

Assessment of Fruit and Vegetable Dealers Awareness about Lead Contamination at Bahri Locality, Khartoum North

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Abstract: Fresh fruits and vegetables are rich in vitamins, minerals, mineral salts, proteins, carbohydrates and fiber. All these nutrients are very essential for health maintenance and diseases prevention. Also they play an important role in neutralizing acidic substances produced during digestion. These products will be used either fresh or for culinary purposes. Recently, fruits and vegetables free of heavy metals contamination have a great concern by the consumers worldwide. Long-term use of contaminated fruits and vegetables with lead will be a health threats for humans. Thus the aim of this research is to assess fruit and vegetable dealer's awareness about lead contamination at the areas of heavy traffic density at Bahri locality in Khartoum North. Descriptive systematic method used for the assessment. The study was based on the primary data collected from 150 fruit and vegetables sellers using structured questionnaire. The age group of 21-40 recorded the highest percent (58%). Results showed that most of the respondents (73.3%) received medium to low level of education and the illiteracy level among them was 24.7%. All interviewees displayed their products uncovered to the street on the shelves, tables ground, in wooden boxes, carton and plastic boxes near heavy traffic areas. They did not have special place for fruits and vegetables storage at their places. More than third (37.3%) of the participants re-displayed the remaining fruits and vegetables in the next day. Generally, all fruit and vegetable vendors had a poor knowledge about hygienic practices and procedures that followed during displaying and selling of their products. The majority (98.7%) of them they did not know anything about fruits and vegetables contamination with lead. However, there were no regulations to control fruits and vegetables displaying and selling. These products are exposed to the pollution at the areas of heavy traffic and are considered as a potentially health hazards for the consumers. Long consumption may lead to the accumulation of this element and then death. Therefore, food regulations should prohibit selling and displaying of foods in such areas. Health education lectures are recommended to increase fruit and vegetable sellers' awareness.

Keywords: Bahri locality, Fruits and vegetables, Khartoum North, Lead, Heavy Metals.

Introduction

Fruits and vegetables are nutritious products that enhance human health and it can be used to improve soup quality particularly leafy vegetables (Sobukola *et al.*, 2010). Heavy metals are dangerous contaminants resulted in a great risk of health due to their bioaccumulation in human body (Bhagure and Mirgane, 2010). Generally, heavy metals are not biodegradable substances, have long biological half-lives, and have a potential effect on human body due to their accumulation in different body organs, leading to serious health problems (Järup, 2003; Sathawara *et al.*, 2004). Different plants parts absorb heavy metals from air in polluted environments as

well as from contaminated soils through roots. Water used for irrigation may contaminate fruits and vegetables with heavy metals (Al Jassir *et al.*, 2005).

Lead is widely distributed in different habitats due to the increase of population activities, the application of new technologies, industrial and urban areas where it can be introduced into food items from different sources. These sources include petrol containing alkyl which combusted and emitted into the atmosphere causing contamination in roadside, soil and air (Fernandes *et al.*, 2000; Beavington *et al.*, 2004). Moreover, manufacturing processes, incineration of refuse and combustion of coal considered as another sources of environments pollution. Age, sex, route of exposure, level of intake, solubility, metal oxidation state, retention percentage, duration of exposure, frequency of intake, absorption rate as well as the mechanisms and efficiency of excretion determine lead toxicity and its effect (Mertz, 1986). In addition, the inhalation of lead can permanently lower intelligence quotients (IQ), damage emotional stability, cause hyperactivity, poor school performance and hearing loss (Goyer, 1996).

Fruits and vegetables are safety for human consumption but the consumption of fruits and vegetables contaminated with lead for a long time will lead to the accumulation of these hazards in human bodies and it results in serious health problems. Accumulation of lead in edible plant products has been reported by many researchers. In Tika in Kenya, vegetables grown in urban areas revealed higher levels of lead, zinc and cadmium than that established by World Health Organization Standard (Inoti *et al.*, 2012). Another study conducted by Elbagermi *et al.*, (2012) who found that fruits and vegetables samples collected from different areas in Misurata in Libya contained measurable level of heavy metals within the permissible level set by WHO1999. Zied (2010) reported that lead can be found everywhere in the environment and the long exposure to lead is an important health concern worldwide. Also he revealed that lead can reach all food items through air, water, soil, during cultivation, processing and packaging.

In Sudan, few researches about vended foods e.g. fruits and vegetables contaminated with lead were conducted. Ehsan (2003) found that 76.19% of vended food investigated samples were contaminated with Lead (Pb). She claimed that 38.10% of the examined samples had higher level of lead than in other foods. Fruits and vegetables are very essential food items for health maintenance and diseases prevention for both children and adults. Sudanese food vendors and hawkers like other vendors in developing countries. Most of them display food products near heavy traffic areas (Plate 1, 2, 3). They have a poor knowledge, poor hygienic practices and lack of awareness about food contamination from different sources. Assessment of awareness data about food items contaminated with lead in Sudan is not available; therefore the aim of this research is to assess the awareness of vendors and hawkers about fruits and vegetables contamination with lead in area of heavy traffic.

