A SURVEY OF SOME METAL LEVELS IN VEGETABLES AND FRUITS IN SOME EGYPTIAN LOCAL MARKETS

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Abstract: A survey was completed to determine the amounts of cadmium (Cd), copper (Cu), iron (Fe), lead (Pb) and zinc (Zn) in vegetables and fruits in Egyptian local markets. Atomic absorption spectrometry was used to determine the amounts of these elements. The recovery was achieved for vegetables and fruits, as it were ranged between 79.3±3.01 -84.17±2.79% for cadmium, 87.74±2.13-88.47±1.77% for copper, 82.21±6.18-84.24±6.81% for iron, 84.28±2.58-87.94±3.44% for lead and 90.01±4.24-96.47±5.12% for zinc. The average of the concentrations of the elements in the analyzed samples were ranged between (0.02±0.28-0.06±1.55 µg/g) for cadmium, while for copper were (1.37±1.5-6.46±2.6 µg/g), (2.8±15.3-20.1±4.29 µg/g) for iron, lead were (0.63±1.12-1.9±1.08 µg/g), and zinc were (8.9±2.14-19.6±1.34 µg/g). The average of concentrations of the elements in the analyzed samples of fruits were reached (0.03±0.95-0.05±1.02 µg/g) for Cd, while Cu were (0.56±2.01-4.61±1.67 µg/g), (12.61±2.38-20.31±2.02 µg/g) for Fe, Pb were (0.47±0.93-2.42±1.17 µg/g) and Zn were (2.82±0.79-7.88±0.11 µg/g). Cadmium is the lowest element in all tested samples. The average of concentration of iron in tested samples is higher than other metals.

Keywords: Survey, Metals, Vegetables and Fruits.

1. Introduction

Metals are essential inorganic remains components of the environment, but their amounts have increased as the origin of industry (petroleum contamination like paints, rubber and batteries **(Santoe *et al.,* 2005),** mining, transport, agricultural activities (manure and herbicides) **(Kalay and Canli, 2000)** and natural (sea water, volcano gases, forest fire, soil and dust) **(He *et al.,* 2004).** Heavy metals as zinc, copper, chromium and iron are micronutrients, which have significant physiological purposes in the life and are important for existence of human **(Njagi *et al.,* 2017)**.

The wastewater irrigation is the major source of contamination with heavy metal in soils, which causes implications on human health. Accumulation of different elements in plants caused by using waste water for irrigation purpose **(Amin *et al.,* 2013**). Vegetables and fruits can soak up metals from the soil and its remains on the parts of the vegetables and fruits exhibited to the polluted air (**Haiyan and Stuanes, 2003**). Contamination of vegetables and fruits crops with heavy metals is a health apprehension. The consumption of vegetables contaminated by heavy metal cause a hazard to the human health, and the greatest significant aspect of food quality assurance in the contamination of the food with heavy metals **(Ali and Al-Qahtani, 2012).**

Even though the metals (Cr, Cu, Fe, Mn and Ni) are necessary components for various biological activities in human body, raised levels of them can cause many health significances to human. In comparison with Cd and Pb are toxic elements and nonessential which are related to different chronic diseases in human (**Chibueze *et al.,* 2016).** The contaminated food, water and air are the source of human exposure to the heavy metals **(Qiao-qiao *et al.,* 2007; Hu *et al.,* 2010 and Kim *et al.,* 2008)** and the exposure to the contaminated food chain has been announced all over the world **(Muchuweti *et al.,* 2006).** There is an increasing fear about contact to heavy metals round the world, as heavy metal accumulation in the environment and arrive the food chain so, measurement the metal accumulation in the environment have added more significance. **(He *et al.,* 2004).** The vegetable species are influence on the uptake and bioaccumulation of elements by plants and vegetables **(Lukšienė and Račaitė, 2008); (Rattan *et al.,* 2005)** and **(Arora *et al.,* 2008)**. International and national guidelines reduced the maximum acceptable limits of the heavy metals in food items because of improving the knowledge of the danger of contamination of food chain by heavy metals (**Radwan and Salama, 2006**).

The present study was aimed to estimate the levels of (Cd, Cu, Fe, Pb and Zn) on the content of these elements in some vegetable and fruit crops from some native markets in Egypt.

