, which have varying effects due to poor storage or handling conditions. In the study total target hazard quotients of cumulative cancer risks of samples (Amin Mohammadpour *et al*., 2022).

The trace metals observed were compared with previously reported values. Trace elemental data were subjected to statistical analysis to examine the interrelationship between the investigated trace elements and possible sources of trace metal contamination in vegetables and fruits. The daily intake of trace metals through the ingestion of vegetables and fruits was also calculated (May *et al*., 2019). Aluminum, iron, manganese, silicon, and tin concentrations in the canned foods chosen for analysis ranged from 4.40 to 21.59 mg/kg, 2.38 to 19.70 mg/kg, 0.19 to 5.97 mg/kg, 16.46 to 359.63 mg/kg, and 1.99 to 138.48 mg/kg, respectively, when kept at room temperature for the duration of their shelf lives. The information showed that the amounts of the elements being studied were higher thanthose of the FAO/WHO Codex Alimentarius Commission's (Jayashree Parkar *et al*., 2014). Fruit buildup and consumption have made heavy metal contamination one of the biggest risks to human health. The purpose of our study was to investigate the health risks posed (Pb), manganese (Mn), zinc (Zn), iron (Fe), copper (Cu), chromium (Cr), and cadmium (Cd) in fruits Dessie Ezez *et al*. (2018) Demonstrated that the main factor of elements pollution is environmental factors, differences in pollution levels, soil content, agricultural products and methods between canning factories can lead to varying heavy metal concentrations. So, health risks may occur to elevated levels of Pb and Cb in some vegetables could pose health risks if consumed in large quantities over time. Higher mineral contents, such as iron, zinc, and copper, in vegetables suggest that they could be beneficial for nutritional intake but should be monitored to prevent excessive accumulation.

Conclusion

Continuous monitoring and regulation are necessary to ensure vegetable safety, especially with regard to toxic metals, such as lead and cadmium.

Table (1): Concentrations of heavy metals (lead, cadmium, cobalt, and nitrates)

Canned	Type	Origin	Dry Soild %	Heavy Metals in Solid Material (mg/100g)			
				Pb	Cd	Co	No_3
Mixed Vegetables	Chopped fruit	Sudia	12.4	0.21	0.01	0.15	147.2
		Labnan	9.5		0.04	0.03	158.4
mushroom	Chopped	China	5.7	0.52	0.01	0.13	162.1
	Full grain	china	3.3	0.29	0.01	0.18	174.8
Fava Beans	Full grain	UAE	17.5	0.20	0.05	0.10	82.6
		Sudia	19.1	0.55	0.02	0.08	88.9
		Jordan	20.2	0.58	0.03	0.06	93.5
		Kwait	19.0	0.34	0.01	0.09	99.1
chickpeas	Full grain	Sudia	18.6	0.22	0.04	0.05	109.3
		Jordan	20.4	0.21	0.04	0.05	69.0
	Hummus With Tahina	Sudia	29.7	0.39	0.02	0.07	90.7
		Jordan	25.9	0.35	0.02	0.09	96.4
		Labanan		0.45	0.01	0.08	90.9
Corn	grain	Thailand	16.8	0.12	0.03	0.08	85.04
		Sudia	19.1	0.18	0.02	0.09	73.1
pineapple	Slices	Thailand	16.7	0.21	0.00	0.01	39.8
		China	19.5	0.30	0.00	0.00	44.6
Fruit cocktail	Chopped fruit	Malaysia	15.2	0.12	0.00	0.00	28.3
		Thailand	18.8	0.28	0.00	0.00	38.6
peaches	halves	Thailand	19.3	0.42	0.00	0.00	60.5
		Malaysia	16.7	0.22	0.00	0.01	58.9

Table (2): Concentration of trace elements in some cans in the local market

Canned	Type	Origin	Dry Solids %	Heavy Metals in Solid Material (mg/100g)			
				Mn	Fe	Zn	Cu
Mixed Vegetables	Chopped	Sudia	12.4	0.76	7.05	6.83	0.51
		Labnan	9.5	0.80	6.22	1.60	0.35
mushroom	Chopped	China	5.7	0.42	6.84	2.37	2.11
	Full grain	China	3.3	0.39	7.72	4.50	2.07
Fava Beans	Full grain	UAE	17.5	0.77	4.00	3.86	0.63
		Sudia	19.1	0.51	4.52	3.41	0.96
		Jordan	20.2	0.47	2.86	11.2	1.18
		Kwait	19.0	0.80	3.50	3.90	1.42
chickpeas	Full grain	Sudia	18.6	1.90	3.01	10.5	0.65
		Jordan	20.4	2.01	3.25	3.07	0.53
	Hummus With Tahina	Sudia	29.7	1.59	2.97	0.55	0.89
		Jordan	25.9	1.35	9.42	3.67	0.69
		Labanan	24.5	0.85	3.88	3.99	0.83
Corn	Grain	Thailand	16.8	0.42	0.78	5.32	0.65
		Sudia	19.1	0.38	2.01	2.56	0.01
Pineapple	Slices	Thailand	16.7	1.01	12.5	7.67	2.08
		China	19.5	0.30	0.34	2.62	0.25
Fruit cocktail	Chopped fruit	Malaysia	15.2	0.12	0.56	1.83	0.66
		Thailand	18.8	0.28	0.77	0.95	0.23
Peaches	Halves	Thailand	19.3	0.42	1.28	0.23	1.70
		Malaysia	16.7	0.22	1.42	0.41	0.58

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