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The Contamination Status of Heavy Metals Associated with Fruits and Vegetables Collected from some Markets at El- Gharbia Governorate

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El-Saka, M. S.[1*]; M. M. El-kholy[1] and M. A. Aiad[2]

[1] Environ. Res. Dep., Soils, Water and Environ.Res. Instit., Agric. Res. Center, Egypt
[2] Soil improvement and conservation Res. Dep., Soils, Water and Environ.Res. Instit., Agric. Res. Center, Egypt

ABSTRACT

Continuous consumption of local vegetables (veg.) and fruits polluted with heavy metals (HMs) lead to metals accumulation over time causing an array of diseases. Therefore, the current work aimed to assess the concentrations of heavy metals (HM) namely Cadmium Cd , Lead Pb , Nickel Ni , Cobalt Co and Chromium Cr in various fruits (Grab, Apple, Mango and Figs) and vegetables (Tomato, Cucumber, Potato, Jews mallow and Nasturtium) traded in three different markets i.e. Tanta (M1), Kafr Elzayate (M2) and Zefta (M3), at El-Gharbia Governorate, Egypt . The results showed that, great variations in the HMs concentrations across the vegetables and fruits and also within the same vegetable/fruits sourced from different markets which are exceeded the recommended WHO/FAO standers to humans. In various studied samples, Cd content ranged from 0.525 to 3.96 mg kg^{-1}, Co value ranged from 0.001 to 0.95 mg kg^{-1}, Cr concentration ranged from 1.09 to 4.96 mg kg^{-1}, Ni concentration ranged from 1.04 to 4.66 mg kg^{-1} and Pb concentration ranged from 2.02 to 4.88 mg kg^{-1}, respectively. The daily intake of metals through food consumption was in the ascending order Co < Cd < Ni < Pb < Cr for M2 market and hazard index (HI) for most of examined metals was more than 1 and this revealed desirable effects on human health. The excessive content of these HMs in vegetables and fruits samples may causes number of diseases with continued consumption.

Keywords: heavy metals, daily intake of heavy metals (DIM), non-carcinogenic risk index and hazard index, vegetables, fruits, markets.

INTRODUCTION

The Environmental pollution with heavy metals in Egypt consider a concern and derives from rapid industrial growth, advance in agriculture fertilizers and urban human activities. According to state information service (SIS.2013) in Egypt, Gharbia Governorate are agricultural as well as industries provinces. Gharbia host big industries such as : fertilizers , pesticides, petrol, textile, soap and oils factory and coal screws which consider sources of environmental contaminations with heavy metals for food and may be capable of causing human health problems when enter the human body through consumption vegetables and fruits (Zhou *et al*.,2016) .

Vegetables and fruits consumption a long with daily meals (Garba *et al*., 2018), and are specially valued in human diet as they contain important component of human platter. The consumption of vegetables and fruits on a regular basis is one of the possible health improving practice because of high nutritional value and have beneficial anti oxidative effects on human diet *(Naila et al., 2018)*. Also, vegetables and fruits play an important role in preventing a number of chronic diseases *(Agrawal et al., 2007)*.

Most consumers buy the conventional produce of vegetables and fruits which are highly valued in human diet for vitamins and minerals. So, eating of artificially treated fruits and vegetables contains heavy metals are the most harmful and responsible for many life-threatening diseases in human beings and the consumption/ingestion of contaminated vegetables/fruits are the direct route where humans and animals are exposed to it. Therefore, due to the low safety factor, all artificially treated in food should be abandoned or avoided (Salawu *et al*., 2015).

The consumption of contaminated vegetables/fruits with heavy metals is a major problem and consider a contaminating agents of our food (Shobha and Kalshetty ,2017), it could results in much human health risk (Uroko *et al*., 2019).

Heavy metal elements, such as (Cd), (Pb), (Co), (Cr) and (Ni) have toxic effects on human health. Toxic metals can be accumulate persistently in the body over a lifetime (Zhou *et al*., 2016).

(Salawu *et al*., 2015). declear that, Pb toxicity has been linked to low intelligent quotients in children and found to affects several organs and systems – blood, kidneys, reproductive, and immune systems . Also, Cd is known to affect the renal tubules and causes damage that results in proteinuria in the body. Cd affects the enzymes responsible for reabsorption of proteins in kidney tubules, Cd reduces the activity of delta-amino levulinic acid synthetase,. On the other hand Cr is associated with allergic dermatitis in humans. Elevated Ni concentrations in soils have potential negative impact on plants, microorganisms and animals (Thakali, *et al*., 2006).