Materials and Methods

Study area

This study was conducted at Bahri locality which located at the Northern part of Khartoum State at altitudes 8-15 and longitudes 24-25 and 31-16. It bordered with Nile State from the North, Blue Nile State from the South, Sharg El Neel locality from the East and the Nile River from the West. The estimated area is 455907Km² with total population of 9040749. The main activities of the residents at this area are the agriculture and industrial activities beside the other economical activities. It composed of 10 administrative units including Bahri El Kubra, Bahri Shreg, El Safia, Halfiat El Mulook, El Sambrab, Drdoug, Droasahb, El Kadro, El Selate and El Jili unit.



Data collection

A descriptive systematic method was used to collect data. In January 2017, a total of 150 vegetables and fruit dealers at traffic density areas at Bahri locality were selected (Suque Sitta, Bus station, Almahatuh alwasti , Alkudru lafah janub , Super Markets and Alssuqe Almarkazi Shamabat) using a systematic descriptive technique. A structured questionnaire was used to collect information about the socio-demographic status of fruits and vegetables sellers, types of building and containers, displaying methods, hygienic washing and wiping practices, storage and transportation methods, sources of fruit and vegetables, chemical and organic treatments after receiving their products, knowledge about lead contamination and the diseases caused by this element, the effect of cars exhausted pipes, control of flies and insects, lectures or forums and training about lead contamination and its effect on human health, medical investigation and medical cards. Face to face dialog bases was used. The data was analyzed by descriptive statistics method using SPSS version 20.

Results

Demographic status of fruits and vegetables vendors presented in Table. 1. The age group of 21-40 recorded the highest percent (58%) while the group of less than ten years reported the lowest percent (2%). More than the third (34%) of the participants were primary graduate, 29.3% secondary graduate, 24.7 % illiterate, 10% university graduate and 2% others (Khalwa). The majority of the fruits dealers were male (91.3%). The types of building used for selling and displaying of fruits and vegetables were stalls 54%, movable cars 4.7%, barrow cars 5.3%, cars 4.7%, improved food centers 4% and sacs on the ground 27.3% (Fig.1). However, 42 % of the interviewees displayed their products uncovered on the shelves to the street, 2.7% in wooden boxes, 0.7 % in plastic boxes, 22% in carton containers, 25.3% on the ground and 6.7% on covered tables (Fig. 2). According to the abuse of cigarettes and snuff by vegetables dealers during selling and displaying of their products, results revealed that half (52%) of the respondents answered that they did not abused cigarettes and snuff, 32% of them abused cigarettes, 10% abused snuff and 6% of them did not abused any one of them. However, results recorded that 52% of fruit sellers answered that there were toilets near the displaying and selling area of their products while 48% answered no.

Regarding the hygienic washing and wiping practices, results showed that 58.7% of the fruits and vegetables vendors answered that there was no specific places for hands washing and all of them washed their hands before touching fruits and vegetables. Additionally, the majority (98%) of them answered that they washed their hands after using toilets. With regards to the washing methods of the fruits and vegetables, 47.3% of the participants washed fruits and vegetables once, 12.7% two times, 6.7% three times and 4% washed them more than three times. Fifty eight of the interviewees used water public network for washing their fruits and vegetables. Generally, more than third (37.3%) of the fruits and vegetables dealers wiped these products with clean cloths, 2% used clean cloth and oil for wiping, 1.3% used piece of cloth that used to clean serving tables, 0.1% used handkerchief and 16% used others ways as wiping with their hands and their clothes (Table 2). All fruits and vegetables vendors and hawkers did not have a uniform for selling their products.

