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Detection Of Some Heavy Metals In Nile-Delta Water Beds And Their Hygienic Significance

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Abstract:

This study was conducted to assess the levels of some heavy metals (copper, lead, cadmium and chromium) in water and sediments of Ismailia canal, El-Bagoria canal and Drainage No. 1, and their accumulated effects in tilapia fish and berseem plant and its implication on both human and animal health. The highest copper values were detected at Ismailia canal where its level reaches 0.32mg/l at 1st site, while the lowest copper values were detected in all sites of Drainage No.1. Low concentrations of Cu were found in muscles while, the highest concentrations were found in liver. The highest level of Pb was detected at 3rd site of Ismailia canal where it reached 7.72 and 1.25 µg /g in liver and muscles tissues, respectively. While the Pb was not detected totally in liver tissue, in 3rd site of El-Bagoria canal and in muscles tissues in 1st site of Drainage No.1. It could be also noticed that the highest level of Cd in berseem was (0.65 mg/kg) detected in 2nd site of El-Bagoria canal, while Cd level was not detected in all sites of Drainage No.1.It is recommended from this study that the areas of heavy pollution along the River Nile should be under control to prevent access to the water with increasing frequency of cleaning of the canals, minimizing the rate of obstruction of the canals; public awareness should be applied to prevent unhygienic practices, which imposes a major health risk. Avoid fish market from polluted areas.

Key words: heavy metals, tilapia fish, Oreochromis niloticus, berseem, River Nile

Introduction

Sources of water pollution are categorized into 4 groups: domestic water pollution, industrial water pollution, agriculture water pollution and shipping water pollution **(Vesilind et al., 1990).** Pollution of the environment with toxic metals has increased dramatically since the onset of the industrial revolution **(Nriagu 1979)**. Industrial effluents as well as agriculture and domestic sewages constitute a real threat to the aquatic ecosystem of River Nile **(El-Bouraie et al., 2010)**.Pollution of the aquatic environment by inorganic chemicals has been considering a major threat to the aquatic organisms including fishes. The agricultural drainage water containing pesticides, fertilizers, and effluents of industrial activities and runoffs in addition to sewage effluents supply the water bodies and sediment with huge quantities of inorganic anions and heavy metals **(ECDG, 2002)**. The most anthropogenic sources of metals are industrial, petroleum contamination and sewage disposal **(Santos et al., 2005).** Heavy metals are among the most common environmental pollutants, and their occurence in water and biota indicate the presence of natural or anthropogenic sources. The main natural sources of metals in waters are chemical weathering of minerals and soil leaching. The anthropogenic sources are associated mainly with industrial and domestic effluents, urban storm, water runoff, and landfill, mining of coal and ore, atmospheric sources and inputs rural areas **(Kabata- Pendias and Pendias 1992; Biney et al.,1994; Zarazua et al., 2006)**. Also heavy metals contamination usually results from anthropogenic activities such as mining, smelting and mineral processing, metalliferous electroplating, internal combustion engine operating, energy and fuel production **(Kim et al., 2003)**. Environmentally hazardous matters have been emitting into the atmosphere from factories, building heating systems and motor vehicles using fossil fuels. The effect of air containing hazardous matter varies with chimney height, climatic factors, topographic layout and wind direction and speed **(Dursun and Soyleyici 2001)**. The present work aimed to investigate the levels of some heavy metals (Cu, Pb, Cd and Cr) in the water and sediment and their bioaccumulating effect in fish organs of Nile Tilapia (Oreochromisniloticus) and berseem plant in the River Nile ducts in Delta Egypt.

Materials and Methods: For determination of heavy metals in Nile river beds in Delta area , water, sediment, berseem plant & fish samples were collected during the period from December (2012) to May (2013)

Sampling area: The Nile River ducts 1) Ismailia Canal.

