Egyptian Journal of Aquatic Biology & Fisheries
Zoology Department, Faculty of Science,
Ain Shams University, Cairo, Egypt.
ISSN 1110 - 6131
Vol. 22(5): 309- 321 (2018)
ejabf.journals.ekb.eg

Pathological impacts of environmental toxins on *Oreochromis niloticus* fish inhabiting the water of Damietta branch of the River Nile, Egypt.

Safaa I. Tayel[1], Soaad A. Mahmoud[1], Nasr, A.M. Ahmed[1] and Amina. A.S. Abdel Rahman[2]

1. Aquaculture division, Fish pathology lab, National Institute of Oceanography and Fisheries (NIOF), Cairo, Egypt.

2. Zoology department, Women's College for Arts, Science and Education, Ain Shams University, Cairo, Egypt.

Corresponding author: amina_abdelrahman@women.asu.edu.eg

ARTICLE INFO

Article History:
Received:Aug.2 ,2018
Accepted:Nov., 2018
Available online: Dec.2018

Keywords:
Pathology
Histopathology
Heavy metals
Oreochromis niloticus
River Nile
Damietta branch

ABSTRACT

The present study was carried out at El-Kanater El-Khayria & Talkha stations, Damietta branch of the River Nile. The concentrations of heavy metals (iron, zinc, copper, cadmium and manganese) in water and their accumulations in organs (muscles, gills, liver and kidneys) of *Oreochromis niloticus* fish were determined seasonally during year 2016. Also, the histopathological alterations in the same organs of selected fish samples were studied during the same year. The obtained results showed an increase in heavy metals concentrations in water collected from investigated area and these concentrations followed an abundance of: Fe > Mn > Zn > Cu > Cd. These metals accumulated in some organs of the studied fish and caused histopathological alteration in these studied organs. The histopathological alteration included degeneration, necrosis, edema, hemorrhage, hemolysis, hemosiderin, parasitic forms and hyperplasia in selected organs. Those changes were observed in all studied organs at the two stations during the period of study with severe degree at Talkha station during hot seasons. So, it is necessary to treat the polluted water before its discharging into the Damietta branch to protect fish and human beings from the dangers of pollution.

INTRODUCTION

The River Nile is considered as the life artery of Egypt. It bifurcates north of Cairo into two branches, Rosetta and Damietta embracing the delta in between. The Nile and its two branches subjected to different types of pollutions (Mahmoud and Abd El Rahman, 2017 and Kadry *et al*., 2012).

Heavy metals play an important role in water pollution since they are toxic to aquatic animals and may become a threat to mankind (Tayel and Mahmoud, 2008 & El-Sayed, 2015). The primary source of heavy metals in the River Nile is the discharge of domestic sewage, industrial wastes and washing of herbicides and pesticides of the agricultural land (Saad *et al*., 2012 and Kadry *et al*., 2015). Thus, the ingestion of contaminated fish should receive special attention in order to protect human beings from the dangerous hazards of the different kinds of heavy metals with varying toxicity levels (Tayel *et al*., 2013 and Yacoub *et al*., 2008).

Oreochromis niloticus fish is one of the most important aquatic organisms greatly affected by toxicants in the form of histopathological alterations (Tayel, *et al*., 2014 and Saad *et al.,* 2011). This study aimed to investigate the impact of heavy metals (iron, zinc, copper, cadmium and manganese) concentrations in water and their accumulations in fish organs (muscles, gills, liver and kidneys) on histological structures of these organs.

MATERIALS AND METHODS

Water and fish samples were collected during four seasons of the year 2016 from two stations. The first was El-Kanater El-Khayria city (Qaliubiya-Egypt); this station receives some drainage and agricultural runoff, while the second was from Talkha city (Dakahlia-Egypt). This station receives the hot water from the electrical station and the wastes of Talkha Ammonium Fertilizer Production.

Heavy metals in water

The heavy metals concentrations (iron, zinc, copper, cadmium and manganese) in water were determined using atomic absorption (model Perkin Elmer 3110, USA) with graphite atomizer HGA-600, according to atomic absorption spectrometry (AAS) method described by (APHA, 1998). The results were expressed in μgl^{-1}.

Fish analysis

Samples of the fresh water fish *Oreochromis niloticus* were selected for the present study. They were collected seasonally from El-Kanater El-Khayria and Talkha stations during the period of the year 2014.