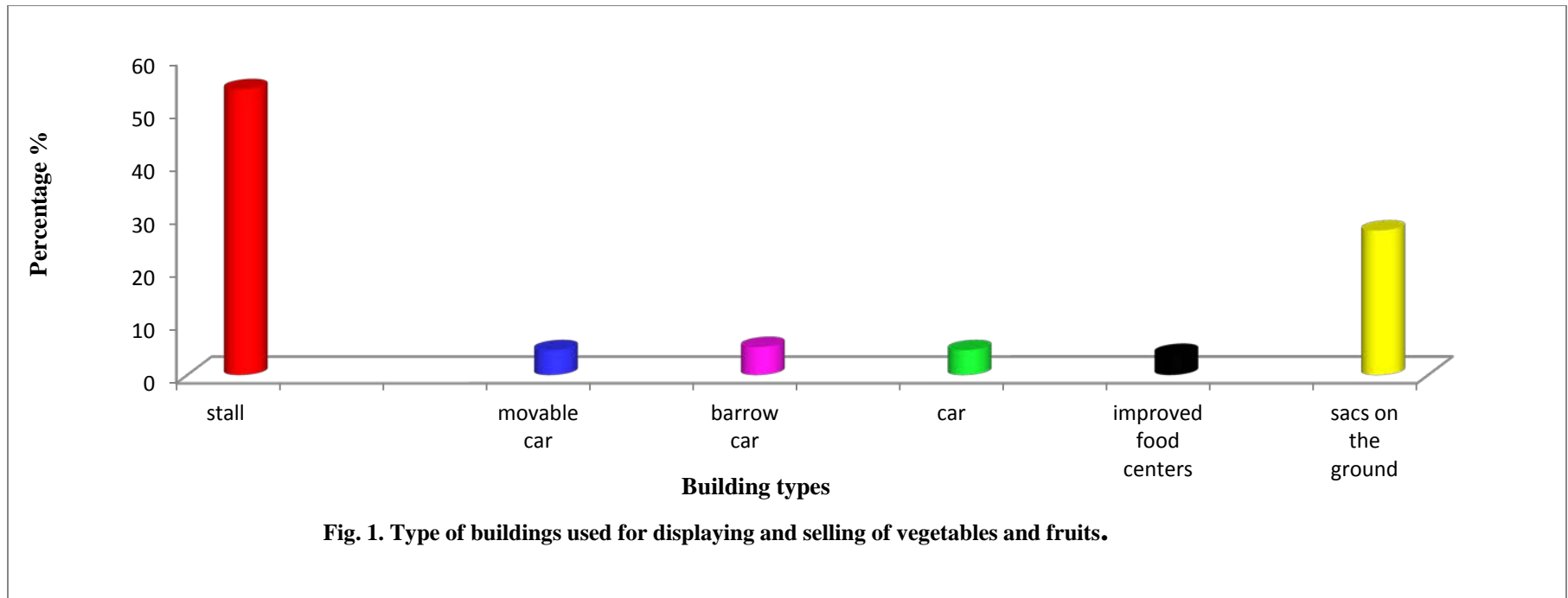
Results reported in Fig 3 shows the types of containers that used for fruits and vegetables washing. The majority (90%) of the respondents used plastic containers for washing, 8% of them used metal containers and 2% used wooden containers.

As it can be observed from the results, 51.3% obtained their fruits and vegetables from local market, 38% Wholesales, 7% from farm and 3% from refrigerator (Table 3). Survey claimed that 3.3% of the participants used organic compounds to treat fruits and vegetables that purchased from farms, 2% of them used chemical substance and 2% answered that they did not know. However, most of the fruits and vegetables dealers (69.3%) answered that they did not store their products; while 30.7% answered that they stored them. The storage methods followed by sellers recorded that 6% of them stored their fruits and vegetables uncovered at the ordinary room, 6.7% in the refrigerator, 4% on the table, 2.7% in carton, 9.3% in packages and 2% in plastic sacks (Table 3).

Table 1. Demographic status of fruits and vegetables dealers.

Age		
Age group	Frequency	Percentage
less than 10 year	3	2.0
11-20 years	22	14.7
21- 40 year	87	58.0
more than 40	38	25.3
Total	150	100.0
Education level		
Education level	Frequency	Percentage
Illiterate	37	24.7
Primary	51	34.0
Secondary	44	29.3
University	15	10.0
Others	3	2.0
Total	150	100.0
Sex		
Gender	Frequency	Percentage