2) El-Bagoria Canal
3) Drainage Number "1"

Canal	1st. site	2nd. site	3rd. site
(I)IsmailiaCanal	Mahadet ElGayish - Elkhasoos – Kalyobia located beside Cairo ring road	Basatein Barakat - Belbais – Sharkia (away from the 1st site by 65 km)	Om Azzam Village - Elkasassin – Ismailia (away from the 2nd site by 50 km)
(II)El-Bagoria Canal	El-Ghonimaia village- El-Bagour- El-Monofia	Dalgamoon- Kafr El-Zayat – El-Gharbia	Mahalet Abu Ali- Dassouk- Kafr El-Sheikh
(III)Drainage Number One	Samanoud -El-Gharbia	Dekerness – El-Dakahlia	El-Rekabia - Damietta

Sampling and sample preparation

Water, sediment, tilapia fish as well as berseem samples were collected from the sampling sites.

Water Samples:

A total of 9 samples were collected from each of the study area. Water samples were taken at different sites by a PVC tube column sampler at depth of half meter from the water surface.

The sampling bottles were pre-conditioned with 5% nitric acid and then rinsed thoroughly with distilled de-ionized water. At each sampling site, the polyethylene sampling bottles were rinsed at least three times before sampling was done. Pre-cleaned polyethylene sampling bottles were immersed about 10 cm below the water surface. About 1 L of the water samples were taken at each sampling site. Samples were acidified with 10% nitric acid, to place in an ice bath and brought to the laboratory. The samples were filtered through a 0.45 µm micro pore membrane filter and kept at 4 ° C until analysis. The samples were analyzed directly.

Determination of heavy metals in water samples

Dry Ashing method used to prepare the water samples then Copper, Cadmium, Chromium and Lead in water were determined by using atomic absorption spectrophotometry (Unicam 969) at Soils and Water Department – Faculty of Agriculture – Cairo University according to the method described by **(APHA et al 1989)**

Determination of heavy metals in sediment samples

Sediment samples analysis were carried out according to the procedures described by **(Binning and Baird, 2001)** as follow:A total of 9 sediment samples were collected using grab sampler from Sampling Sites.Samples were transported to the laboratory and air-dried in the laboratory at room temperature. Once air-dried, sediment samples were powdered and passed through 160 µm sieve. The samples packed in polyethylene bags and stored below – 20°C prior to analysis.

Sediments samples were weighed placed into the digestion bombs with 10 mL of HNO_3/HCl (1:3 v/v) and digested in a microwave digestion systemand Copper, Cadmium, Chromium and Lead in sediment samples were determined by using atomic absorption spectrophotometry (Unicam 969) at Soils and Water Department – Faculty of Agriculture – Cairo University.

Determination of heavy metals in Liver and Muscle of tilapia Fish

Sampling

A total of 27 different sized Nile tilapia (Oreochromis niloticus) samples were collected from the studied sites. Fish samples were transported in icebox to the laboratory, where sorted (muscle tissues or liver organ) and investigated.

Preparation of Fish sample (Dry Ashing)

Dry Ashing method used to prepare both the liver and muscle samples.

Copper, Cadmium, Chromium and Lead in liver and muscle of tilapia fish were determined by using atomic absorption spectrophotometry (Unicam 969) at Soils and Water Department – Faculty of Agriculture – Cairo University, according to method described by **(Pearson 1976).**

Determination of heavy metals in berseem samples

Dry Ashing method used to prepare the berseem samples.

Copper, Cadmium, Chromium and Lead in berseem plant were determined by using atomic absorption spectrophotometry (Unicam 969) at Soils and Water Department – Faculty of Agriculture – Cairo University, according to method described by **(Kalra 1998)**

Results

I- Assessment of heavy metals concentration in different water, sediment and berseem samples:

Table (1):- Average levels of heavy metals in different water, sediment & berseem samples (mg/l for water & mg/kg for sediment and berseem).