Heavy metals in fish organ

Samples of the major organs: muscles, gills, liver and kidneys were collected from the selected fish, *Oreochromis niloticus,* specimens. The accumulations of iron, zinc, copper, cadmium and manganese in those organs were determined using Hitachi model 170–30 with graphite atomizer (G.A.Z) atomic absorption spectrophotometer, according to atomic absorption spectrometry (AAS) method described by (Goldberg *et al.,* 1963). The results were expressed in µg /g dry weight.

Bioaccumulation Factor (BAF): The bioaccumulation factor (BAF) was calculated according to Authman and Abbas, (2007) using the following equation:

Bioaccumulation Factor (BAF) = Pollutant concentration in fish organ (mg/kg)/ pollutant in water (mg/l).

Histological studies

Histopathological studies were carried using selected organs of the studied fish which were collected seasonally. Immediately after dissection of the fish, parts of muscles, gills, liver and kidneys were fixed in 10 % formalin at 4 ^{0}C, dehydrated in ascending grades of alcohol and cleared in xylene. The fixed tissues were embedded in paraffin wax and sectioned into five micrometers thick, then stained with hematoxylin and eosin dyes according to Bernet, (1999).

Statistical analysis

The comparison among means ±SE (standard errors) was tested for significance using one-way ANOVA analysis and Duncan's multiple range tests. The statistical analyses were calculated using the computer program of SPSS Inc. (2001 version 10.0 for Windows) at 0.5 significance level.

RESULTS

Heavy metals concentrations in water

The mean concentrations of the tested metals in water of two studied stations and permissible limits of these metals were presented in Tables 1&2. Metal concentrations in the water of the two studied areas followed an abundance of: Fe > Mn > Zn > Cu > Cd. The minimum values of Fe, Zn, Cu and Mn were recorded during autumn, while the minimum value of Cd was recorded during winter. However, maximum values of Fe, Zn, Mn were recorded during winter, whereas for Cu and Cd, their maximum values were registered during summer. On the other hands, the concentrations of all heavy metals at Talkha were higher than those of El-Kanater El-Khayria during all seasons except cadmium during spring and summer at El-Kanater which were higher than those of Talkha. Talkha station seemed to be more contaminated with heavy metals than El-Kanater El-Khayria station.

Table 1: Seasonal variations of iron, zinc, copper, cadmium and manganese concentrations (µg/l) in water of the investigated areas during year 2016.

Items	Sites	Seasons			
		Winter	Spring	Summer	Autumn
Fe (µg/l)	El-Kanater El-Khayria (I)	472.0±0.8	311.6±0.4	355.0±0. 4	173.0±0. 2
	Talkha (II)	692.0±0.1	94.2±0.07	15.0±0.08	460.0±0. 9
Zn (µg/I)	El-Kanater El-Khayria (I)	72.60±5.5	36.10±1.0	58.70±1.2	28.55±0.5
	Talkha (II)	117.36±1.1	54.40±1.0	81.00±1.5	72.13±1.2
Cu (µg/I)	El-Kanater El-Khayria (I)	12.0±0.3	12.7±0.5	24.0±1.2	4.1±0.8
	Talkha (II)	16.27±1.5	16.87±0.8	46.33±1.1	25.3±1.0
Cd (µg/I)	El-Kanater El-Khayria (I)	0.2±0.01	1.2±0.01	2.0±0.9	0.3±0.08
	Talkha (II)	1.4±0.2	0.93±0.5	0.867±0.5	1.2±0.7
Mn (µg/I)	El-Kanater El-Khayria (I)	133.9± 1.7	23.90±0.9	28.20±1.2	7.30±1.0
	Talkha (II)	138.40±1.9	30.867±1.1	55.2±1.3	19.63±0.7

El-Kanater El-Khayria (I) Talkha (II)

Table 2: Recommended permissible limits of heavy metals in water (µg/l), according to WHO, 1993.

Heavy metals		Present study	Permissible limit
Fe µg/l	Range	173.0±0.02 -692.0±0.1	100 – 1000 µg/l
Zn µg/l	Range	28.55±0.5 -117.36±3.1	100 µg/l
Cu µg/l	Range	4.1±0.8 - 46.33±2.1	100 µg/l
Cd µg/l	Range	0.2±0.01 - 2.0±0.9	2 µg/l
Mn µg/l	Range	7.30±3.0 - 138.40±4.2	5 - 50 µg/l

Fish analysis

Heavy metals accumulations in fish organs:

Tables 3&4 show the accumulations of the analyzed metals in the muscles, gills, liver and kidneys of *Oreochromis niloticus* caught from the two studied stations and the permissible limits of these metals. The highest accumulations of the iron, zinc and copper were observed in the kidneys, while the maximal value of cadmium was noticed in muscle and the highest value of manganese was observed in the gills. The lowest accumulations of iron and zinc were recorded in the muscle, whereas the minimal values of copper and manganese were observed in the liver, while the minimal value of cadmium was shown in kidneys. Also, the maximal values of studied metals were recorded at Talkha station during hot seasons (summer & spring), while the minimal values of these metals were recorded at El-Kanater El-Khayria station during cold seasons (winter & autumn) except for copper, where its minimal values observed during summer.