Female	13	8.7
Male	137	91.3
Total	150	100.0



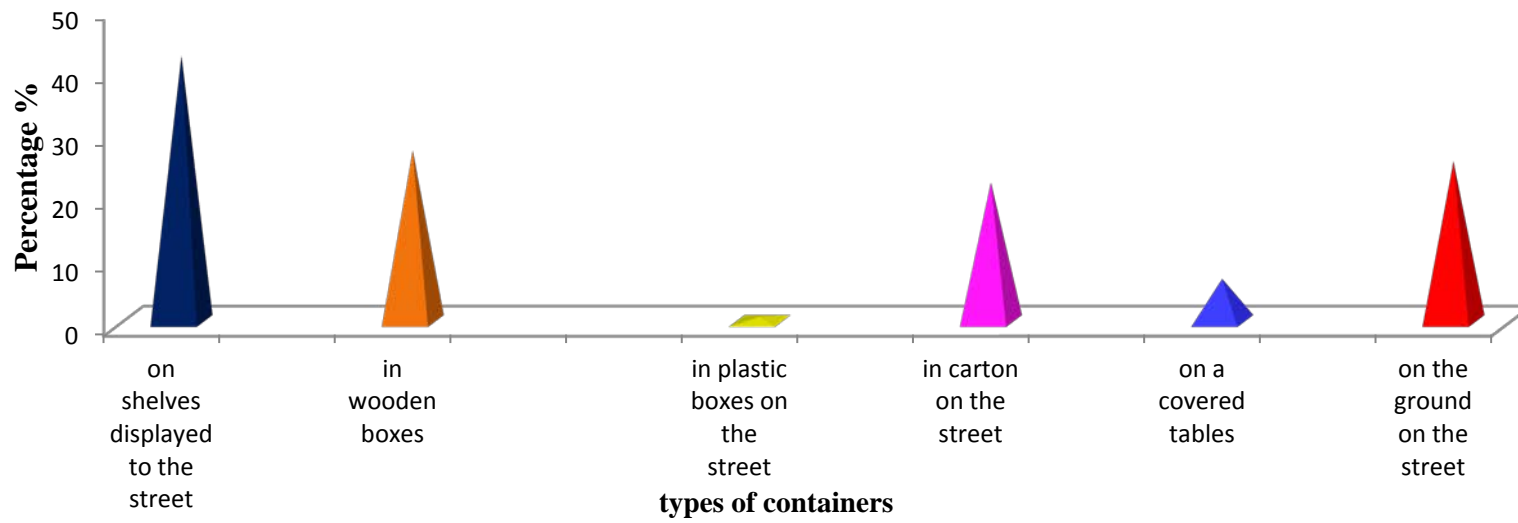


Fig. 2 .Types of containers for displaying and selling of fruits and vegetables.

Table. 2. Hygienic washing and wiping practices of hands, fruits and vegetables.

Specific place for hand washing		
Answers	Frequency	Percentage %
Yes	62	41.3
No	88	58.7
Total	150	100.0
Do you wash your hands after using toilet?		
Answers	Frequency	Percentage
Yes	147	98.0
No	3	2.0
Total	150	100.0
Do you wash your hand before dealing with vegetables and fruits?		
Answers	Frequency	Percentage
Yes	150	100.0
If the answer is yes. how do you wash your hands?		
Method of washing	Frequency	Percentage
only with water	147	98.0
with water and soap	3	2.0
Total	150	100.0
Do you wash fruits and vegetables before selling?		
Answers	Frequency	Percentage
Yes	106	70.7
No	44	29.3
Total	150	100.0
How many times do you wash them?		
Times	Frequency	Percentage
Once	71	47.3
two times	19	12.7
Three times	10	6.7
more than three times	6	4.0
Missing	44	29.3
Total	150	100.0

Con. Table. 2. Hygienic washing and wiping practices of hands, fruits and vegetables.

Sources of washing water		
Source	Frequency	Percentage
Water network	87	58.0
Water stored in barrels	34	22.7
Missing	29	19.3
Total	150	100.0
Do you wipe fruits and vegetables at your shop?		
Methods of wiping	Frequency	Percentage %
clean piece of clothes	56	37.3
clean clothes+ oil	3	2.0
clean clothes that used to clean the serving tables	2	1.3
Handkerchief	1	0.7
Others	24	16.0
Missing	64	42.7
Total	150	100.0

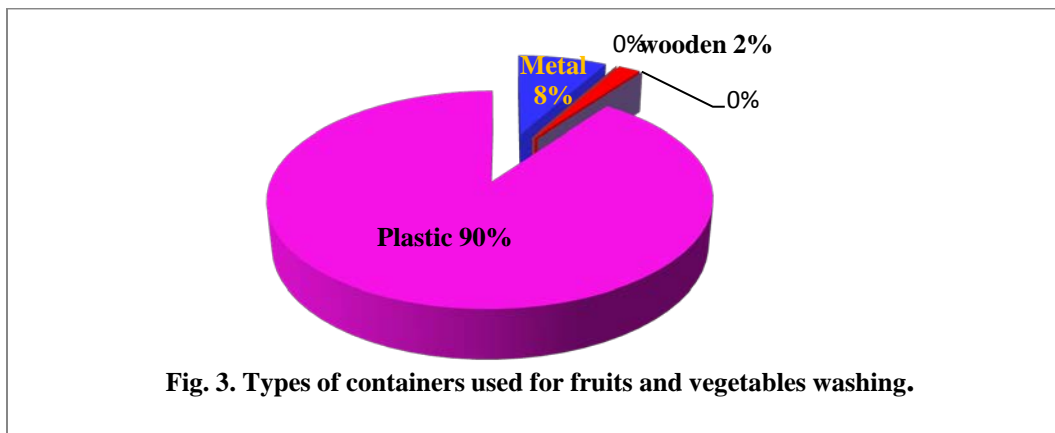


Table. 3. Sources, treatment with chemical compounds, storage and transportation of fruits and vegetables.