Sample	Heavy Metal	Ismailia canal			El-Bagoria canal			Drainage No. 1		
		1st site	2nd site	3rd site	1st site	2nd site	3rd site	1st site	2nd site	3rd site
water	Cu	0.32	0.12	0.25	0.06	0.07	0.1	0.05	·0.01	0.00
	Pb	1.11	2.7	2.32	0.25	0.00	0.35	0.05	0.00	0.38
	Cd	0.02	0.01	0.01	0.07	0.06	0.07	0.02	0.06	0.01
	Cr	0.23	0.27	0.35	0.7	0.31	0.52	0.23	0.14	0.00
Sediment	Cu	2.68	3.15	3.47	29.33	38.93	45.33	58.28	48.17	38.76
	Pb	22.26	21.88	19.13	10.58	16.82	22.27	0.00	7.00	0.00
	Cd	0.02	0.00	0.27	0.48	0.00	0.00	0.00	0.45	0.00
	Cr	8.38	10.74	7.1	112.5	117.5	112.14	79	294	92
Berseem	Cu	2.33	2.67	7.22	7.8	0.61	4.46	5.24	9.56	6.93
	Pb	1.35	2.76	4.29	2.23	1.55	1.51	0.00	0.7	1.68
	Cd	0.05	0.13	0.16	0.56	0.65	0.52	0.00	0.00	0.00
	Cr	0.55	0.4	1.11	1.35	0.02	0.28	0.00	0.00	0.00

II- Assessment of heavy metals concentrations in both liver and muscle tissues of Nile Tilapia (Oreochromis niloticus)

Table (2): Average levels of heavy metals in both liver and muscle samples of tilapia (Oreochromis niloticus) (µg /g):

			Ismailia canal			El-Bagoria Canal			Drainage No. 1		
			1st Site	2nd Site	3rd Site	1st Site	2nd Site	3rd Site	1st Site	2nd Site	3rd Site
Copper	Liver	1st Sample	49.566	89.616	24.568	8.729	17.448	12.194	11.196	8.408	7.748
		2nd Sample	33.949	118.71	91.846	7.17	11.03	2.643	11.356	15.8	5.102
		3rd Sample	23.769	26.293	34.769	2.115	37.101	2.089	8.812	18.96	12.008
		Average	35.76	78.2	50.39	6.01	21.86	5.64	10.45	14.39	8.29
	Muscles	1st Sample	0.8596	1.4318	0.9146	‘0.8378	0.86	1.0222	0.5356	1.0422	0.472
		2nd Sample	0.3968	1.5182	1.0116	1.6656	1.1792	1.0228	0.5042	0.7356	0.3858
		3rd Sample	1.5218	1.5182	0.7154	2.0294	0.6884	0.874	0.9682	0.6146	0.4126
		Average	0.93	1.73	0.88	1.51	0.91	0.97	0.67	0.80	0.42
Lead	Liver	1st Sample	1.42	2.432	4.287	0.052	1.128	0.00	8.176	0.00	4.302
		2nd Sample	5.17	5.234	12.718	2.256	0.007	0.00	0.00	2.512	0.208
		3rd Sample	5.136	10.02	6.142	0.00	1.116	0.00	4.316	0.00	0.00
		Average	3.91	5.9	7.72	0.77	0.75	0.00	4.16	0.84	1.5
	Muscles	1st Sample	0.00	0.2238	1.6484	0.7832	0.00	0.00	0.00	0.00	0.00
		2nd Sample	0.0962	1.4186	1.4616	0.00	0.00	0.00	0.00	0.1652	0.4102
		3rd Sample	1.689	1.481	0.6256	0.9136	0.3529	0.638	0.00	0.00	0.1192
		Average	0.6	1.04	1.25	0.57	0.13	0.21	0.00	0.06	0.18
Cadmium	Liver	1st Sample	0.092	0.336	0.406	1.288	1.289	2.413	0.236	0.00	0.00
		2nd Sample	0.276	0.663	0.356	2.197	2.058	1.245	0.00	0.282	0.1
		3rd Sample	0.115	0.378	0.381	1.159	1.702	1.254	0.00.	0.00	0.576
		Average	0.16	0.46	0.38	1.55	1.68	1.64	0.08	0.09	0.23
	Muscles	1st Sample	0.0142	0.0454	0.1054	0.261	0.4116	0.4766	0.0268	0.00	0.00
		2nd Sample	0.0102	0.0324	0.1016	0.4654	0.2306	0.486	0.00	0.00	0.027
		3rd Sample	0.0268	0.091	0.079	0.2662	0.3108	0.1214	0.0042	0.001	0.00
		Average	0.02	0.06	0.1	0.33	0.32	0.36	0.01	0.003	0.01
Chromium	Liver	1st Sample	0.00	5.975	3.362	0.00	0.328	0.00	0.00	0.00	0.00
		2nd Sample	0.565	2.082	2.906	0.00	0.074	0.592	6.234	1.462	0.00
		3rd Sample	1.38	2.412	4.054	0.00	0.5	0.263	0.00	4.61	0.00
		Average	0.65	3.49	3.44	0	0.3	0.29	2.01	2.02	0
	Muscles	1st Sample	0.1124	0.4136	0.539	3.6	0.1328	0.00	0.538	1.522	0.00
		2nd Sample	0.2842	0.5532	0.5488	0.00	0.00	0.00	0.00	0.186	0.00
		3rd Sample	0.587	0.8512	0.243	0.0276	0.253	0.1342	0.00	0.00	0.00
		Average	0.33	0.61	0.44	1.21	0.13	0.05	0.18	0.57	0

