International Journal of Multidisciplinary Research and Development
Online ISSN: 2349-4182, Print ISSN: 2349-5979
Impact Factor: RJIF 5.72
Received: 05-02-2018; Accepted: 04-03-2018
www.allsubjectjournal.com
Volume 5; Issue 3; March 2018; Page No. 101-105

Determination of lead and cadmium in food stuff at Khartoum state by atomic absorption spectroscopy

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Abstract
The samples of natural food with different kinds (vegetables, fruits, legumes, meat, milk) were collected from three locations in Khartoum state. Omdurman, Bahri and Khartoum. The samples were treated for reading by atomic absorption spectroscopy (AAS) with stander Method for determination of heavy metals the results of cadmium concentration are within levels of World Health organization. Except for vegetables they are higher than maximum limit levels of World Health organization (In addition, cadmium levels in vegetables at bahri area were higher than Omdurman and Khartoum areas) but it not reached the toxicity limit. This due to use Fertilizers. And the mean concentrations of lead within World health Organization.
Maximum permitted concentration in parts per million according WHO: Cadmium (Cd:) legumes s and vegetables (0.1ppm), Fish and meat (2ppm) Meat of animal (0.2ppm).
Lead (Pb): All food in solid form all food in liquid form (6ppm), all food in liquid form (1ppm).

Keywords: WHO, milk, AAS, meat, fruits, toxicity

1. Introduction
Lead and cadmium are natural constituents of earth's crust, their omnipresence resulting largely from anthropogenic activities: mining and siderurgical activities, burning fossil fuels, paint industry, waste storage and incineration etc [1, 2]. Air is considered to be a pollution source with lead and cadmium, as metal particles emitted from factories, cars etc. are carried by air currents and are deposited on soil and plant surface [3]. Metals can change their chemical form but cannot be degraded or destroyed, which means that they are persistent in the environment and can bioaccumulate in the animal or plant body [4].

1.1. Food pollution by cadmium and lead
Diet is the main route of exposure to heavy metals in the case of non-smoking population [5]. Exposure to these toxic metals has been associated with a broad range of biochemical, physiologic and behavioural dysfunctions. Therefore, the accumulation of these two metals in the environment represents a stringent problem, due to the food safety issues and potential risks to human health. Although the quantities of cadmium and lead in food are relatively low and absorption in the gastrointestinal tract is reduced, daily exposure for a long period of time and the long half-lives in the body leads to a significant accumulation of the metals [6, 7]. The lead and cadmium content in food products varies depending on numerous factors: The nature of the food product, geographic area, time of the year in which it was cultivated or produced. Various methods used for processing and packaging food products can influence the chemical parameters and implicitly the metals content [8].

1.2. Sources
- Grains, fruits and vegetables grown on soils contaminated with these metals [9].
- The use of chemicals: fertilizers, insecticides, fungicides and herbicides.
- Food stuff's contact with the processing machineries [10].

2. Materials and Methods
2.1 Materials
Hydrochloric acid HC, Nitric acid HNO_3, Lead nitrate Pb (NO_3), Cadmium (II) nitrate hex hydrate $Co(NO_3)_3.6H_2O$,De ionizer water**.** All chemicals used were of analytical-reagent grade. Deionized water was used throughout. Standard (various concentrations) and model solution were prepared by dilution of single element 1000 mg in litter, solutions of Lead and Cadmium.
The concentrations of cadmium and lead were determined in an air-acetylene flame. Instrumental parameters were optimized in accordance with manufacturer's recommendations.

2.2 Methods
2.2.1 Sample preparation
20 grams of samples were left overnight at a temperature of 105 º C and after that the samples were dry-ashed at a temperature of 450 º C using a muffle furnace until a white or grey ash residue was obtained. The residue was treated with 5 ml HNO3 65% and maintained on a sand bath at a temperature of approximately 150 º C in order to dissolve the remaining ash. The solution was filtered and diluted up to a volume of 25 ml with purified water. A blank was carried out in the same process.