2. MATERIALS AND METHODS

2.1. Sample Collection:

Vegetable and fruit samples were collected from four local markets (Kafr Elzayat, Etaiy Elbarood, Tanta and Qutoor) cities in El-Gharbia and El-Behaira governorates, Egypt during 2015-2016. To provide replicate, the samples were collected randomly. Vegetable samples were collected including carrot, chili, cucumber, eggplant, green pepper, melon, okra, onion bulb, potatoes, tomatoes and zucchini. Fruit samples include apple, banana, grapes, peach and pear.

2.2. Sample preparation and treatment:

Stock standard solutions of Cd, Cu, Fe, Pb and Zn were received by Merck in a high concentration 1g/L (Merck, Darmstadt, Germany. Nitric acid (HNO_3) 95% was obtained from SDS, Peypin, France.

The collected samples of vegetables and fruits were processed as soon. The samples of vegetables and fruits were cut to get the edible portion for analysis. The samples were dried in the oven at 105°C for 24 hrs. The dry samples were mashed using a porcelain mortar and then the samples were digested by weighing 0.5g of dried sample, crushed and filter (<1mm) with 5 mL HNO_3 and placed on the hot plate for about 1 h and getting semi dried, then 5 mL of HNO_3 was added and kept on a hot plate for another 1 h, then when the samples were getting semi dried, they were cooled and filtered on Wattman filter paper. The filtrate was then transmitted to 25 mL volumetric flask (with addition of distilled water) for determination (**Akan *et al.,* 2013** and **Alexander & Ubandoma, 2014)**.

Measureable determination was conducted by using thermo atomic absorption spectrometer model M5 equipped with hollow cathode lamp and a deuterium background corrector, at respective wavelengths using an air-acetylene flame. Recoveries were completed by adding the standards of each metal at several levels. Calibration standards were achieved to estimate the precision of the analytical method. Calibration standards and blank solutions were investigated in the same way as for the processed samples. Working calibration standards of cadmium (Cd), copper (Cu), iron (Fe), lead (Pb) and zinc (Zn) were set by sequential dilution of concentrated stock of 1g/L.

2.3. Quality control:

Quality control was supposed from using blank and spike. The blank samples were prepared in the same way as the samples. All the samples readings were corrected with the blank. A recovery check of the entire technique was completed by a spike and analyzed with known standard concentration of the metal of interest. An acceptable recovery percentage (%R) for vegetables (Table 1) ranged between 79.3±3.01 - 84.10±2.08% for cadmium, 87.74±2.13 - 88.47±1.77% for copper, 82.21±6.18 - 84.24±6.81% for iron, 84.28±2.58 - 87.94±3.44% for lead and 90.01±4.24 - 96.33±2.61% for zinc. The recovery percentage (% R) for fruits (Table 2) ranged between 79.58±1.56 – 84.17±2.79 for Cd, 87.9±1.45 for Cu, 82.98±2.33 – 84.2±1.79 for Fe, 84.29±1.29 – 86.93±2.69 for Pb and 92.41±2.08 – 96.47±5.12 for Zn.

$$R = \frac{\text{Concentration of spiked sample} - \text{Concentration of unspiked sample}}{\text{Concentration of spike}} X \frac{100}{1}$$

3. RESULTS AND DISCUSSION

3.1. Levels of metals in vegetable samples:

The mean and the range of Cd, Cu, Fe, Pb and Zn which were found in different vegetable samples collected from the native markets in four cities located in two large Egyptian Governorates (El-Gharbia and El-Behaira governorates) were given in Table 3. The results are means of eight replicates. The determined levels of metals were based on plant dry weights. The concentrations of the metals in these samples were ranged between (0.02±0.28-0.061.55 μg/g) for Cd, (1.37±1.5-6.46±2.6 μg/g) for Cu, (2.8±15.3-20.1±4.29 μg/g) for Fe and Pb were (0.63±1.12-1.9±1.08 μg/g) while Zn were (8.9±2.14-19.6±1.34 μg/g).

The obtained results for this investigation showed that the mean concentration of Fe in vegetables is higher than other metals, while Cd is the lesser one in all vegetable samples.

Cadmium is the lowest element in all vegetable samples and the level of this element in chili, zucchini and cucumber samples were below the detection limits.

The samples of tomatoes were the highest level of copper (6.46±2.6 μg/g). Onion bulb and potato samples had the convergent level of copper (4.57±2.09 and 4.23±4.03 μg/g). Also the samples of zucchini and carrot had the convergent level (3.40±1.04 and 3.28±1.08 μg/g). The lowest level was 1.37±1.5 and 1.5±0.25 μg/g for okra and melon, respectively.