Discussion

(I) Detection of Heavy metals in water samples:1) Copper

The highest copper values were detected at Ismailia canal where its level reached 0.32mg/l at 1st site, while the lowest copper values were detected in all sites of Drainage No.1. (Table 1).The results of average concentration of copper were nearly close to those recorded by **(Elmaci et al., 2007)** where they found that Cu level recorded 0.14mg/l.

Current results were lower than those recorded by **(El-Dahshan 2004;El-Shehawi et al.,2007).** However, our results were higher than those recorded by **(Saeed and Shaker 2008andEl-Bouraie et al.,2010)**. The increase in copper values in water may be due to agriculture run-off where copper is still used in manufacturing of pesticides, or may be due to human activities and waste disposal **(Chapman, 1997). 2) Lead**

Table (1) showing that the highest level of Pb was 2.7 mg/l detected in 2nd site of Ismailia canal, while the Pb was not detected totally in the other 2 sites, 2nd site of El-Bagoria canal as well as the 2nd site of Drainage No.1.These results for Pb concentrations in Ismailia canal were higher than those detected by **(Moustafa et al.,2011)** for the same canal.

The average concentrations of Pb in all sites of Ismailia canal exceeded the permissible guide line value recommended by **WHO, 2011** (0.01 mg/l), and that matching with the results recorded by **(Abou Salem et al.,1992)**. These results of Pb were similar to those reported by **(Medani and Ahmed 1999)**; and lower than those determined by **(El-Shehawi etal.,2007).** However they were higher than those reported by **Saeed and Shaker 2008; El-Bouraie et al.,2010)**where the recorded was 0.09 andn 0.057 mg/l value for Pb respectively.

3) Cadmium

Table (1) showing that the highest level of Cd was (0.07 mg/l) detected in 1st and 3rd site of El-Bagoria canal, while the lowest level was 0.01 mg/l in 3 sites; 2nd and 3rd site of Ismailia canal as well as the 3rd site of Drainage number "1"

The results for average concentrations of Cd were similar to those estimated by **(Saeed and Shaker 2008; Bahnasaw et al.,2011)**, and were lower than those detected by **(El-Kattan and Nahla 2008; Iqbal et al.,2011)** or**(Salah El-Dine 2011).** While they were higher than those recorded by **(Moustafa et al.,2011).** All the results of Cadmium concentration in the water samples exceeded the permissible guideline value (0.003 mg/l) for Cd which was reported by **(WHO 2011)**. These results are matching with those recorded by **(Abou Salem et al.,1992)** and**(Khalaf Allah 1998).**

4) Chromium

Table (1) showing that the highest level of Cr was (0.7 mg/l) detected in 1st of El-Bagoria canal, while the lowest Cr levels detected was 0.14 mg/l in 2nd site of Drainage number "1"and not detected in 3rd site of Drainage number "1".