Different health implication results from Exposure of plant products to various heavy metals source during the growth stage of plant products (Soomro *et al*., 2008). Polluted Vegetables and fruits with Hms may be due to irrigation with contaminated water, the quantity of fertilizers addition, transportation, metals released from pesticides, emission from industrial activities, and the harvesting process (Zaidi *et al*.,2005).

[*] Corresponding author.
E-mail address: elsaka3@yahoo.com
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Due to the importance and attendant danger posed by these metals to human coupled with an increase in environment pollution, and there is a great demand for food safety . The present work deals with Estimation of the HMs Cd, Co, Cr, Ni and Pb concentration in the selected vegetables and fruits sold in three different local markets of Gharbia Governorate. And evaluate perceived human health risk associated with the consumption of fruits and vegetables. And assessment health guidance value such as daily intake of heavy metals (DIM), non-carcinogenic risk index and hazard index.

MATERIALS AND METHODS

Collection of veg. and fruits samples:

Two Kilograms from veg. and fruits were collected randomly from three markets at El- Gharbia Governorate main markets. Tanta (M1), Kafr Elzayate (M2) and Zefta (M3). during August to November 2018. The description of the tested vegetables and fruits samples are shown in table (1).

Using distilled water and washing the collected veg. and fruits samples to remove dust particles. Then we used the edible portions. The edible parts of veg. and fruits were air-dried and then placed in a dehydrator at 80 ^{o}c for 2-3 day and then dried in an oven at 100^{o}c and ground into a fine powder and stored in polyethylene bags, after that digestion the samples.

Table 1. Description of the studied vegetables and fruits collected from markets

Type	Common name	Botanical name	Family	Edible part vegetables/ fruits
Vegetables	Cucumber	*Cucumis sativus*	Cucrbitaceae	fruity
	Tomato	*Lycpersion esculentum*	Solanaceae	fruity
	Jews Mallow	*Corchorus olitorius*	Tilliaceae	leafy
	Nasturtium	*Eruca sativa*	Brassicaceae	leafy
	Potato	*Solanum tuberosum*	Solanaceae	tuber
Fruits	Grapes	*Vitis sp*	Vitaceae	fruit
	Figs	*Ficus carica*	Moraceae	fruit
	Apple	*Molus domestica*	Rosaceae	fruit
	Mango	*Mangifcra indica*	Anacardiaceae	fruit

Determination of studied heavy metals:-

Triplicate samples (0.5 g) of each edible parts of veg. and fruits were weighed in digestion flasks and treated with 5 ml of concentrated HNO_3. Then a blank sample was prepared applying 5 ml of HNO_3 into empty digestion flask(Sahito *et al*.,2002).

By using an electric hot plate The flask were heated for 2 hours at 80-90 ^{o} C until the samples were made to boil add 3-5 ml from 30% H_2O_2 and digestion continued until a clean solution was obtained.

After that, the solution was filtered with what man No.42 filter paper, then transferred quantitatively to a 25 ml volumetric flask by adding distilled water. By using atomic absorption spectrophotometer to measurement of elements.

Estimate daily intake of heavy metals (DIM) (Roba *et al*.,2016)

$$DIM= C_{metal} \times D_{food\ intake} \times C_{factor} \times EFr \times ED / BW_{average} \times AT$$

Where:

C_{metal} is the metal concentration in vegetable and/or fruit in mg kg^{-1}

$D_{food\ intake}$ is the daily intake of food in kg $person^{-1}$ (0.300 kg/day) (WHO, 199).

$BW_{average}$ is average body weight in kg $person^{-1}$ 70kg in egypt(Mohamed and Salama, 2006)

EFr is the exposure frequency (365 days/year);

ED is the exposure duration of 70 years, consider average lifetime for Egyptians;

AT is the period of exposure for noncarcinogenic effects (EFr × ED), and 70 years life time for carcinogenic effect (Manahan,2003).

The conversion factor (CF) of 0.085 (Jan *et al*., 2010) was used for the conversion of the samples to dry weights.

Non-cancer risks

Non-carcinogenic risks for individual heavy metal or vegetable were evaluated by computing the target hazard quotient (THQ) using following equation (Manahan, 2003).

$$THQ=DIM/RfD$$

RfD is the oral reference dose (mg/kg/d) which is an estimation of the maximum permissible risk on human population through daily exposure, taking into consideration a sensitive group during a lifetime (Scragg,2006). The following reference doses were used (Pb = 0.004,Cd = 0.001,Co = 0.03 , Ni = 0.02, , Cr = 0.003) (USEPA,2010) .To evaluate the potential risk to human health through more than one heavy metal, chronic hazard index (HI) is obtained as the sum of all hazard quotients (THQ) calculated for individual heavy metals for a particular exposure pathway (WHO,2001). It is calculated as follows:

$$HI=THQ1+THQ2+\ldots+THQn$$

Where, 1, 2 …, n are the individual heavy metals or vegetable and fruit species.