2.2.2 Analysis of foods

After preparation the samples were directly analyzed, by AAS. The result shown in tables1, 2and 3 for the Omdurman, Bahri and Khartoum respectively.

3. Results and discussion

3. 1 Concentration of cadmium in food

Cadmium concentration are ranged; in vegetables (0.040 to 0.059 ppm, 0.056 to 0.089 ppm, 0.051 to 0.145 ppm in Omdurman, Bahri, Khartoum respectively. In fruits (0.028 to 0.052ppm,,0.0312 to 0.058 ppm, 0.0315 to 0.059 ppm in Omdurman, Bahri, Khartoum respectively.In Cereals ranged (0.0594 to0.0661 ppm,0.0631 to0.0691ppm, 0.0683 to 0.0712 ppm in in Omdurman, Bahri, Khartoum respectively.In meat ranged (0.006 to 0.055 ppm, 0.007 to0.045ppm 0.0069 to 0.0415ppm in in Omdurman, Bahri, Khartoum respectively. And in milk ranged (0.028 ppm, 0.027 ppm 0.0031 ppm in Omdurman, Bahri, Khartoum respectively. mean concentrations of cadmium are within levels of World Health organization. Except for vegetables they are higher than maximum limit levels of World Health organization (In addition, cadmium levels in vegetables at bahri area are higher than Omdurman and Khartoum areas) but it not reached the toxicity limit. This due to use Fertilizers with super phosphate. Beside bahri area it in srounded with many factories due to the Economical activity in the area.

3.2 Concentration of lead in food

-Lead concentrations in vegetables ranged (0.510 to 0. 608ppm, 0.511to 0.614 ppm, 0.511 to 0.815 ppm in Omdurman, Bahri, Khartoum respectively. In fruits ranged (0.287 to 0.335ppm, 0.276to0.405 ppm 0.239to 0.421ppm in Omdurman, Bahri, Khartoum respectively. In Cereals ranged (0.266 to0.656 ppm, 0.299 to 0.369ppm, 0. 300 to 0.680ppm in Omdurman, Bahri, Khartoum respectively. In meat ranged (0.295to0.327 ppm, 0.299 to 0.369 ppm, 0.296to0.390 ppm in Omdurman, Bahri, Khartoum respectively. And in milk ranged (0.329 ppm, 0.349ppm, 0.339 ppm in Omdurman, Bahri, Khartoum respectively. From these results, the mean concentrations of lead within World health Organization.

4. Tables and figures

Table 1: concentration of cadmium and lead in Omdurman

Sample	Sample Number	Concentration of cadmium(mg l^{-1})	Concentration of lead(mg l^{-1})
vegetables	A1	0.050	0.534
	A2	0.040	0.510
	A3	0.059	0.608
fruits	A5	0.052	0.335
	A6	0.039	0.317
	A7	0.028	0.287
legumes	A10	0.0661	0.656
	A2	0.060	0.273
	A9	0.0594	0.266
Meat	AM1	0.006	0. 330
	AM11	0. 013	0. 338
	AM2	0.026	0.327
	AM22	0.055	0.317
	AM3	0.026	0.291
	AM33	0.038	0.295
Milk	A4	0.028	0.329

Key: AM1-fish, AM11-chicken, AM2, A M22-beaf, AM3, AM33-lamp, A10-bean, A2-lentils, A9-chickpeas, A5-banana, A6-orange, A9-guava, A1-tomatoes, A2-potatoes, A3-lettuce

Table 2: concentration of cadmium and lead in Bahri

location	Sample Number	Concentration of cadmium(mg l^{-1})	Concentration of lead(mg l^{-1})
vegetables	B1	0.089	0.511
	B2	0.076	0.530
	B3	0.056	0.592
fruits	B5	0.058	0.410
	B6	0.0442	0.373
	B7	0.0312	0.276
legumes	B10	0.0631	0.678
	B2	0.0691	0.299
	B9	0.0649	0.298
Meat	BM1	0.007	0. 390
	BM11	0. 021	0. 350
	BM2	0.029	0.345
	BM22	0.045	0.369
	BM3	0.033	0.319
	BM33	0.043	0.299
Milk	B4	0.027	0. 349