As shown in same table the average levels of Cr in El-Bagoria canal was the highest one between the three studied canals while Drainage number "1" recorded the lowest concentration for Cr. The results of average Cr concentrations were nearly close to that detected by **(El-Bouraie et al.,2010)**. The results for average Cr concentrations in different water samples of all studied sites of River Nile in delta region exceeded the permissible guide line values recommended by **WHO, 2011**(0.05 mg/l), except 3rd site of Drainage number "1" where the levels of Cr was nil.

(II) Detection of Heavy metals in sediment samples.

1) Copper

The average copper values in different sediment samples collected from different sites along Ismailia canal ranged from 2.68 mg/kg at 1st site to 3.47 mg/kg at 3rd site and was 3.15 mg/kg at 2nd site of Ismailia canal. The average copper values in different sediment samples collected from different sites along El-Bagoria canal were 29.33, 38.93 and 45.33 mg/kg at 1st, 2nd and 3rd sites, respectively. Drainage number "1" recorded the highest copper value in the 3 studied sites where its level was 58.28, 48.17 and 38.76 mg/kg in 1st, 2nd and 3rd sites, respectively (table no.2).

The results of average concentration of copper were similar to those reported by **(El-Bouraie et al.,2010)**; who reported that the range of Cu concentration was from 11.8 to 60.20 mg/kg. Our results were nearly close to those recorded by **(Saeed and Shaker2008)**. Our results were higher than those recorded by **(Binning and Baird 2001;Onder et al., 2007).** However, our results were lower than those recorded by **(Malik et al., 2010; Zhang et al., 2014).**

2) Lead

Table (1): is showing that the highest level of Pb was (22.27 mg/kg) in 3rd site of El-Bagoria canal, while the Pb was not detected totally in the 1st site and 3rd sites of Drainage No. 1. The average concentrations of Pb in different sediment samples collected from different sites along Ismailia canal, El-Bagoria canal and Drainage No.1 were (22.26, 21.88 and 19.13), (10.58, 16.82 and 22.27) and (0.00, 7 and 0.00) mg/kg in 1st, 2nd and 3rd sites, respectively.

These results of Pb are similar to those reported by **(Abdel-Moati and El-Sammak 1997)** or**(Malik et al.,2010)**, while they are higher than those reported by **(Essa and Faragallah 2006; Onder et al., (2007)**. And lower than those recorded by **(El-Bouraie et al., 2010; Zhang et al., 2014)**.

3) Cadmium

Table (1) also shows that the highest level of Cd was (0.48 mg/kg) detected in 1st site of El-Bagoria canal, while the lowest level was 0.02 in 1st site of Ismailia canal and it was not detected in 2nd site of Ismailia canal, 2nd& 3rd sites of El-Bagoria canal and 1st& 3rd sites of Drainage No.1.

The results for average concentrations of Cd were similar to those estimated by **(Buszewski et al., 2000)** and were lower than those detected by**(El-Bouraie et al., 2010; Zhang et al., 2014)**, while they were higher than those recorded by **(Onder et al., 2007)**. Cadmium as a pollutant in phosphate fertilizers **(Järup, 2003)**, is added to land through normal farming practice **(Martelli et al., 2006)**.

4) Chromium

Table (1) shows that the highest levels of Cr were (294mg/kg) detected in 2nd site of Drainage No.1, while the lowest level was 7.1 mg/kg in 3rd site of Ismailia canal. From the same table, we can notice that the average levels of Cr in Drainage No.1 were the highest one between the three studied canals, while Ismailia canal recorded the lowest concentrations for Cr.

The results of average Cr concentrations were nearly close to those detected by **(El-Bouraie et al.,2010)**. The results for average concentrations of Cr were higher than those detected by **(Binning and Baird 2001)**or**(Onder et al., 2007)**, while they lower than those recorded by **(Malik et al., 2010)**. The presence of Cr in soaps and detergents used for washing and bathing in the river could be responsible for Cr highest level in water and sediment **(All et al., 2005)**.