The concentration of Fe metal in carrot is the highest among other vegetables followed by onion bulb, eggplant, green pepper, tomatoes, cucumber, chili, potatoes, melon, zucchini and okra, descending.

The levels of lead in okra, tomatoes, chili were the lowest level (0.63±1.12, 0.64 ±0.34and 0.68±0.29 μg/g), respectively, compared with carrot which had the highest level (1.9±1.08 μg/g). While zucchini and potatoes had the convergent level (1.4±0.28 μg/g and 1.03±1.06 μg/g), respectively. Also cucumber, onion bulb and eggplant showed (0.96±0.69 μg/g, 0.95±1.28 μg/g and 0.94±0.38 μg/g), respectively. The lead level in melon and green pepper were 0.86±1.01 μg/g and 0.76±0.95 μg/g, respectively.

While Zn concentration in green pepper was higher than eggplant, followed by tomatoes, chili, carrot, zucchini, okra, onion bulb, cucumber, potatoes and melon, descending.

3.2. The levels of metals in fruit samples

The mean and the range of Cd, Cu, Fe, Pb and Zn found in different fruit samples collected from the local markets in four cities located in two large Egyptian Governorates are given in Table 4. The results are means of eight replicates. The determined levels of metal were based on plants dry weight.

Cadmium is the lowest element in all fruit samples. The element levels in apple and peach were below the detection levels. While the level of Cd in pears, grapes and bananas were 0.05±1.02, 0.04±1.52 and 0.03±0.95 μg/g, respectively.

Copper levels in pear, banana and peach were 4.61±1.67, 3.29±1.93 and 2.38±0.58 μg/g, respectively. While the element levels in grapes and apples was 1.81±1.06 and 0.56±2.01 μg/g.

Table (1): Recovery percentage and relative standard deviation of heavy metals in vegetables.

Crops / Metals	Carrot	Chili	Cucumber	Eggplant	Green pepper	Melon	Okra	Onion bulb	Potatoes	Tomatoes	Zucchini
	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD
Cd	80.25±1.38	84.10±2.08	79.84±3.65	79.30±3.01	84.01±2.04	79.59±6.08	82.09±3.01	80.67±4.77	80.98±2.61	82.72±1.91	83.43±4.16
Cu	88.33±3.09	87.98±1.35	87.81±3.67	88.41±2.14	88.22±3.67	87.90±3.04	87.97±1.06	88.47±1.77	88.42±2.36	87.74±2.13	87.93±1.95
Fe	82.28±1.21	83.04±3.30	82.21±6.18	84.01±4.21	83.94±2.34	84.24±6.81	82.28±3.39	84.01±2.50	83.94±2.63	84.19±4.01	82.66±1.43
Pb	84.28±2.58	87.94±3.44	86.02±1.39	85.36±2.14	87.14±2.31	84.34±1.96	86.74±2.69	87.88±2.73	86.92±3.91	85.05±2.21	84.82±2.66
Zn	91.25±1.95	90.55±1.53	95.82±2.06	96.33±2.61	90.01±4.24	91.04±3.12	90.48±2.40	95.47±3.12	92.38±4.73	93.19±3.08	94.98±4.66

Table (2): Recovery percentage and relative standard deviation of heavy metals in fruits.

Metals \ Crops	Apple	Banana	Grapes	Peach	Pear
	%R±RSD	%R±RSD	%R±RSD	%R±RSD	%R±RSD
Cd	84.17±2.79	79.58±1.56	80.24±2.32	83.91±3.10	80.97±4.75
Cu	88.15±3.33	88.44±2.99	87.90±1.45	88.35±2.35	87.95±5.22
Fe	83.21±2.63	83.25±4.32	83.01±3.01	82.98±2.33	84.20±1.79
Pb	86.82±1.02	84.29±1.29	85.08±3.17	85.30±3.54	86.93±2.69
Zn	96.47±5.12	92.41±2.08	95.52±2.36	93.49±5.95	96.38±3.31

The obtained results declared that, Fe values have little fluctuation between different fruit types. The amount of Fe in the samples of peach was found to be higher than other fruits (20.31±2.02 µg/g), followed by apple (17.61±1.97 µg/g), grapes (16.87±3.34µg/g), pear (15.7±6.57 µg/g) and banana (12.61±2.38µg/g).