Table 3: Seasonal variations of iron, zinc, copper, cadmium and manganese accumulations (µg/g dry wt.) in fish organs obtained from investigated areas during year 2016.

Organs	Site	Seasons																			
		Winter					Spring					Summer					Autumn				
		Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn
Muscles	I	76± 1.5	25.85 ±1.7	15.7 ±0.6	3.7 ±0.2	34.7 ±0.4	103.1 5±1.5	27.95 ±0.5	13.4 ±0.2	3.6 ±0.3	27.3 ±1.4	78.7 ±1.0	66.5 ±0.8	7.8 ±0.4	2.6 ±0.2	20.8 ±1.1	82.2 ±1.1	36.2 ±1.2	13.0 ±0.5	4.2 ±0.1	23.0 ±1.2
	II	130.5 ±1.2	44.9 ±1.2	22.5 ±0.7	8.0 ±0.2	75.2 ±1.1	145.3 ±1.0	49.9 ±0.5	16.4 ±0.5	12.0 ±0.1	37.2 ±0.8	210.0 ±1.9	41.3 ±0.8	10.2 ±0.4	14.7 ±0.3	30.5 ±0.9	250.0 ±1.5	67.5 ±0.9	25.3 ±0.8	11.5 ±0.3	41.2 ±1.0
Gills	I	197.9 ±1.0	63.8 ±1.5	12.2 ±0.4	2.0 ±0.09	38.9 ±1.2	289.1 ±1.3	65.1 ±0.3	10.2 ±0.2	2.3 ±0.1	28.6 ±1.6	280.8 ±1.6	87.4 ±0.8	11.7 ±0.3	2.7 ±0.1	28.1 ±1.6	210.4 ±1.5	65.4 ±1.1	9.7 ±0.3	2.1 ±0.08	13.4 ±0.8
	II	230.0 ±1.0	98.0 ±0.9	28.5 ±1.4	3.5 ±0.5	61.4 ±0.6	402.9 ±1.2	86.1 ±0.5	22.5 ±1.1	3.6 ±0.3	143.5 ±1.5	324.5 ±1.5	82.9 ±1.1	25.3 ±1.3	6.2 ±0.2	78.4 ±0.8	396.4 ±1.9	104.6 ±1.2	22.5 ±1.1	3.8 ±0.1	92.5 ±1.2
Liver	I	260.0 ±1.0	85.7 ±1.1	2.1 ±0.2	1.5 ±0.6	14.3 ±0.5	176.5 5±1.5	68.1 ±0.7	9.0 ±0.4	1.3 ±0.5	17.6 ±1.1	261.1 ±1.0	87.4 ±0.5	5.0 ±0.2	1.2 ±0.4	16.6 ±1.5	116.3 ±1.0	59.7 ±0.3	2.2 ±0.1	2.1 ±0.8	7.5 ±1.4
	II	347.3 ±1.5	125.5 ±1.3	15.7 ±0.9	4.5 ±0.8	14.3 ±0.5	443.7 ±1.4	73.3 ±0.2	22.5 ±1.2	5.2 ±0.2	74.6 ±1.5	420.5 ±1.8	91.2 ±0.8	25.3 ±1.3	9.1 ±0.3	34.7 ±1.4	310.0 ±1.9	81.5 ±1.1	28.2 ±1.5	8.2 ±0.5	30.5 ±1.2
Kidney	I	380.9 ±1.9	86.2 ±0.8	27.2 ±0.9	0.4 ±0.1	38.6 ±1.2	405.4 5±1.5	70.4 ±0.5	15.4 ±0.8	0.2 ±0.1	21.2 ±1.1	581.1 ±2.0	127.8 ±0.4	62.2 ±1.5	0.5 ±0.2	78.6 ±1.1	474.5 ±1.1	71.3 ±0.7	6.6 ±0.7	0.9 ±0.2	19.4 ±1.0
	II	398.9 ±1.8	114.8 ±1.4	39.6 ±0.7	2.5 ±0.09	48.5 ±0.7	606.0 ±1.5	81.2 ±0.8	32.5 ±0.8	1.2 ±0.08	55.5 ±1.2	989.9 ±1.0	134.7 ±0.9	86.5 ±1.8	1.4 ±0.1	110.2 ±1.8	603.0 ±1.0	119.0 ±1.2	9.2 ±0.5	2.1 ±0.1	24.5 ±0.5

Table 4: Recommended permissible limits of heavy metals accumulation in organs (µg/g dry wt), according to FAO 1992.