Fruits and vegetables sources		
Source	Frequency	Percentage
Farm	11	7.3
Wholesales	57	38.0
local markets	77	51.3
Refrigerator	5	3.3
Total	150	100.0
If the answer is from the farm, do they treat their products with chemicals or organic materials?		
Answer	Frequency	Percentage
Chemical	3	2.0
Organic materials	5	3.3
I do not know	2	1.3
Total	10	6.7
Missing	140	93.3
Total	150	100.0
If the answer is wholesales trader are fruits and vegetables stored or directly transported from the farm?		
Answer	Frequency	Percentage
Stored	29	19.3
Directly transported from farm	30	20.0
Missing	91	60.7
Total	150	100.0

Con. Table. 3. Sources, treatment with chemical compounds, storage and transportation of fruits and vegetables.

Do you store vegetable		
Answer	Frequency	Percentage
Yes	46	30.7
No	104	69.3
Total	150	100.0
How vegetables are stored in your place		
Storage	Frequency	Percentage
Ordinary room	9	6.0
Refrigerators	10	6.7
On tables	6	4.0
In cartons	4	2.7
Packages	14	9.3
In plastic sacks	3	2.0
Missing	104	69.3
Total	150	100.0
How the vegetables are transported from the source		
Transported	Frequency	Percentage
Uncovered cars	110	73.3
Covered car	30	20.0
Freezing refrigerators	3	2.0
Rickshaw	7	4.7
Total	150	100.0

With respect to the selling and rejection of fruits and vegetables, results recorded that 66.7% of fruits and vegetables dealers answered yes that they consumed and sold the whole quantity of fruits and vegetables, 33.3% of them answered they did not consume the whole quantity of the fruits and vegetables. Generally, 29.3% of them answered that they stored the remaining fruits and vegetables, while 5.3% of the rejected their products (Table 4). Regarding the displaying of their products next day, results declared that 37.3% of the participants stored the remaining products and displayed them next day, while 5.3% of them answered that they did not display the remaining one. Additionally, 26% of the participants answered that they separated the fresh fruits and vegetables from the old ones, while 20% of them they did not. More than half (58%) of the respondents get rid of the remained fruits and vegetables by organized way, 18% they rejected them by the random way on the street and 7.3% of them used the remaining one for the personal consumption.

Results reported in Table.5 reveals the awareness about lead and pesticides contamination. The majority of the participants (98.7%) answered that they did not know anything about the pollution of fruits and vegetables with lead substance. However, all fruits and vegetables venders didn't know any information about the diseases that caused by lead and they did not know that cars exhausted pipes will contaminate fruits and vegetables with lead. The majority (94.7%) of them answered that there was no smell of remaining pesticides in fruits and vegetables, while 5.3% of them smell the remaining pesticides.

The majority (96.7%) of fruits and vegetables venders did not spray their places with pesticides while 3.3% of them use pesticides for pest control. Information about legislations that set for hygienic selling and displaying were presented in Table 6. All fruits and vegetables dealers answered that there was no regulations and laws set to control selling and displaying. Most of them (77.3%) answered that there was a place for garbage collection and half of them suffered from flies and insects presents. Additionally, 65.3% of the interviewees had a health card and 34.7% had not. Generally, results revealed that 60.7% of the participants renewed their cards every six months, 58.7% of them answered that they did the medical investigation, and 14.7% they did not (Table6). However all fruits and vegetables sellers answered that there was no training about fruits and vegetables hygiene, safety, awareness about heavy metals contamination and no any sector responsible for this training.

Discussion

Results showed that the aged group of 21-40 years recorded the highest percentage (58%) among fruits and vegetables sellers, while the group of less than ten years reported the lowest percent (2%) which was higher than that obtained by Elhaj *et al.*, (2012) who found that the majority of food vendors of age group 21-30 comprises 40% in Gizan, Saudi Arabia. It is a fact that both knowledge and experience increases with the age. Generally, results revealed that most of the participants (65.3%) had a low to medium education level, while the illiterate level was 24.7% among them. Similar result obtained by Federal Ministry of Health (2011) who recorded that the most of the participants (80%) of the Sudanese communities attained low to medium level of education. These findings may be referred to the socio-economical conditions of the fruits and vegetables handlers. High percent of illiteracy among the respondents reflected the poor knowledge and awareness about the proper hygienic practices, lead

Table. 4. Selling and hygienic rejection of fruits and vegetable.