Where EDI is the estimated daily intake of metal via consumption of millet;

Results are expressed as the mean of three replicates.

I = standard error

RESULTS AND DISCUSSION

In various part of the world many survey was done to monitoring the HMs in the edible parts of veg. and fruits (Hu *et al*., 2013).

Considerable levels of Hms were clarify it in all tested samples in this study. All the samples tested in this study were found to contain detectable levels of heavy metals. Analysis of the samples for risks elements appear that content of Cd, Co, Cr, Ni and Pb in all samples were more than the permissible limit Table(2).

Table 2. The assessment standards of the heavy metals (HMs)

Heavy metals	Assessment standards(mg kg^{-1})	References
Cadmium (Cd)	0.05	
Cobalt (Co)	0.01	
Chromium (Cr)	0.5	*FAO/WHO,1999*
Nickel (Ni)	0.3	
Lead (Pb)	0.5	

Concentration levels of heavy metals

Cadmium (Cd)

Cadmium element at minimum concentration of 1 mg kg^{-1} is capable of producing chronic toxicity (Sarkar *et al*.,2016), and not exceed 0.05 mg kg^{-1} according to FAO/WHO . In this study (Fig 1 , a and b) Cd was present in all the vegetables and fruits sourced from the different markets (M1-M2 and M3) in concentrations that are above the safe limit as recommended by FAO/WHO. However, there were variations in the Cd concentrations across the vegetables and fruits sourced from different markets. The concentration of Cd in various tested vegetables samples ranged from 0.525 to 3.96 mg kg^{-1}. Also, the highest amount of Cd was observed in *Corchorus olitorius*, which attained 3.96 mg kg^{-1} for M2 followed by 2.90 mg kg^{-1} for M1 and 2.85 mg kg^{-1} for M3. On the other hand, the lowest values was observed in *Lycpersion esculentum* (Tomato) (Fig.1).All fruit samples collected from M2 had a highest concentration from Cd about 3.11 mg kg^{-1}.

Cadmium has been reported to accumulate in the human body and hence induce kidney dysfunction, skeletal damage and reproductive deficiencies (EC, 2001). Also, Demirezen and Aksoy (2006) revealed that Cd is consider apart from the industrial pollution and the main source of Cd is using phosphoric fertilizer in agriculture soils. Also, spead in the environment due to human activities (Alam, 2003). (Maalem, *et al*. 2012) found that P fertilization of Atriplexes induced higher levels of Cd in their leaves than control plants and even exceeded the standards. They suggested that phosphates raise the levels of Cd in the soil and, thus, its bioavailability for the plant is increased. However, the rate of transfer of the Cd from soil to the plant Concentration (conc.) depending on the plant species.

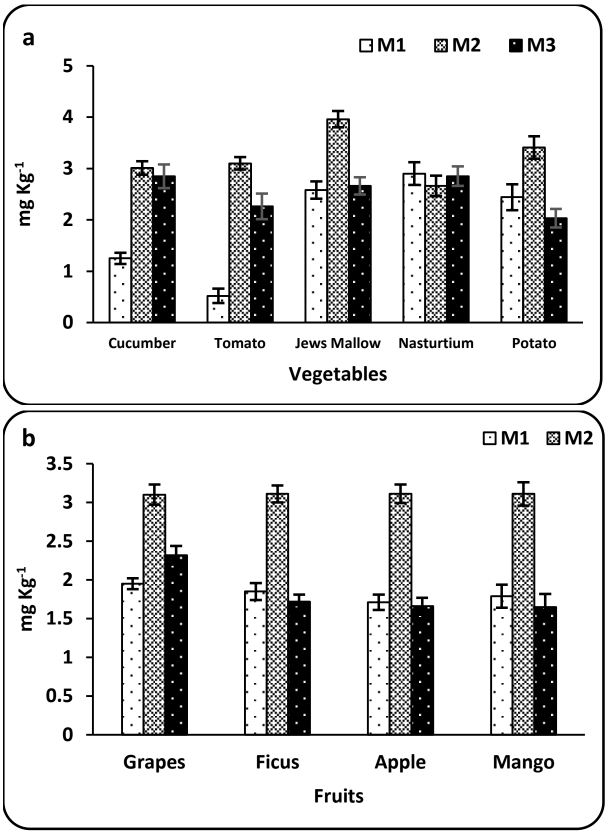

Fig. 1. Cd conc. in veg. and fruits collected from different markets

Cobalt (Co)

Cobalt is a basic component of vitamin-B12. It is essential in synthesis of red blood cells and prevents anemia. Too much intake of cobalt may cause overproduction of red blood cells (Kalagbor and Diri, 2014). The obtain results in (Fig. 2), declare that, *Eruca sativa* and *Vitis* sp. collected from M3 market had the highest concentration more than collected from M1 and M2 markets (0.95 mg kg^{-1}), but the lowest Co concentration was 0.01 mg kg^{-1} in Cucumber. The Co content is higher than the permissible limits given in the assessment standards. Co uptake by plants is a function of content of its mobile fractions and of the Co content in soil solution.