Key: BM1-fish, BM11-chicken, BM2, BM22-beaf, BM3, BM33-lamp, B10-bean, B2-lentils, B9-chickpeas, B5-banana, B6-orange,

B9-guava, B1-tomatoes, B2-potatoes, B3-lettuce

Table 3: concentration of cadmium and lead in Khartoum

location	Sample Number	Concentration of cadmium(mg l^{-1})	Concentration of lead(mg l^{-1})
vegetables	K1	0.145	0.815
	K2	0.051	0.526
	K3	0.089	0.511
fruits	K5	0.059	0.421
	K6	0.0405	0.345
	K7	0.0315	0.239
legumes	K10	0.0683	0.680
	K2	0.0712	0.317
	K9	0.0687	0.300
Meat	KM1	0.0069	0. 357
	KM11	0. 026	0. 382
	KM2	0.0310	0.341
	KM22	0.0415	0.390
	KM3	0.039	0.338
	KM33	0.046	0.296
Milk	K4	0.00311	0. 339

Key: KM1-fish, KM11-chicken, KM2, KM22-beaf, KM3, KM33-lamp, K10-bean, K2-lentils, K9-chickpeas, K5-banana, K6-orange, K9-guava, K1-tomatoes, K2-potatoes, K3-lettuce

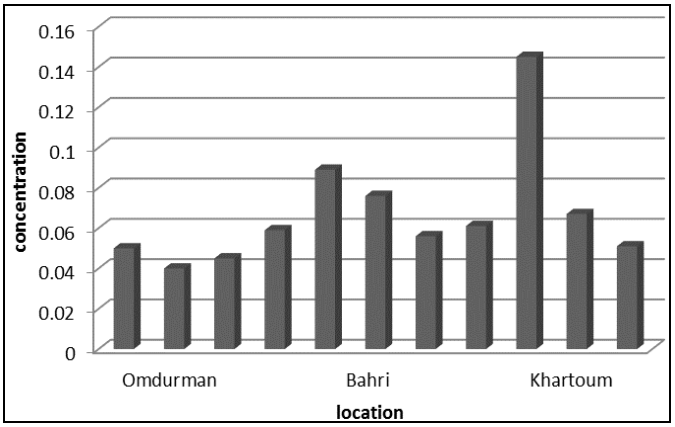

Fig 1: concentration of cadmium in vegetables for Khartoum state

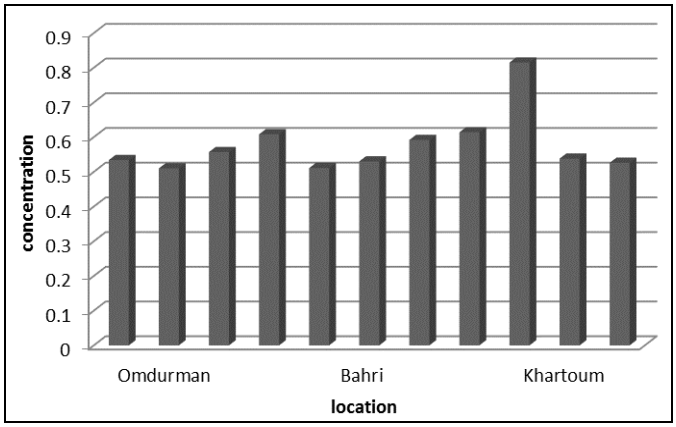

Fig 2: concentration of lead in vegetables for Khartoum state

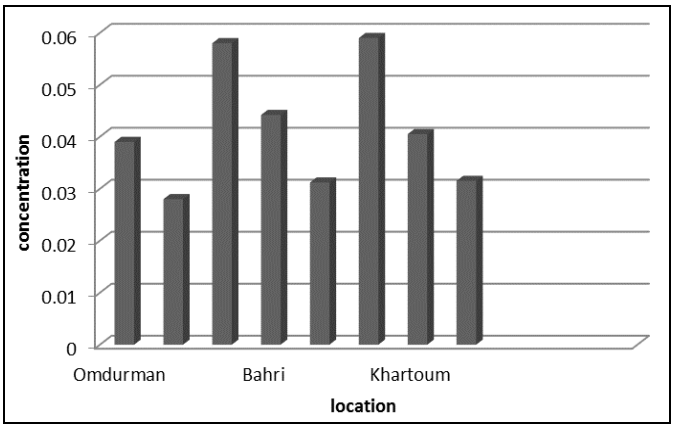

Fig 3: concentration of cadmium in Fruits for Khartoum state

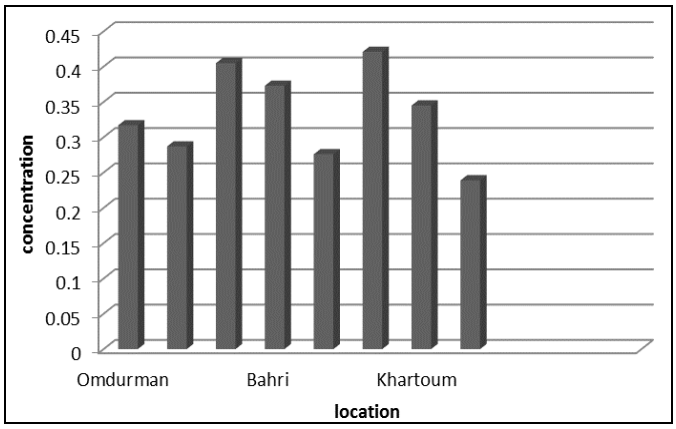

Fig 4: concentration of lead in Fruits for Khartoum state:

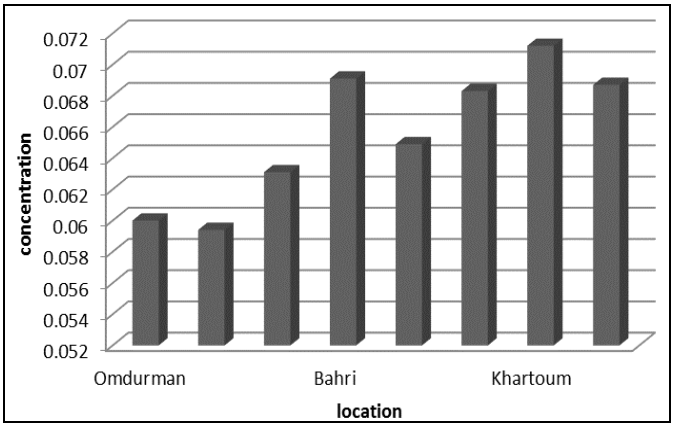

Fig 5: concentration of cadmium in legumes for Khartoum state

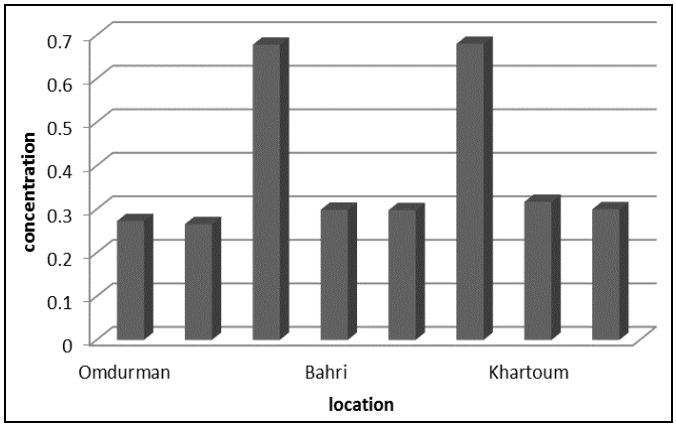

Fig 6: concentration of lead in legumes for Khartoum state

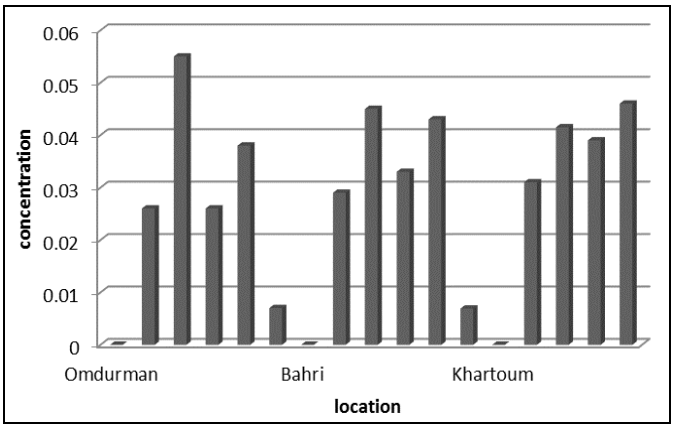

Fig 7: concentration of cadmium in Meat for Khartoum state

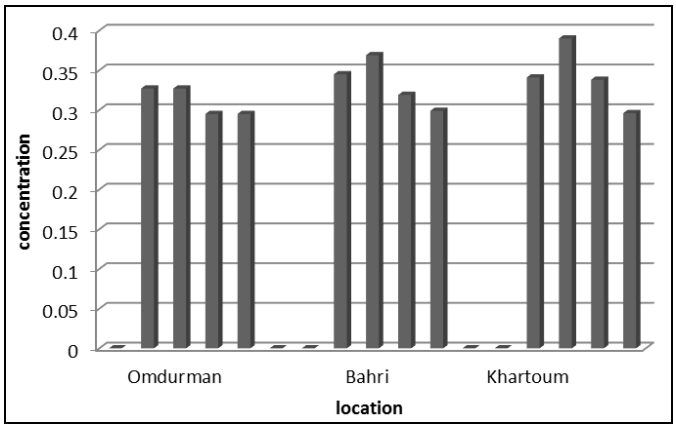