Do you consume or sell all the available quantity of vegetables and fruits at your place?		
Answer	Frequency	Percentage
Yes	100	66.7
No	50	33.3
Total	150	100.0
Do you store the remaining fruits and vegetables or do you reject it?		
Answer	Frequency	Percentage
Stored the item	44	29.3
get rid of the item	8	5.3
Missing	98	65.3
Total	150	100.0
If they are stored, how they are stored?		
Storage	Frequency	Percentage
ordinary room	18	12.0
Refrigerator	10	6.7
Others	19	12.7
Missing	103	68.7
Total	150	100.0
Are the stored vegetables will be displayed for the next day?		
Answer	Frequency	Percentage
Yes	56	37.3
No	8	5.3
Missing	86	57.3
Total	150	100.0
Do you separate the fresh vegetables from old ones?		
Answer	Frequency	Percentage
Yes	39	26.0
No	30	20.0
Missing	81	54.0
Total	150	100.0
How do you get rid of the useless fruits and vegetables?		
Answer	Frequency	Percentage
In a well-organized way	87	58.0
In random way	27	18.0
Personal consumption	11	7.3
Others	17	11.3
Missing	8	5.3
Total	150	100.0

Table.5. Awareness of fruits and vegetables dealers about lead and pesticides pollution.

Do you know anything about fruits and vegetables pollution with lead substance		
Answer	Frequency	Percentage
Yes	2	1.3
No	148	98.7
Total	150	100.0
Do you know that lead causes diseases?		
Answer	Frequency	Percentage
No	150	100.0
If your answer is yes mention these diseases?		
Answer	Frequency	Percentage
Missing	150	100.0
Do you think that cars exhaust pipes contaminate fruits and vegetables with lead/		
Answer	Frequency	Percentage
No	150	100.0
Do you observe any smell of remaining pesticides in fruits and vegetables?		
Answer	Frequency	Percentage
Yes	8	5.3
No	142	94.7
Total	150	100.0
Do you spray your place by pesticides?		
Answer	Frequency	Percentage
Yes	5	3.3
No	145	96.7
Total	150	100.0

Table.6. Legislations and laws set for hygienic selling of fruits and vegetables.

Are there any regulations and laws to control fruits and vegetables selling?		
Answer	Frequency	Percentage
No	150	100.0
Are there any places for garbage collection?		
Answer	Frequency	Percentage
Yes	116	77.3
No	34	22.7
Total	150	100.0
Do you have a health card?		
Answer	Frequency	Percentage
Yes	98	65.3
No	52	34.7
Total	150	100.0
If the answer is yes do you renew it every six months?		
Answer	Frequency	Percentage
Yes every six months	91	60.7
No	20	13.3
Every year	39	26.0
Total	150	100.0
Is there a periodic medical check		
Answer	Frequency	Percentage
Yes	88	58.7
No	22	14.7
Missing	40	26.7
Total	150	100.0

contamination and their effect on human health. Moreover, 42 % of the respondents displayed their products on the shelves to the street in wooden boxes, in plastic boxes, in carton, on the ground and on covered tables. The way of displaying these products may enhance the absorption of Pb from polluted air on the side road of heavy traffic. High percentage (32%) of the respondents abusing cigarettes also may contaminate the air inside the shops and lead to the products contamination. Levels of lead in indoor air are affected by the presence of cigarette smoke (Reilly, 1980). The presence of toilet near the fruits and vegetables retail outlets considered as source of contamination with microorganisms, flies and insects.

However, more than half (58%) of the fruits and vegetables vendors had not specific place for hands washing, while 2% did not wash their hands after using the toilet. Unwashed hands and improper hands washing practice may increase the probability of fruits and vegetables contamination. Most of the containers used in fruits and vegetables washing were made of plastic materials and some of them use metal containers. Metal containers may affect fruits and vegetables quality. After the receiving of fruits and vegetables from farm 5.3% of the participants treated their products with organic and chemical substances. These treatments may introduced different elements (as Pb) into fruits and vegetables and then increase the level of these elements. These products could also be contaminated by various substances including traces of metals as farmers wash them with unhygienic water before bringing them into the market (Divrikli *et al.*, 2006).

The result showed that third of the participants stored their fruits and vegetables and redisplay and re-sell them on the next day. This unhygienic practice may lead to the prolonging subjection of these products to the polluted air which leads to the accumulation of lead inside the products. Vegetables and fruits absorb lead from the soil (Mapanda *et al.*, 2005) contaminated irrigation water (Demirezen, and Ahmet, 2006) and polluted air. Khairiah *et al.*, (2004) reported that the most important source of contamination is the atmospheric pollution from industrial or motor vehicle emission, where it represents 73 to 95% of the total lead in plants (Delenberg and Van Dried, 1994). Generally, 70%.3 of fruit and vegetable vendors transport their products by open car and this lead to the exposure of fruits and vegetables to the dust, house fly, vehicles exhaustion and increase the level of lead in these products. On the other hand, vegetables and fruits grown near highways or downwind of industrial plants may contain lead (Abou-Arab *et al.*, 2011). It was also observed that these foods are sold and displayed adjacent to the exhaust emission in areas of heavy traffic which lead to more deposition and absorption of Pb. There is relationship between the displaying distance and the degree of lead contamination. As the food products displayed close to the heavy traffic areas more lead will be absorbed by these products and vis versa (Hassan and Gewifed (1998). Abou-Arab *et al.*, (2015) found that the highest levels of lead was detected in samples collected from industrial areas and the lowest level was found in samples collected from rural areas.