The samples of pear had the highest level of lead (2.42±1.17 µg/g) followed by banana (1.59±2.3 µg/g). Grape samples had the lowest level of lead (0.47±0.93 µg/g).

The Zn values in grapes, banana, peach, pear and apple were 2.82±0.79 µg/g, 4.62±0.95 µg/g, 3.93±0.84 µg/g, 5.16±1.39 µg/g and 7.88±0.11 µg/g, respectively.

Contamination of food substances by heavy metal is one of the greatest significant considerations in food quality assurance (**Marshall, 2004; Wang *et al.*, 2005; Ali and Al-Qahtani, 2012**). Contaminated vegetables with heavy metals cannot be disregarded because these food substances are highly nutritious, largely consumed and form essential components of human diet. International and national regulations on food quality have decreased the maximum acceptable levels of toxic metals in food substance due to an increased cognizance of the danger of heavy metal contamination in food chain contamination. Based on the heavy metal persistent and cumulative behavior and the possibility of potential toxicity effects of heavy metals as a result of intake vegetables and fruits, so test and analyze these food substances is needed to confirm that the levels of these trace elements agreed with international requirements.

The concentration of cadmium (Cd) observed in vegetables (onion bulb, carrot and potatoes) were lower than the maximum acceptable values (0.1 mg/kg) **(FAO/WHO. 2011)**, while some samples of vegetables (green pepper, tomatoes, melon and eggplant) were greater than the maximum acceptable values (0.05 mg/kg) **(FAO/WHO. 2011)**, but other samples of okra were below the maximum acceptable values.

The concentration of lead (Pb) observed in some cucumber samples was exceeded the maximum acceptable values (0.1 mg/kg) (**FAO/WHO. 2014**). Some samples of grapes didn't exceed the maximum acceptable values (0.2 mg/kg) (**FAO/WHO. 2014**). All samples of peach exceeded the acceptable limits (0.1 mg/kg).

According to **(EU, 2006)** standards for the permissible levels of Cu (20 µg/g), so all vegetables and fruits samples were below the permissible limits. While the permissible level allowed by **(EU, 2013)** standards for Zn is 50 µg/g, so all vegetable and fruit samples were below the permissible limits.

The permissible levels of Fe were (0.1 µg/g) for vegetables and fruits, and for grapes were 0.2 µg/g. so all samples were exceeded the permissible limits. **Rao *et al.*, 2017** determined the heavy metals in vegetables and soil samples, the average concentration detected range from 0.2 to 5.75 mg/kg for vegetables and soil. The highest mean is of Cd, Fe, Cu and Pb respectively. Copper, iron and lead concentrations were below the safe limit. Also the study pointed out, the metals are present in the vegetable samples.

Also **(Salhotra and Verma, 2017)** determined Cd, Co, Cu, Pb, Fe, Zn in vegetables and fruit samples and they found that the heavy metals in samples and these metals are harmful to human health. Also purchasing fresh fruits and vegetables with high level of heavy metals affect consumers.

Accumulation of heavy metals in plants and vegetables become very dangerous, because it is consumed by animals and humans. Consuming the contaminated vegetables with heavy metals affect on human health; so, checking contamination of heavy metals will allow for avoiding unnecessary exposures **(Kovalchuk and Kovalchuk, 2008).**

Our results are compared with other published results: Cadmium is unnecessary metal in foods and waters and it accumulates mainly in the kidneys and liver (**Divrikli *et al.*, 2006**). Cadmium levels in vegetable samples were below the acceptable levels (0.05 µg/g) except some samples of green pepper, carrot, tomatoes, eggplant and melon which exceed the acceptable level of Cd. Also some of fruit samples were under or equal the acceptable levels of Cd, while some of grapes and pear samples were exceed the permissible levels. Several values have been formerly reported for fruits and vegetables, which contain 0.05 mg/kg for apple and 0.02 mg/kg for banana **(Radwan and Salama, 2006),** 0.14 mg/kg for apple and 0.001 mg/kg for banana (**Karavoltsos *et al.*, 2002**) and 0.003 mg/kg for apple by **(Parveen *et al.*, 2003).**

One of the most essential metals for regular growth and improvement in human is Zinc (**Divrikli *et al.*, 2006**). Its absence may be due to poor intake, reduced absorption, extreme excretion or inherited defects in zinc metabolism (**Colak *et al.*, 2005; Narin *et al.*, 2005**). The levels of Zn in our study were 7.88±0.11 and 4.62±0.95µg/g for apple and banana, respectively compared with 1.36 and 5.59 mg/kg, for apple and banana respectively (**Radwan**

Table (3): Heavy metals concentrations (µg/g dry weight) of common vegetables.