(III) Detection of Heavy metals in Berseem samples.1) Copper

It can be noticed from table no.7 that the highest copper values were detected at 2nd site of Drainage No.1 where its level reached 9.56 mg/kg, while the lowest copper values were 0.61 mg/kg which detected in 2nd site of El-Bagoria canal.

The results of average concentration of copper in berseem plant were nearly close to those recorded by **(Onder et al., 2007)** andwere lower than those recorded by **(Malik et al., 2010; Zhang et al., 2014)**. However, our results were higher than those recorded by **(Osma et al., 2011; Rapheal and Adebayo 2011)** or **(Liao et al., 2013)**.

All the results of copper concentration in the berseem plant samples are below the permissible guideline recommended by **(WHO, 1996)** (10 mg/kg), while **(Kabata- Pendias and Pendias 2001)** recorded that the acceptable limit of Cu in plant is 15- 20 ppm.

2) Lead

The highest level of Pb was (4.29 mg/kg) detected in 3rd site of Ismailia canal, while the lowest level was 0.7 mg/kg in 2nd site of Drainage No. 1 and the lead was not detected at 1st site of Drainage No.1

These results were nearly close to those estimated by **(Shad Ali Khan et al., 2008)** or **(Iqbal et al., 2011)**, while they were higher than those recorded by **(Bytyqi and Sherifi 2010; Liang et al., 2011)** or **(Rapheal and Adebayo 2011)**. However, our results were lower than those recorded by **(Osma et al., 2011; Liao et al., 2013)** or **(Zhang et al., 2014)**.

Majority of the results of lead concentration in the berseem plant samples are below the permissible guideline value which recommended by **(WHO, 1996)** (2 mg/kg); also **(Allen 1989)** mentioned that the acceptable level of Pb is 3 ppm for most plants.

3) Cadmium

The highest level of Cd was (0.65 mg/kg) detected in 2nd site of El-Bagoria canal, while Cd level was not detected in all sites of Drainage No.1. The average concentrations of Cd in different berseem plant samples collected from different sites along lands irrigated by Ismailia canal were (0.05), (0.13) and (0.16) mg/kg in 1st, 2nd and 3rd sites of Ismailia canal, respectively.

The results for average concentrations of Cd were nearly close to those estimated by **(Osma et al., 2011)** and were lower than those detected by **(Iqbal et al., 2011; Liao et al., 2013)** or **(Zhang et al., 2014)**. However, they were higher than those recorded by **(Onder et al., 2007; Liang et al., 2011)** or **(Rapheal and Adebayo 2011)**.

Our results of cadmium concentration in the berseem plant samples in both Ismailia canal and

El-Bagoria canal are exceed the permissible guide line value recommended by **(WHO, 1996)** (0.02 mg/kg).

4) Chromium

It can be noticed that the highest level of Cr was (1.35 mg/kg) detected in 1st site of El-Bagoria canal, while the lowest level of Cr was detected in all sites of Drainage No.1 The results of average Cr concentrations were nearly close to those detected by **(Iqbal et al., 2011)**, while they were higher than those detected by **(Shad Ali Khan et al., 2008)**, and they were lower than those recorded by **(Liang et al., 2011; Osma et al., 2011)** or **(Liao et al., 2013)**.

The results of Cr concentration in the berseem plant samples are below the permissible guide line value recommended by **(WHO, 1996)** (1.3 mg/kg), except the 1st site of El-Bagoria canal was higher.

The concentration of heavy metals in the tested berseem plant samples could originate from atmospheric deposition as well as transfer from soil which contains another source of heavy metals contaminants such as phosphate fertilizers and that explain the reason of absence or lowering of heavy metals in irrigation water analyzed. So there is no contribution of water in the presence of heavy metal in alfalfa **(Rapheal and Adebayo, 2011)**.