The majority of fruit and vegetable dealers did not know any things about the fruits and vegetables pollution by lead and all of them did not know that lead causes disease. Moreover, they did not know that car exhaustion pipes

contaminated fruit and vegetable with lead. Similar results reported by Shafie *et al.*, (2016) who found that the level of awareness regarding the presence of toxic metals in daily-consumed rice was low in 78.2% and moderate in 21.8% of the participants in Iran. The lack of awareness among fruits and vegetables sellers in this research may be attributed to both medium level of education and the high level of illiteracy among them. It is alarming signs for health authorities to set and conduct programs on the risk factors that affect vegetables and fruits safety. Additionally, half of them suffered from flies and other insects. The presence and the increase number of flies and insects at the area of selling may lead to the increase of pesticides use, thus it increases the contamination with lead and other chemicals. Lead is poisonous compounds can enter human body via inhalation or swallowing and it affect the internal organs. This element is harmful for all humans particularly children and fetuses because it interferes with the development of the nervous system. It is dangerous for human health even at low levels in the blood. Low levels of lead may cause nervous system and kidney damage, learning disabilities, attention deficit disorder, and decreased intelligence, while high levels have devastating effects on children, including seizures, unconsciousness and in some times lead to death (USEPA, 1985). The accumulation of lead have damaging effects on the hematopoetical, hematic, renal and gastrointestinal systems (Correia *et al.*, 2000). In addition, lead has been associated with various forms of cancer, nephrotoxicity, central nervous system effects and cardiovascular diseases in human (Ryan *et al.*, 2000).

Result reported that all fruits and vegetable vendors had no regulations to control fruits and vegetables displaying and selling. The lack of the regulations and laws may increase the physical, microbiological and chemical contamination. However, 22.7% had not specific place for garbage collection and this may lead to the soil and environment contamination, production of bad odor, insects, rodents, and microorganisms multiplication. With regards to the health cards, results showed that more than third (34%) of the interviewees have no health card and this can transmit different diseases from vendors to vegetables and fruits and lastly to the consumers.

References

- A. A. K. Abou-Arab, M. A. Abou Donia, Sherif R. Mohamed, A. K. Enab. Risk Assessment of Lead in Egyptian Vegetables and Fruits from Different Environments. World Academy of Science, Engineering and Technology International Journal of Biological, Biomolecular, Agricultural, Food and Biotechnological Engineering Vol:9, No:3, 2015.
- M. S. Al Jassir, A. Shaker, and M. A. Khaliq, "Deposition of heavy metals on green leafy vegetables sold on roadsides of Riyadh City, Saudi Arabia," Bulletin of Environmental Contamination and Toxicology, vol. 75, no. 5, pp. 1020–1027, 2005. View at Publisher · View at Google Scholar · View at Scopus.
- F. Beavington, P.A. Cawes, and A. Wakenshaw, "Comparative studies of atmospheric trace elements: improvement in air quality near copper smelters," Total Environ., vol. 332, pp. 39-49, 2004.
- G.R. Bhagure, and S.R. Mirgane. Heavy metal concentrations in ground waters and soils of Thane Region of Maharashtra, India. *Environmental Monitoring and Assessment*, 173(1-4), 643-652. 2010.
- K. Chojnacha, Chojnacki, A. Gorecka, H. and H. Gorecki. "Bioavailability of heavy metals from polluted soils to plants," Sci.Total Environ, vol. 337, no.13, pp. 175-185. 2005.
- P.R.M. Correia, E. Oliveira, and P.V. Oliveira, "Simultaneous determination of Cd and Pb in foodstuffs by electrothermal atomic absorption spectrometry," Analytica Acta, vol. 405, pp. 405-211, 2000.