Chromium (Cr)

Cr can helps the body use sugar, protein and fat (Institute of medicine, 2003). Cr is regarded as an essential trace element in humans and animals. Cr is a mineral found in fruits which plays a role in the metabolism of nutrients through its impact on insulin. Cr picolinate is the form found in dietary supplements (Salawu *et al*., 2016).

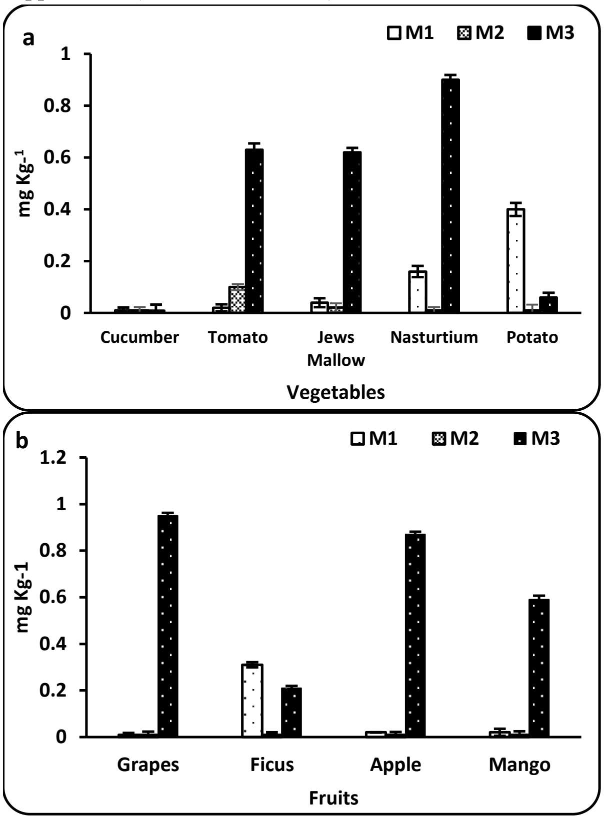

Fig. 2. Cobalt Co concentration in vegetables and fruits samples collected from different markets

Cr conc. in all the samples in all markets exceeded the limits safe 0.5 mg kg^{-1} in the assessment standards. Cr concentration ranged between 1.09 and 4.96 mg kg^{-1}, for *Eruca sativa*, *Vitis* sp and *Corchorus olitorius*, the highest Cr concentration was found in those sourced from M2 market (4.96, 4.65 and 4.54 mg kg^{-1}) respectively (Fig.3). The EU Standards for the metal in soils and vegetables are 150 and 0.5 mg/kg, respectively. The data reflect that the Cr concentration in all samples due to the element concentration is higher in different studied markets and it uptake from soils by vegetables and fruits. Song *et al*., 2009 revealed that carrot, radish, garlic contained 0.089, 0.031, 0.013 mg 100 g^{-1} from Cr respectively.

Nickel (Ni)

Nickel is believed to play a role in physiological processes as a co-factor in the absorption of iron from the intestine (Das *et al*.,2008). Nickel is consider a coenzyme in different enzymes. Deficiency of Ni affect on blood sugar level. Major man-made source of Nickel release are the combustion of coal and heavy fuel oil. Nickel was present in all vegetables and fruits sourced from the different markets (M1, M2 and M3) in concentrations that are above the safe limit in the assessment standards. There were variation in Ni concentrations among the vegetables and fruits as well as among the same vegetables and fruits obtained from the different markets. The highest Ni concentration was found in *Solanum tuberosum* sourced from M2 4.66 mg kg^{-1}. The levels of Ni in the current study vary considerably the Ni concentration ranged between 1.04 mg kg^{-1} (M3) and 4.66 mg kg^{-1} (M2) (Fig. 4).

Nickel is mobile the plant body and usually accumulated in vegetative part such as the leaves it is moved to the seeds for accumulation (Das *et al*.,2008).