(IV) Detection of Heavy metals in both liver and muscles tissues of Nile Tilapia samples

1) Copper. Table (2) describes the average levels of copper in both liver and muscles samples of tilapia fish collected from different sites of Ismailia canal, El-Bagoria canal and Drainage No. 1

The highest copper values were detected at Ismailia canal where the level in liver samples reaches 78.2 μg /g at 2nd site and 1.73 μg /g in muscles tissue at the same site, while the lowest copper values were 5.64 μg /g in liver samples at 3rd site of El-Bagoria canal and 0.42 μg /g in muscles samples at 3rd site of Drainage No. 1. From the same table, it can be noticed that the average copper values in different liver tissue of tilapia fish samples collected from different sites along Ismailia canal ranged from 35.76 μg /g at 1st site to 78.2 μg /g at 2nd site, and 50.39 μg /g at 3rd site of Ismailia canal. The average copper values in different muscles tissue were 0.93, 1.73 and 0.88 μg /g at 1st, 2nd and 3rd site, respectively in Ismailia canal.

The results of average concentration of copper were nearly close to those reported by **(Abdel-Kader et al., 1993; Zaki 1994)**. Our results were lower than those recorded by **(Saeed and Shaker 2008; Bahnasawy et al., 2011)**. However, our results were higher than those recorded by **(Abou Salem et al., 1992; El-Moselhy (1999)**. Low concentrations of Cu were found in muscles while the highest concentrations were found in liver, which matching with results recorded by **(Abu Helal and Ismail, 2008)**.

2) Lead

The highest level of Pb was detected at 3rd site of Ismailia canal where it reaches 7.72 and 1.25 μg /g in liver and muscles tissues, respectively. While the Pb was not detected totally in liver tissue in 3rd site of El-Bagoria canal and in muscles tissues in 1st site of Drainage No.1 (table 4).

The average concentrations of Pb in different liver tissue samples of tilapia fish collected from different sites along Ismailia canal were 3.91, 5.9 and 7.72 μg /g in 1st, 2nd and 3rd sites, respectively. The average concentration of Pb in muscles tissues were 0.6, 1.04 and 1.25 μg /g in 1st, 2nd and 3rd sites, respectively.

These results of Pb are similar to those reported by **(Seddek et al.,1996)**; and are nearly close to those determined by **(El-Kattan and Nahla 2008)**. Our results are higher than those reported by **(El-Safy 1996; Moselhy 1999)**. Our results are lower than those recorded by **(Saeed and Shaker 2008; Bahnasawy et al., 2011)**.

Our results for average Pb concentrations in different fish samples of all studied sites exceed the permissible guideline values (0.5 mg/l) recommended by **(FAO/ WHO 1992)** and (1ppm) recommended by **(E.O.S 2005)**.

3) Cadmium. Table (2) showing that the highest level of Cd was 1.68 μg /g which detected in 2nd site of El-Bagoria canal and was 0.36 μg /g which detected in 3rd site of El-Bagoria canal in liver and muscle tissues, respectively, while the lowest level of Cd was 0.08 μg /g in 1st site of Drainage No.1; and was 0.003 μg /g in 2nd site of Drainage number "1" in liver and muscle tissues, respectively.

The results for average concentrations of Cd were similar to those estimated by **(El-Safy1996)** and were nearly close to those recorded by **(El-Kattan and Nahla 2008)**. While they were lower than those detected by **(Khallaf et al., 1998; Saeed and Shaker 2008)** or **(Bahnasawy et al., 2011)**. However, they were higher than those recorded by **(Moustafa et al.,2011)**.