Heavy metals		Present study	Permissible limit
Fe µg/l	Range	76.5±4.5-989.9±1.0	30 µg/g dry wt
Zn µg/l	Range	25.85±1.7 - 134.7±1.4	50 µg/g dry wt.
Cu µg/l	Range	0.0±0.0 - 86.5±1.8	30 µg/g dry wt.
Cd µg/l	Range	0.0±0.014.7±0.3	20 µg/g dry wt.
Mn µg/l	Range	3.9±0.8 - 143.7±1.5	30 µg/g dry wt

Bioaccumulation Factor

Table 5 shows the bioaccumulation factor of analyzed metals in the muscles, gills, liver and kidneys of *Oreochromis niloticus* obtained from the two studied stations during the four seasons. Iron and zinc bioaccumulation factors of selected organs were in the following order: Kidney > Gills > Liver > Muscles. Copper bioaccumulation factor of selected organs was in the following order: Muscles > Kidney > Gills > Liver. Cadmium bioaccumulation factor in selected organs was in the following order: Muscles > Liver > Gills > Kidney. Manganese bioaccumulation factor of selected organs was in the following order: Gills > Muscles > Kidney > Liver.

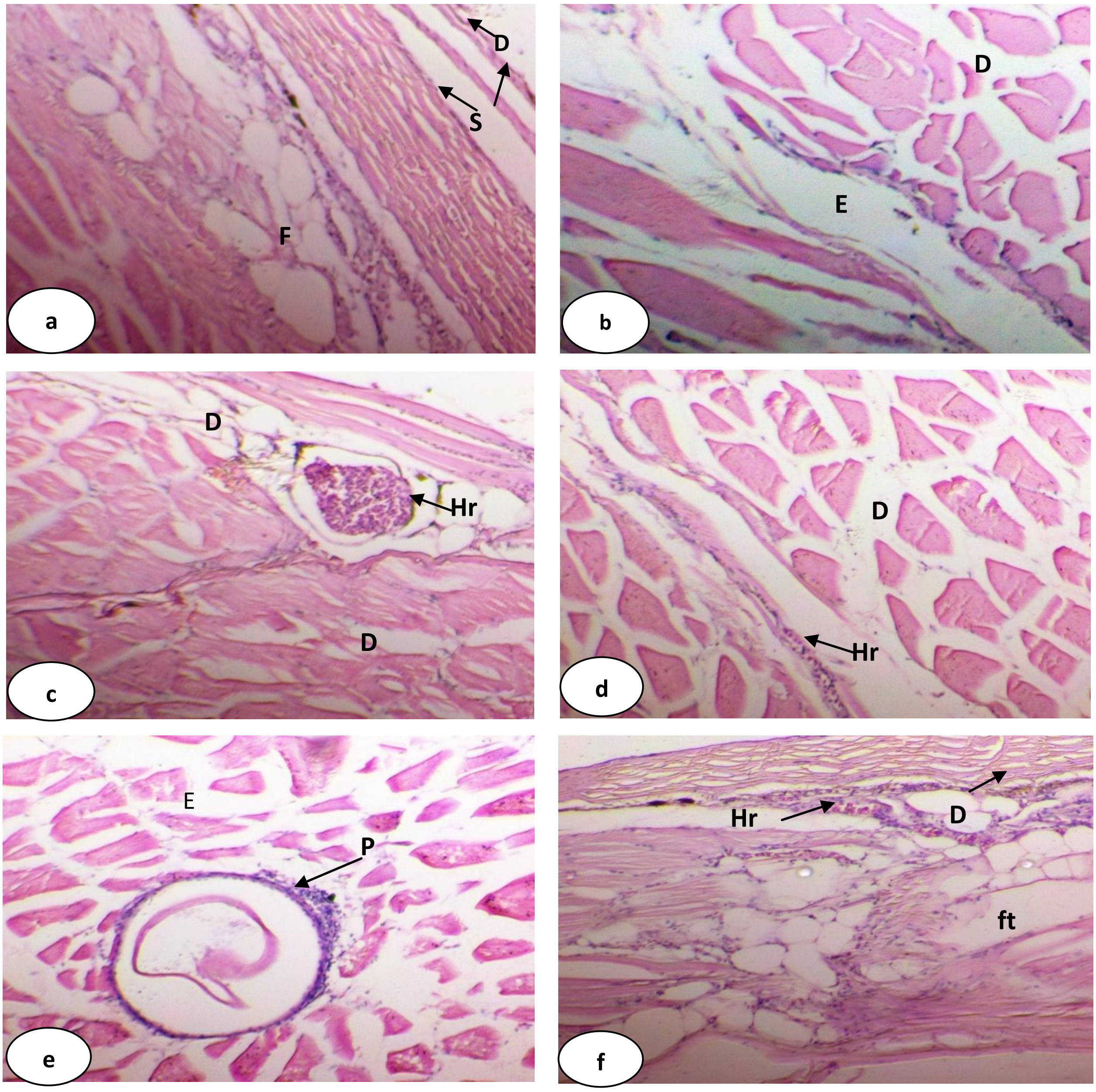
Table 5: Seasonal variations of iron, zinc, copper, cadmium and manganese bioaccumulation factor in fish organs obtained from investigated areas during year 2016.