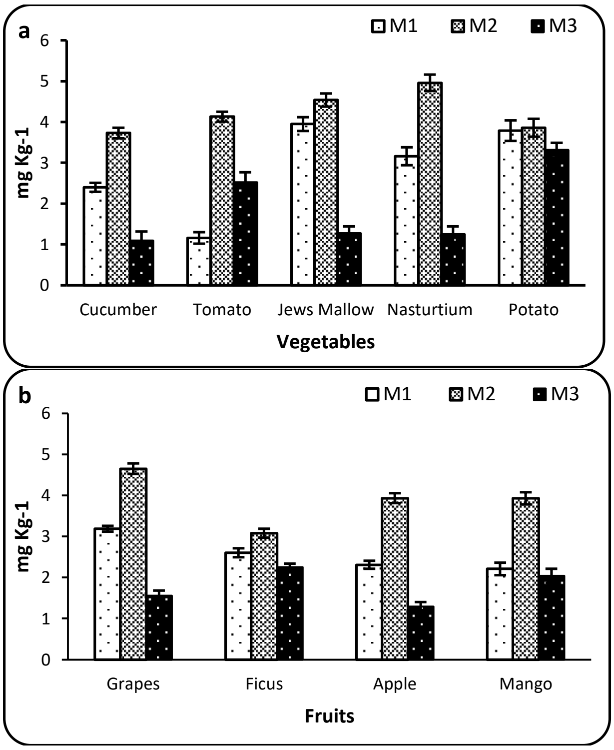

Fig. 3. Chromium (Cr) concentration in vegetables and fruits samples collected from different markets

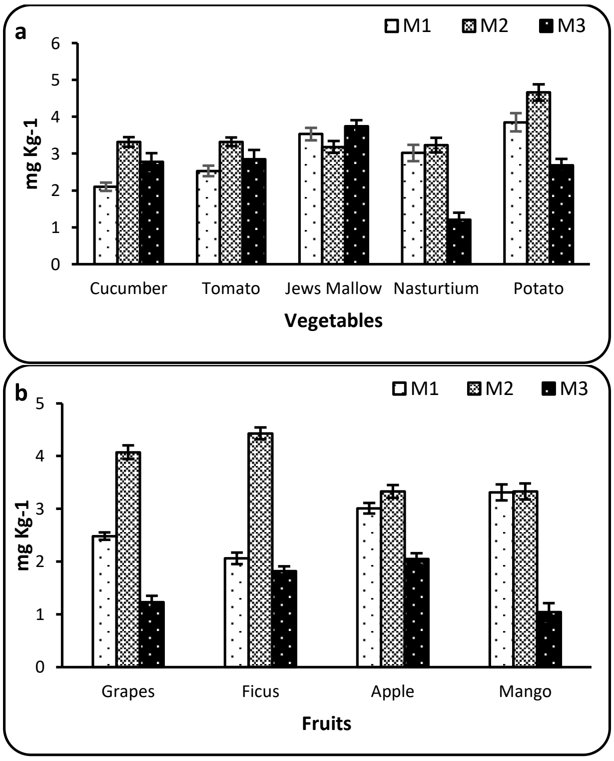

Fig. 4. Nickel (Ni) concentration in vegetables and fruits samples collected from different markets

Lead (Pb)

Lead reduced cognitive development and intellectual performance in children and cardiovascular disease and increased blood pressure in adults**.**

During the current study, the conc. of Pb content varies from 4.88 to 2.02 mg kg^{-1} .High concentration of Pb was found in *Solanum tuberosum* collected from M3 market.

The recent results were in agreement with that obtained by (Sharma *et al*.,2007),who reported the Pb concentration (17.54 and 25.00 mg kg^{-1}) in vegetables grown in industrial areas. The high levels of Pb in the vegetables and fruits might be a consequence of road traffic and Pb emission from petrol (Zhen,2008).Pb and Cd can easily accumulate in soil due to its low solubility and can persist in the environment for a long time (Agrawal *et al*.,2007).