Crop	Fe		Zn		Pb		Cu		Cd	
	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range
Carrot	20.1±4.29	17.9-20.3	15.5±1.66	13.45-17.55	1.90±1.08	0.85-2.95	3.28±1.08	2.42-4.14	0.05±0.31	0.02-0.08
Chili	10.9±2.39	9.3-11.66	16.1±2.75	13.99-18.21	0.68±0.29	0.53-0.83	2.83±1.36	1.46-4.2	ND	ND
Cucumber	11.6±10.6	11.1-13.1	9.9±1.56	8.17-11.63	0.96±0.69	0.59-1.33	2.42±2.03	1.94-4.22	ND	ND
Eggplant	17.2±1.39	16.4-17.14	18.1±2.43	15.36-20.84	0.94±0.38	0.70-1.18	2.39±0.98	1.95-2.83	0.05±0.06	0.05-0.09
Green pepper	16.3±3.01	16.2-20.1	19.6±1.34	18.62-20.58	0.76±0.95	0.29-1.23	2.78±1.52	1.41-4.15	0.06±1.55	0.03-0.1
Melon	8.6±15.6	6.4-10.2	8.9±2.14	6.79-11.01	0.86±1.01	0.28-1.44	1.5±0.25	1.01-1.99	0.04±0.92	0.01-0.09
Okra	2.8±15.3	2.1-3.81	13.5±1.21	11.52-15.48	0.63±1.12	0.19-1.07	1.37±1.5	0.84-2.03	0.03±0.45	0.02-0.04
Onion bulb	19.7±2.24	18.2-20.2	12.9±1.39	10.17-15.63	0.95±1.28	0.25-1.56	4.57±2.09	1.3-7.84	0.03±0.93	0.02-0.05
Potatoes	8.7±3.76	7.9-9.61	9.2±1.52	8.27-10.13	1.03±1.06	0.52-1.54	4.23±4.03	1.85-6.38	0.02±0.28	0.01-0.04
Tomatoes	15.9±4.35	13.9-18.9	16.7±2.07	14.20-19.2	0.64±0.34	0.31-0.97	6.46±2.6	2.83-10.10	0.04±0.09	0.03-0.08
zucchini	3.5±6.39	2.2-5.28	13.5±1.19	10.12-16.88	1.40±0.28	0.96-1.84	3.40±1.04	2.98-4.43	ND	ND

Table (4): Heavy metals concentrations (µg/g dry weight) of common fruits.

Crop	Fe		Zn		Pb		Cu		Cd	
	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range	Mean±RSD	Range
Apple	17.61±1.97	15.11-20.10	7.88±0.11	7.11-8.83	0.68±0.36	0.5-0.86	0.56±2.01	0.53-0.62	ND	ND
Banana	12.61±2.38	11.37-14.85	4.62±0.95	3.77-6.27	1.59±2.3	0.52-2.66	3.29±1.93	0.69-8.61	0.03±0.95	0.02-0.05
Grapes	16.87±3.34	14.25-19.48	2.82±0.79	1.06-4.46	0.47±0.93	0.24-0.70	1.81±1.06	0.94-2.68	0.04±1.52	0.01-0.08
Peach	20.31±2.02	17.45-21.16	3.93±0.84	2.57-5.61	0.51±1.02	0.34-0.68	2.38±0.58	2.17-2.59	ND	ND
Pear	15.7±6.57	13.56-17.84	5.16±1.39	3.14-7.56	2.42±1.17	1.07-3.77	4.61±1.67	2.14-7.52	0.05±1.02	0.04-0.06

and Salama, 2006), 0.16 and 1.50 mg/kg for apple and banana, respectively, (**Onianwa *et al*., 2000**) and 2.05 mg/kg for apple (**Parveen *et al*., 2003**).