organs	Site	Seasons																			
		Winter					Spring					Summer					Autumn				
		Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn	Fe	Zn	Cu	Cd	Mn
Muscles	I	0.48	1.27	3.17	18.5	0.26	0.22	1.13	0.33	3.00	1.14	0.33	0.77	1.06	1.30	0.74	0.16	0.36	1.31	14.00	3.15
	II	0.54	0.94	1.00	5.71	0.54	0.41	0.51	0.22	12.90	1.21	0.37	0.92	0.97	16.95	0.55	0.19	0.38	1.38	9.50	2.10
Gills	I	1.22	2.20	2.37	10.00	0.29	0.79	1.49	0.49	1.92	1.20	0.93	1.80	0.80	1.35	1.00	0.42	0.88	1.02	7.00	1.84
	II	0.86	1.45	0.89	2.50	0.44	0.63	1.02	0.55	3.87	4.65	1.02	1.58	1.33	7.15	1.42	0.33	0.84	1.75	3.17	4.71
Liver	I	0.67	2.09	0.54	7.50	0.11	0.74	1.49	0.20	1.08	0.74	0.57	1.89	0.71	0.60	0.59	0.55	1.18	0.18	7.00	1.03
	II	0.67	1.13	1.11	3.20	0.15	0.82	1.13	0.55	5.60	2.42	1.13	1.35	1.33	10.50	0.63	0.50	1.07	0.96	6.83	1.55
Kidney	I	2.74	2.49	1.61	2.00	0.29	1.64	2.17	2.59	0.17	0.89	1.30	1.95	1.21	0.25	2.79	0.81	1.19	2.27	3.00	2.66
	II	1.31	1.65	0.36	1.79	0.35	1.92	1.66	1.87	1.30	1.80	1.54	1.49	1.93	1.61	2.00	0.58	0.98	2.43	1.75	1.25