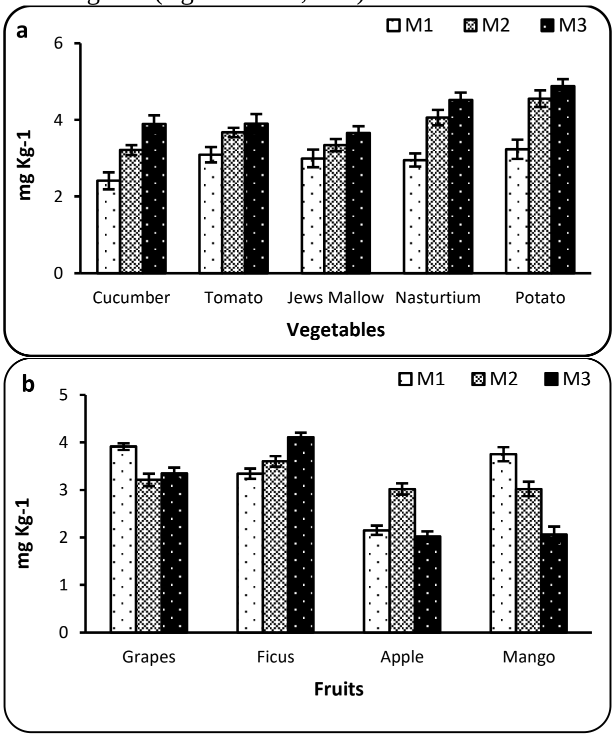

Fig. 5. Lead (Pb) concentration in vegetables and fruits samples collected from different markets

Pb concentration in this study in vegetables and fruits samples exhibited higher levels than other detected by (Mansour *et al*., 2009)

According to Hamid *et al*., 2017; the aerial parts of vegetables /fruits are taken heavy metals from the soil results to the continuous use and extravagance of pesticides, fungicides, fertilizer and agrochemicals by farmers for high production of vegetables may increase the concentration of heavy metals.

From above results, high accumulation of Cd, Cr, Ni and Pb in leafy vegetables (*Corchorus olitorius)* and in tuber vegetables (*Solanum tuberosum*) due to atmospheric deposition.

Among all the vegetables and fruit samples, the Cr is found above the permissible limits and it was ranged as M3 <M1<M2.The concentration of Pb in all samples was in a decreasing order M1 <M2<M3. Also, the fruit samples accumulate a high concentration from Pb, Ni and Cr.

According to (Markert, 1993) The obtain results declared that plant species have a variety of capacities in removing and accumulating heavy metals. Vegetables, especially leafy vegetables accumulate higher amount of heavy metals because of the fact that they absorb heavy metals in their leaves and leads to risks when it consumped as a food chain. irrigation with contaminated water lead to contaminated vegetables and fruits by heavy metals (Sharma *et al*.,2007), and is owed to usage of industrial wastewater, automobiles, organic substances used for enhancing plant growth, pesticides and harvesting processes. The food components absorb heavy metals from land polluted with wastewater around those sites (Nadeem *et al*.,2019).

Heavy metal concentrations in edible parts each vegetables and fruits is directly associated with the soil contents from these metals (Kabata-pendias and pendias, 2011).

All the pesticides contain different concentration of heavy metals which is available in considerable amount in the soil once they are being used. The available heavy metals in the soil get accumulated in the vegetation by the natural process of bioaccumulation (Chao *et al*., 2007). Defarge *et al*.,2018 declear that, Different types of heavy metals are basically released from pesticide .The heavy metals (Co), (Cr), (Ni) and (Pb) consider the more elements that the formulation of pesticides and herbicid containing .

Parkpian *et al*. 2003 declear another reason, Long-term use application of fertilizer and manure in the soils increase metal accumulation in the soil then plants .

The contamination of fruits with heavy metals from atmosphere and the soil (Yusuf *et al*.,2003).

In order to determine the extent of environmental contamination by heavy metals, the degree of human exposure and potential health risks via vegetable and fruits consumption has been estimated.

Estimated daily intake of heavy metals (DIM)

Tables 3 show the estimated daily intake of (Cd, Co, Cr, Ni and Pb) from three markets.

The DIM is used to calculate the amount of metal taken by adult per day. The daily consumption rate determines the degree for heavy metals toxicity to humans (Singh, 2010). The DIM of five metals (Cd, Co, Cr, Ni and Pb) was calculated according to the concentration of each metal in each samples and consumption rates.

The result showed that DIM through food consumption was in the ascending order Co < Cd < Ni < Pb < Cr for M2.