Fig 8: concentration of lead in Meat for Khartoum state

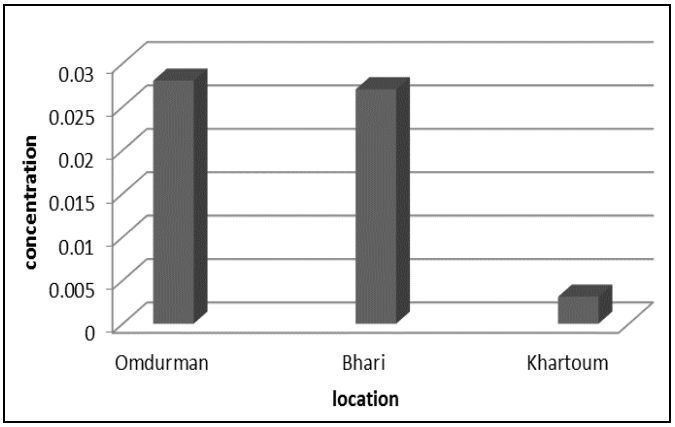

Fig 9: concentration of cadmium in Milk for Khartoum state

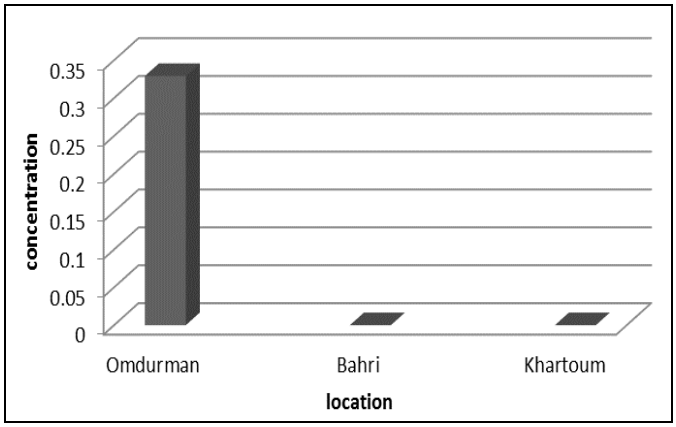

Fig 10: concentration of lead in Milk for Khartoum state

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