- D. Demirezen, and A. Ahmet, "Heavy metal levels in vegetables in turkey are within safe limits for Cu, Zn, Ni and exceeded for Cd and pb," *J. Food Qual.*, vol. 29, pp.252-265, 2006.
- J.W. Delenberg and W. Van Dried. "Netherlands J. Agriculture Science," vol.38, pp. 369-379., Cabrera *et al.*, 1994, *J. of Association Official Analytical Chemistry International*, vol.17, no. 5, pp. 1249-1252, 1990.
- U. Divikli, N. Horzum, M. Soylak, and L. Elci. (2006). Trace heavy metal contents of some spices and herbal plants from western Anatolia, Turkey. *International Journal of Food Science and Technology* 41: 712-716.
- M. A. Elbagermi, H. G. M. Edwards, and A. I. Alajtal. (2012).Monitoring of Heavy Metal Content in Fruits and Vegetables Collected from Production and Market Sites in the Misurata Area of Libya. *ISRN Analytical Chemistry*.Volume 2012 (2012), Article ID 827645, 5 pages. <http://dx.doi.org/10.5402/2012/827645>
- Ehsan Bashir Ali (2003). The Content of Lead in Foods Vended in the Vicinity of Heavy Traffic in El saug Elarbi (Khartoum Governorate). M.Sc. Food Hygiene and Safety, Faculty of Public and Environmental Health, University of Khartoum.
- M. Elhag, S. Siham, A. Mohammed. Surveillance of food safety practices of street food-vendors in Gizan Saudi Arabia. *Agriculture & Forestry*, vol. 58. (4): 119-128. 2012.
- Federal Ministry of Health."Knowledge, Attitudes and Practices (KAP) in the Sudanese communities for their Economics, Research & Information, 2011 Federal Ministry of Health.
- A.G. Fernandes, M.Tertero, and G.F. Barragan, "An approach to characterization of sources of urban air born particles through heavy metal speciation," *Chemosphere*, vol.2, pp.123-136, 2000.
- R.A. Goyer, "Results of lead research: prenatal exposure and neurological consequences," *Environmental Health Perspectives*, vol.104, pp. 1050-1054, 1996.
- I. A. Hassan, and I. M. Gewifel. Heavy metals in Egyptian Soils. *Egyptian Journal of Botony*. 38: 119 – 129. 1998.
- K. J. Inoti, F. Kawaka, G. Orinda, and P. Okemo. Assessment of heavy metal concentrations in urban grown vegetables in Thika Town, Kenya. *African Journal of Food Science*, 6(3), 41-46. 2012.
- L. Järup, "Hazards of heavy metal contamination," *British Medical Bulletin*, vol. 68, pp. 167–182, 2003. View at Google Scholar · View at Scopus.
- T. Khairiah, M.K. Zalifah, Y.H. Yin, and A. Aminnah. The uptake of heavy metals by fruits type vegetables grown in selected agricultural areas," *Pak. J. Biol. Sci.*, vol. 7, no.8, pp. 1438-1442. 2004.
- F. Mapanda, E.N. Mangwayana, J. Nyamangara, and K.E. Giller, "The effect of long-term irrigation using wastewater on heavy contents of soils under vegetables in Harare," *Zimbabwe. Agric. Ecosys. Environ.*, vol.107, pp. 151-165, 2005.
- W. ED. Mertz, "Trace Elements in Human and Animal Nutrition," Vol. 1 and II, 5th ed. Academic Press, New York, 1986.
- C. ReillyMetal Contamination of Food, 1st Ed. London: Applied Science Publisher Ltd.(1980).
- P.B. Ryan, N. Huet and D.L. MacIntosh. "Longitudinal investigation of exposure to arsenic, cadmium and lead in drinking water," *Environmental Health Perspectives*, vol. 108, pp. 731-735, 2000.
- N. G. Sathawara, D. J. Parikh, and Y. K. Agarwal, "Essential heavy metals in environmental samples from Western India," *Bulletin of Environmental Contamination and Toxicology*, vol. 73, no. 4, pp. 756–761, 2004. View at Publisher · View at Google Scholar · View at Scopus.
- L. Shafiei, P. Taymoori, K. Yazdanshenas. Awareness and attitude assessment regarding toxic metal-contaminated rice based on the Health Belief Model. *J Adv Environ Health Res* 2016; 4(2): 78-87.

O.P. Sobukola, M.O., Adeniran, A.A. Odedairo, and O.E Kajihausa,. Heavy metal levels of some fruits and vegetables from selected markets in Lagos, Nigeria. *African Journal of Food Science* 4: 389-393. 2010.

USEPA. 1985. Cost and benefit of reducing lead in gasoline, final regulatory impact analysis:

[http://yosemite.epa.gov/ee/epa/ermfile.nsf/vwAN/EE-0034-1.pdf/\\$file/EE-0034-1.pdf](http://yosemite.epa.gov/ee/epa/ermfile.nsf/vwAN/EE-0034-1.pdf/$file/EE-0034-1.pdf)> Accessed 2006 Jan.15.

A.A. Zeid. Lead Contamination in Selected Foods from Riyadh City Market and Estimation of the Daily Intake, *Molecules*. **15**, 7482-7497; doi:10.3390/molecules15107482. 2010.



Plate 1. Displaying and selling of vegetables in a car.



Plate. 2. Displaying and selling near heavy traffic areas.



Plate. 3. Displaying and selling in the market near bus station.