Table 3. Comparison of the daily intake of heavy metals from three markets

Heavy metals conc. mg kg-1	Markets	Vegetables edibles					Fruits			
		Fruity		leafy		tuber				
		cucumber	tomato	Jews Mallow	Nasturtium	potato	grapes	figs	apple	mango
Cd	M1	0.000509	0.000212	0.001051	0.001182	0.000994	0.000795	0.000754	0.000697	0.000729
	M2	0.001227	0.001263	0.001614	0.001084	0.00139	0.001263	0.001267	0.001267	0.001267
	M3	0.001161	0.000921	0.001084	0.001161	0.000827	0.000945	0.000701	0.000677	0.000672
Co	M1	4.0753E-06	8.1507E-06	1.6301E-05	6.8058E-05	0.00016301	5.2979E-06	0.00012634	8.1507E-06	8.5582E-06
	M2	4.0753E-06	4.0753E-05	8.5582E-06	6.113E-06	6.5205E-06	4.8904E-06	4.0753E-06	4.0753E-06	4.0753E-06
	M3	3.6678E-06	0.00025675	0.00025267	0.00038716	2.4452E-05	0.00038716	8.5582E-05	0.00035455	0.00024045
Cr	M1	0.00098	0.000475	0.001613	0.001288	0.001545	0.0013	0.00106	0.000941	0.000901
	M2	0.00152	0.001683	0.00185	0.002021	0.001573	0.001895	0.001255	0.001602	0.001602
	M3	0.000444	0.001027	0.000518	0.000509	0.001349	0.000636	0.000917	0.000526	0.000831
Ni	M1	0.000859	0.001032	0.001439	0.001231	0.001569	0.001011	0.00084	0.001227	0.001349
	M2	0.001353	0.001353	0.001296	0.001316	0.001899	0.001659	0.001805	0.001357	0.001357
	M3	0.001133	0.001161	0.001524	0.000493	0.001092	0.000501	0.000742	0.000835	0.000424
Pb	M1	0.000982	0.001259	0.001219	0.001202	0.001316	0.001593	0.001361	0.000876	0.001528
	M2	0.001308	0.001496	0.001361	0.001655	0.001854	0.001308	0.001467	0.001231	0.001231
	M3	0.001585	0.001589	0.001492	0.001842	0.001989	0.001365	0.001675	0.000823	0.00084

Table 4. THQ to heavy metals from consumption of polluted vegetables and fruits in different markets M1, M2 and M3.

Heavy metals conc. mg kg-1	Markets	Vegetables edibles					Fruits			
		Fruity		leafy		tuber				
		cucumber	tomato	Jews Mallow	Nasturtium	potato	grapes	figs	apple	mango
Cd	M1	0.509418	0.211918	1.051438	1.181849	0.994384	0.794692	0.753938	0.696884	0.729486
	M2	1.226678	1.263356	1.613836	1.084041	1.389692	1.263356	1.267432	1.267432	1.267432
	M3	1.161473	0.921027	1.084041	1.161473	0.827295	0.945479	0.700959	0.676507	0.672432
Co	M1	0.000136	0.000272	0.000543	0.002269	0.005434	0.000177	0.004211	0.000272	0.000285
	M2	0.000136	0.001358	0.000285	0.000204	0.000217	0.000163	0.000136	0.000136	0.000136
	M3	0.000122	0.008558	0.008422	0.012905	0.000815	0.012905	0.002853	0.011818	0.008015
Cr	M1	0.000653	0.000317	0.001075	0.000859	0.00103	0.000867	0.000706	0.000628	0.0006
	M2	0.001013	0.001122	0.001233	0.001348	0.001049	0.001263	0.000837	0.001068	0.001068
	M3	0.000296	0.000685	0.000345	0.00034	0.000899	0.000424	0.000611	0.00035	0.000554
Ni	M1	0.042954	0.051614	0.07193	0.061538	0.07845	0.050534	0.041976	0.061334	0.067447
	M2	0.067651	0.067651	0.064798	0.065817	0.094955	0.082933	0.090269	0.067854	0.067854
	M3	0.056647	0.058074	0.076209	0.024656	0.05461	0.025063	0.037086	0.041772	0.021192
Pb	M1	0.245539	0.31482	0.304632	0.300557	0.329084	0.398365	0.340291	0.21905	0.382063
	M2	0.327046	0.373913	0.340291	0.413647	0.46357	0.327046	0.366781	0.307688	0.307688
	M3	0.396327	0.397346	0.372894	0.460514	0.497192	0.34131	0.418741	0.205805	0.20988

In this study, the non-cancer risks (THQ) of the investigated heavy metals through the consumption of vegetables and fruits has been recognized as a useful parameter for evaluating the risk associated with the consumption of metal contaminated foods.

THQ is the measure of non-carcinogenic health risks, due to oral exposure to heavy metals, the acceptable guideline value of which has been reported to be ≤1.0 (Zhong *et al*.,2018) In this regard, (Ambedkar and Maniyan2011) concluded that if the THQ of each heavy metal elevates its limit, it might be associated with human health risks.

THQ is interpreted as either greater than 1 (>1) or less than 1 (<1), where THQ >1 shows human health risk concern (Bassey *et al*.,2014).Risk level of Target Hazard Quotient (THQ < 1) was observed for all the evaluated heavy metals. It indicates that intake of these heavy metals through consumption of the samples does not poses a considerable non cancer risk. The highest THQ was for the heavy metal Cd from the sample from M3 1.61473 mg/kg/day from Zefta city, while the lowest was for the heavy metal Co from the sample from M3 0.000122 mg/kg/day.