Lead arrives to the body system through air, water and food and accumulates in the body and the washing fruits and vegetables did not affect on removing it (**Divrikli *et al*., 2006**). Higher levels of Pb in some of plants caused by the pollutants of lead in irrigation water, soil or highway traffic (**Qui *et al*., 2000**). The level of Pb reported in this search is comparable to those described in apple and banana (0.19 and 0.76 mg/kg) by (**Radwan and Salama 2006**) and apple (0.02 mg/kg) by (**Parveen *et al*. 2003**).

Copper is an important micronutrient which acts as biocatalysts, necessary for body coloring in addition to iron, to preserve a healthy central nervous system, prevents anemia and correlative with the function of Zn and Fe in the body **(Akinyele and Osibanjo, 1982)**.

The obtained results were observed that the Cu levels were lower than that found in other published results **(Radwan and Salama, 2006), (Onianwa *et al*. 2000) and (Parveen *et al*. 2003)**. The previous results reported that 1.47, 0.25 and 0.25 mg/kg for apple, respectively. Furthermore, 2.51 and 0.95 mg/kg have been reported for the concentration of Cu in banana by **(Radwan and Salama, 2006)** and **(Onianwa *et al*. 2000)**, respectively.

The results of **(Sobukola, *et al*. 2010)** showed that the levels of Pb, Cd, Cu and Zn ranged from 0.072±0.06 to 0.128±0.03; 0.003±0.01 to 0.005±0.01; 0.002±0.00 to 0.015±0.02 and 0.039±0.01 to 0.082±0.01 mg/kg, respectively, for the fruits, while the levels of Pb, Cd, Cu and Zn for the vegetables, respectively, ranged from 0.09±0.01 to 0.21±0.06; 0.03±0.01 to 0.09±0.00; 0.02±0.00 to 0.07±0.00 and 0.01±0.00 to 0.10±0.00 mg/kg.

In this respect, the concentrations of elements in vegetables and fruits ranged between 75.5-13.9 mg/kg for Fe, 2.3-0.8 mg/kg for Cu, 9.2-3.1 mg/kg for Zn, 0.2-1.4 mg/kg for Pb, 46.5-2.3 mg/kg for Cd **(Basha *et al*., 2014).**

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تقصي مستويات بعض المعادن في الخضروات والفاكهة في بعض الأسواق المحلية المصرية

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الملخص العربى

تم تقصي مستويات بعض المعادن (الكادميوم – النحاس – الحديد – الرصاص – الزنك) في بعض أنواع الخضر والفاكهة في الأسواق المصرية. إستخدم جهاز الإمتصاص الذري لتقدير مستويات هذه المعادن ، تراوحت معدلات الإسترجاع لعينات الفاكهة والخضر مابين 79.3±3.01-84.17±2.79% لعنصر الكادميوم، 87.74±2.13-88.47±1.77% لعنصر النحاس، 82.21±6.18-84.24±6.81% لعنصر الحديد، 84.28±2.85-87.94±3.44% لعنصر الرصاص و 90.01±4.24-96.47±5.12% لعنصر الزنك. أوضحت النتائج أن متوسطات تركيزات العناصر في جميع عينات الخضرتراوحت مابين 0.02±0.28-0.06±1.55 ميكروجرام/جم لعنصر الكادميوم بينما كانت 1.37±1.5-6.46±2.6 ميكروجرام/جم لعنصر النحاس، 2.8±15.3 – 20.1±4.29 ميكروجرام/جم لعنصر الحديد،0.63± 1.12-1.9±1.08 ميكروجرام/جم لعنصر الرصاص و 8.9±2.14- 19.6 ±1.34 ميكروجرام/جم لعنصر الزنك. وتراوحت متوسطات تركيزات هذه العناصر في جميع عينات الفاكهة مابين 0.03±0.95-0.05±1.02 ميكروجرام/جم لعنصر الكادميوم بينما كانت 0.56± 2.01-4.61±1.67 ميكروجرام/جم لعنصر النحاس، 2.38±12.61 – 20.31±2.02 ميكروجرام/جم لعنصر الحديد، 0.47± 0.93-2.42±1.17 ميكروجرام/جم لعنصر الرصاص و 2.82±0.79- 7.88 ±0.11 ميكروجرام/جم لعنصر الزنك. كان مستوي عنصر الكادميوم أقل العناصر تركيزا في جميع عينات الخضر والفاكهة. كما كانت متوسطات عنصر الحديد هي الأعلي تركيزا.

الكلمات المفتاحية: تقصي، العناصر الثقيلة، الخضر و الفاكهة.