The average concentrations of Cd in all fish samples were exceed the permissible guideline value (0.1 ppm) and (0.05 ppm) which recommended by **(E.O.S 2005)** and**(WHO, 2011),** respectively; and that matching with the results recorded by **(Abou Salem et al1992).**

4) **Chromium.**Table (2) showing that the highest level of Cr was 3.49 µg /g detected in 2[nd] site of Ismailia canal and was 1.21 µg /g which detected in 1[st] site of El-Bagoria canal in liver and muscle tissues, respectively, Cd was not detected in both 1[st] site of El-Bagoria canal and 3[rd] sites of Drainage No.1; and also was not detected in 3[rd] site of Drainage number "1" either in liver or muscles tissues, respectively.From the same table, we can notice that the average levels of Cr in liver tissue in Ismailia canal was the highest one between the three studied canals, while El-Bagoria canal recorded the lowest concentration for Cr. However, the average levels of Cr in muscles tissue in El-Bagoria canal record the highest concentration

The results of average Cr concentrations were higher than those detected by **(Dirican et al.,2013; Muiruri et al.,2013).** The results for average Cr concentrations in different fish samples of all studied sites of River Nile in delta region were exceed the permissible guide line values which recommended by **(WHO, 1989)**(0.15 ppm), except 3[rd] site of Drainage No.1 where the Cr was not detected.

It is recommended from this study that the areas of heavy pollution along the River Nile should be under control to prevent access to the water with increasing frequency of cleaning of the canals, minimizing the rate of obstruction of the canals; public awareness should be applied to prevent unhygienic practices which impose a major health risk. Avoid fish market from polluted areas.

The government should have applied new laws provides that the factories should not be allowed to dispose their waste water into the River Nile ducts as well as no permission for establishment of new industries on river banks and obliging the big industries to establish their own waste water treatment plants while small industries should be grouped in clusters to establish a common waste water treatment plants. Also elimination of lead from gasoline which used in engines of agriculture machines and different transport means and use of natural gas to decrease lead concentrations in surface water especially on high ways.

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الملخص العربي

الكشف عن بعض المعادن الثقيلة فى مجارى المياه بدلتا النيل و أهميتها الصحية

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تم إجراء هذه الدراسة لتقييم مستويات بعض المعادن الثقيلة (النحاس والرصاص والكادميوم والكروم) في مياه ورواسب كل من ترعة الإسماعيلية و ترعة الباجورية ومصرف رقم واحد، وبيان الأثار المتراكمة لهذة المعادن في سمك البلطي ونبات البرسيم و مدى تأثيرها على صحة الإنسان والحيوان. تم الحصول على أعلى قيم لعنصر النحاس فى الموقع الأول من ترعة الأسماعيلية حيث بلغت 0,32 ملجم/ لتر، بينما اكتشفت أقل قيم لعنصر النحاس فى جميع مواقع مصرف رقم واحد. اقل تركيز لعنصر النحاس فى أنسجة العضلات بينما اعلى وجد فى أنسجة الكبد لسمك البلطى النيلى. اكتشفت أعلى قيم لعنصر الرصاص فى الموقع الثالث لترعة الأسماعيلية حيث بلغت 7,72 ملجم/ لتر فى أنسجة الكبد و 1,25 ملجم/ لتر فى انسجة العضلات لسمك البلطى، بينما لم يتم أكتشاف عنصر الرصاص أطلاقا فى انسجة العضلات فى الموقع الثالث لترعة الباجورية و فى أنسجة العضلات فى الموقع الأول لمصرف رقم واحد. أيضا يمكن ملاحظة ان أعلى مستويات لعنصر الكادميوم فى البرسيم كانت فى الموقع الثانى لترعة الباجورية حيث بلغت 0,65 ملجم/ كجم بينما الكادميوم لم يتم أكتشافه فى جميع مواقع مصرف رقم واحد. توصى نتائج الدراسة الحالية إلى أنه يجب التحكم فى المناطق شديدة التلوث بطول نهر النيل لمنع الوصول للمياه مع تكرار عملية التنظيف للقناة والإقلال من معدل الإنسداد للقنوات، الوعى المجتمعى لمنع الممارسات غير الصحية والتى تمثل خطورة صحية. كذلك تجنب التسوق أو بيع الأسماك من المناطق الملوثة

الكلمات الدالة: المعادن الثقيلة، سمك البلطى، اوريوكروماس نيلوتيكس، البرسيم، نهر النيل.