Hazard Index (HI). The hazard index, which considers the cumulative effect of the ingestion of various potentially hazardous metals (elements) from the consumption of different vegetables and fruits.

Hazard index (HI) values of the heavy metals studied ranged from 0.57894 to 2.020443 that were, indicating non-acceptable level of non-carcinogenic adverse health effect in HI above 1. Hence, HI recorded in M2 indicates the contribution of heavy metals can lead to aggregate risk via consumption of vegetables and fruits. This high HI values for all heavy metals observed in Jews mallow, potato, figs, tomato, grapes, apple, cucumber and Nastutium have great potential to pose health risk to the consumer.

Table 5. hazards index (HI) for different heavy metals, from consumption of vegetable and fruits in different markets M1,M2 and M3.

Common name	heavy metals polluted index		
	M1	M2	M3
Cucumber	0.798701	1.622524	1.614865
tomato	0.57894	1.7074	1.38569
Jews Mallow	1.429618	2.020443	1.541911
Nasturtium	1.547071	1.565056	1.659887
potato	1.408381	1.949484	1.380814
grapes	1.244634	1.674762	1.325182
figs	1.141123	1.725454	1.16025
apple	0.978166	1.644178	0.936253
mango	1.179882	1.644178	0.912073

An HI<1 indicates no adverse health effects, while HI>1 or=1 indicates that adverse health effects are likely to occur.

The HI for most of examined metals was more than 1 and this revealed desirable effects on human health.

CONCLUSION

The results showed that all the vegetables/fruits obtained from the different markets sites contained varying amount of the metals. The metals detected were found to be bove the safe limits as recommended by the FAO/WHO. Due to metal concentration the vegetables /fruits are not suitable for human consumption and should be consumed with caution because they might cause health effect if the metals concentration remains at the same level or higher. This observation is important as human health is directly affected by eating of vegetables. Thus, a continuous monitoring of heavy metal levels in vegetables/fruits is needed and cannot be over emphasized as these are the main sources of food for humans.

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حالة الملوثات بالعناصر الثقيلة للخضر والفاكهة المجمعة من بعض اسواق محافظة الغربية

محمد سامي السقا [1]*، محمد محسن الخولي[1] و محمود ابوالفتوح عياد[2]

[1] قسم بحوث البيئة ، معهد بحوث الأراضي والمياه والبيئة ، الجيزة ، مصر.

[2] قسم بحوث تحسين وصيانة الأراضي ، معهد بحوث الأراضي والمياه والبيئة ، الجيزة ، مصر.

إن استهلاك الخضر والفاكهة الملوثة بالعناصر الثقيلة مع مرور الوقت يمكن أن يسبب كثير من الأمراض . لذلك أجريت هذه الدراسة لتقييم مستويات العناصر الثقيلة مثل (الكاديوم (Cd) و الرصاص (Pb) والنيكل (Ni) والكوبالت (Co)والكروم(Cr) في عينات الفاكهة (عنب و تفاح و مانجو والتين) وفي عينات الخضر (الطماطم و الخيار والبطاطس والملوخية والجرجير) . تم جمع هذه العينات من أسواق الجملة بثلاث مراكز بمحافظة الغربية من كلا من سوق مدينة طنطا و كفر الزيات وزفتي. وقد أظهرت النتائج وجود اختلافات كبيرة في تركيزات المعادن الثقيلة في كل من عينات الخضر والفاكهة وأيضا في نفس العينات من مختلف الأسواق . وأظهرت النتائج أن تركيزات هذه العناصر تتجاوز حدود هذه العناصر طبقا لمنظمة الصحة والغذاء. حيث تراوح تركيز عنصر الكادميوم بين 0.525-3.96 مجم/كجم ، كذلك تراوح تركيز لعنصر الكوبالت من0.001- 0.95 مجم/كجم ، تركيز عنصر الكروميوم تراوح بين (1.09-4.96) ، كذلك تراوح تركيز عنصر النيكل (1.4-4.66) مجم/كجم ، وكان تركيز الرصاص يتراوح بين (2.02-4.88) مجم/كجم في عينات الخضر والفاكهه محل الدراسه. ومع حساب مؤشر الخطأ لمجموع تركيزات العناصر في عينات الخضر والفاكهه كان قيمة الدليل أكبر من الواحد. لذا فمحتوي الخضر والفاكهه المرتفع من تركيزات هذه العناصر ومع استمرار استهلاكها قد يؤدي الي الاصابة بكثير من الامراض .

الكلمات الدالة:- الفاكهه ، الخضر، العناصر الثقيلة، الأسواق