Histopathological alterations

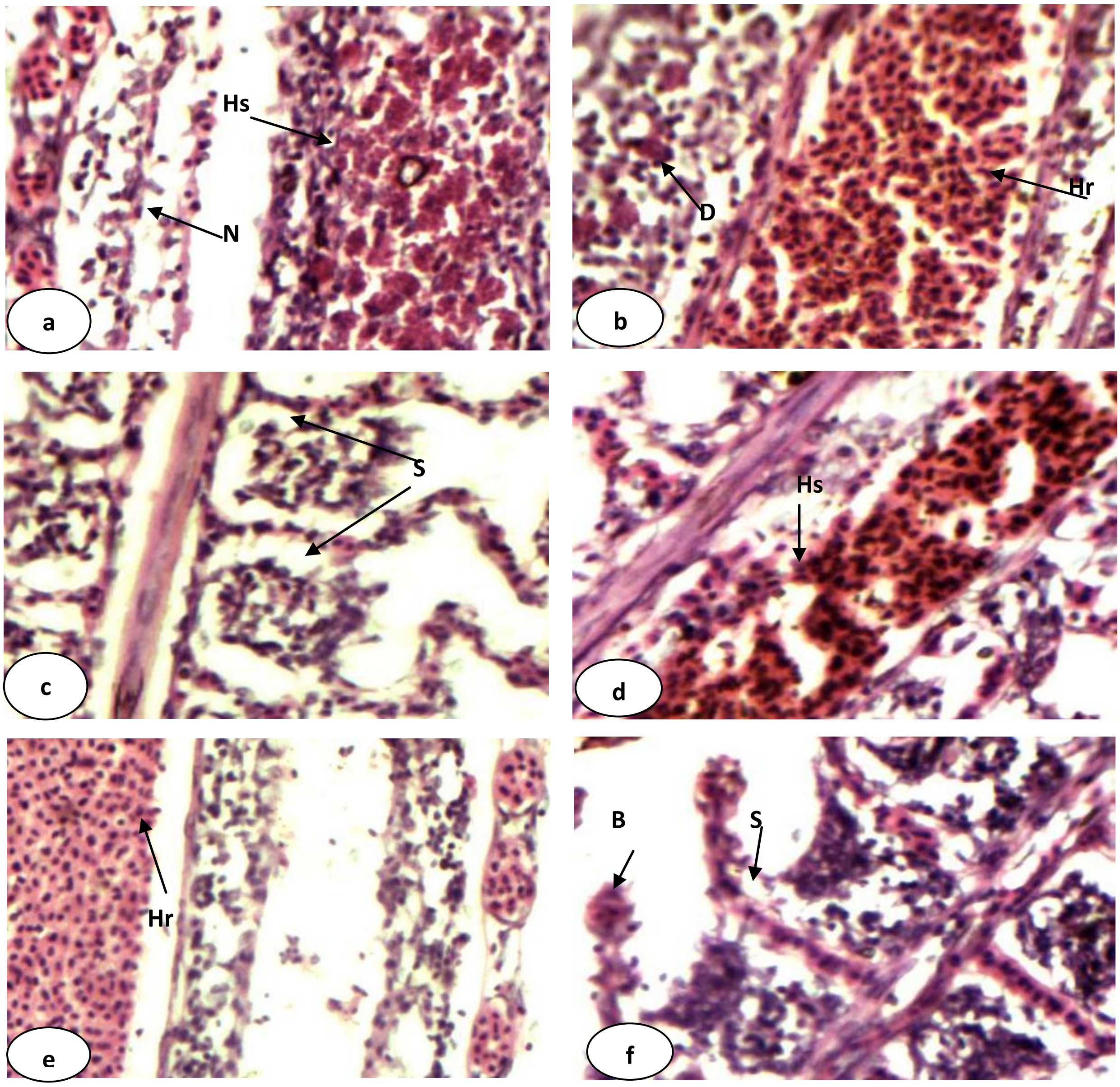
Several histopathological alterations were observed in skin & muscles, gills, liver and kidneys of *O. niloticus* obtained during the four seasons. Those alterations were severe in samples obtained from Talkha station and hot seasons than these obtained from El-Kanater El-Khayria station and cold seasons. The pathological findings of selected organs were shown in (Plate I - IV).

Plate (I)



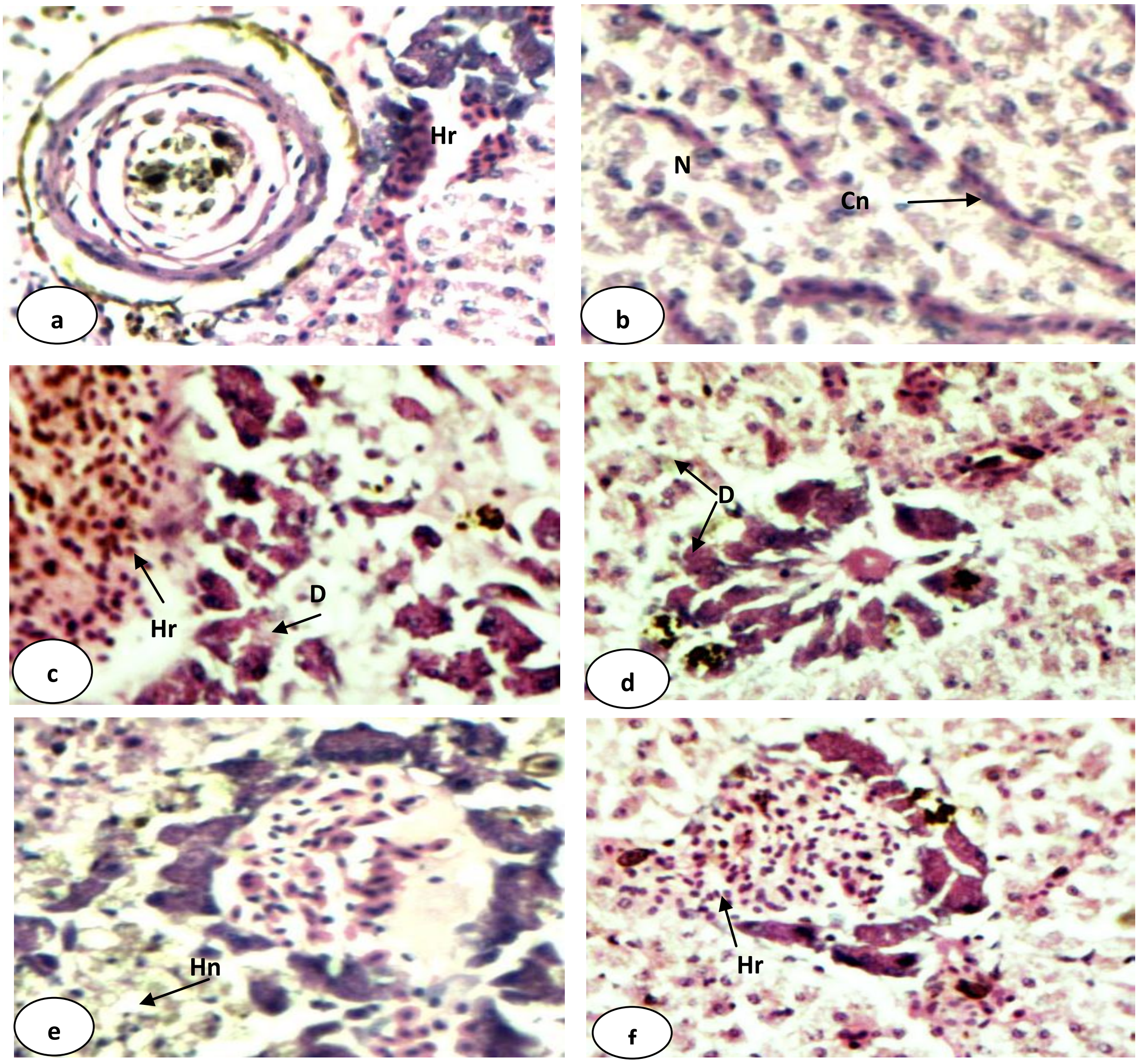
Figs. (a-f): V.S. of skin and muscles of *Oreochromis niloticus* obtained from El-Kanater El-Khayria & Talkha stations stained with H&E, showing : Degeneration (D) in epithelial layer, separation (S) of epidermal from dermal layers. Fatty degeneration (Ft) in hypodermal layer between dermal layer and muscular layer. Degeneration (D), edema (E), hemorrhage (Hr), fatty degeneration (Ft), parasitic form (P) in muscle fibers. Degeneration (D) hemorrhage (Hr) in dermal and hypodermal layers.

Plate (II)



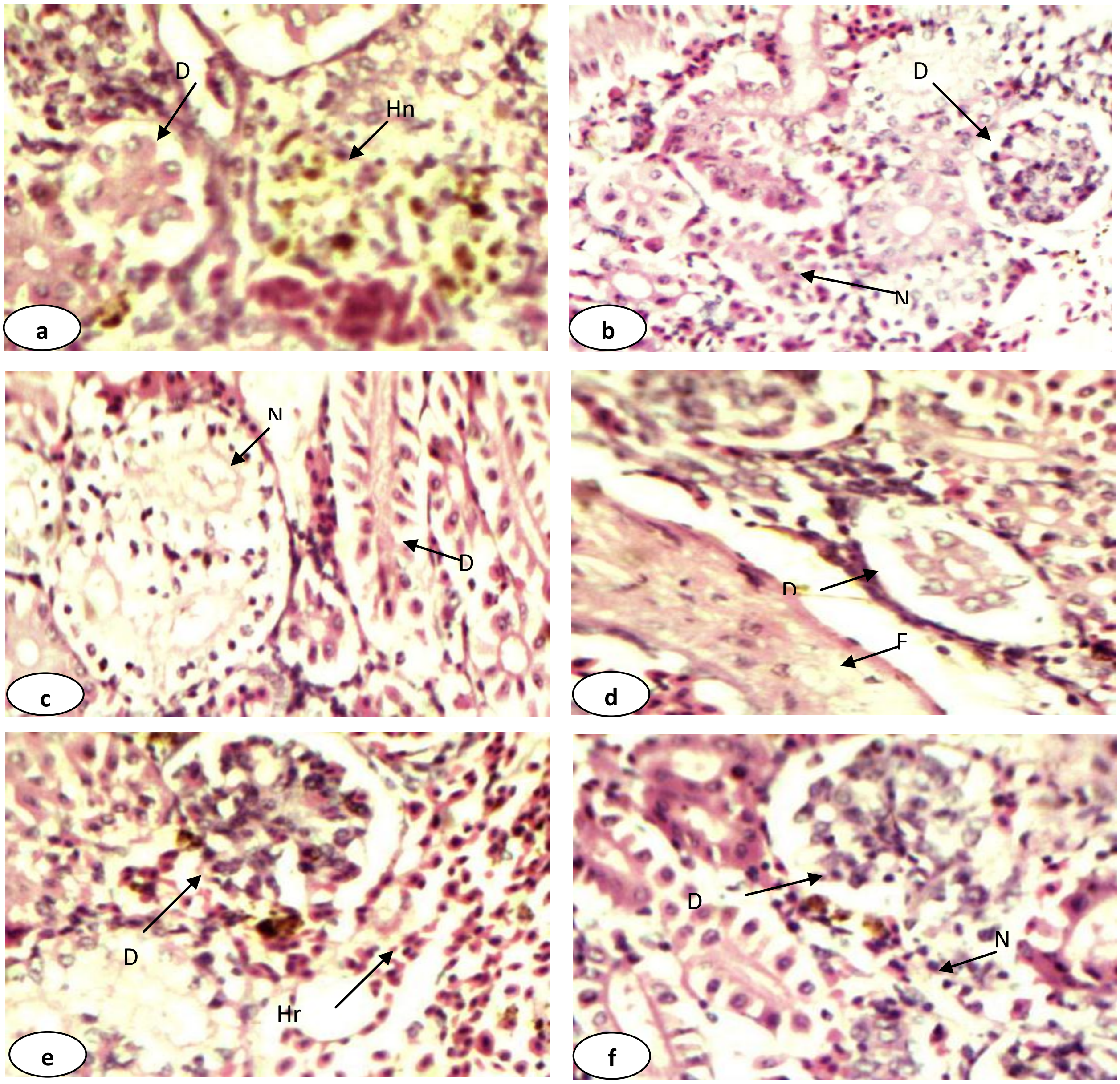
Figs. (a-f): L.S. of gills of *Oreochromis niloticus* obtained from El-Kanater El-Khayria & Talkha stations stained with H&E, showing: Hemorrhage (Hr) and hemolysis (Hs) in primary lamellae. Degeneration (D), necrosis (N), separation (S), curling (Cr) and bump end (B) of secondary lamellae.

Plate (III)



Figs. (a-f): Liver sections of *Oreochromis niloticus* obtained from El-Kanater El-Khayria & Talkha stained with H&E, showing: Degeneration (D), Necrosis (N), Fibrosis (F), Hemorrhage (Hr) and Hemosidrin (Hn) in hepatocytes. Hemorrhage (Hr) and degeneration (D) in blood vessels. Congestion (Cn) of blood sinusoid.

Plate (IV)



Figs. (a-f): Kidney sections of *Oreochromis niloticus* obtained from El-Kanater El-Khayria & Talkha stations stained with H&E, showing: Degeneration (D) and necrosis (N) in the renal tubules. Degeneration (D) in Malpighian corpuscle, fibrosis (F), hemorrhage (Hr), hemosidrin (Hn), and necrosis (N) in hematopoietic tissue.

DISCUSSION

Heavy metals concentrations in water

The presence of heavy metals in the investigated areas is mainly due to either both agricultural influx and sewage via surrounding cultivated land for El-Kanater station or hot water from electrical station and wastes from Talkha Ammonium Fertilizer Production. The present study showed that the abundance of metals in water of areas under study followed the order: Fe > Mn > Zn > Cu > Cd. This result was in agreement with that obtained by Ahmed, (2012) and El-Sayed, (2015). The results revealed that the values of Fe, Zn, Cu and Cd were within the permissible limits according to WHO, (1993). As for zinc, this metal was higher than its permissible limit at Talkha during winter. However, Mn was higher than the permissible limits at the two stations during winter.

The increase in zinc values at Talkha during winter may be due to domestic and agricultural sewage wastes and effluents which are loaded by hot water from electrical station and wastes from Talkha Ammonium Fertilizer Production water discharged into water stream as recorded by El-Sayed, (2011). The high concentration of manganese during winter at the two stations may be due to the effect of the breakdown of organic matter and dead microorganisms with subsequent release of the metal into water as recorded by Elewa *et al*., (2009). It may, also, be attributed to hot water from electrical station and wastes from Talkha Ammonium Fertilizer Production water at Talkha station as recorded by El-Sayed, (2015).

Fish analysis

Heavy metals accumulations in fish organs

The bioaccumulation of heavy metals does not only depend on the structure of the organ, but also on the interaction between metals and the target organs (El-Naggar *et al.*, 2009). Fish could accumulate trace metals and acts as indicator of pollution (Abou El-Gheit, 2012). The relationship between the concentrations of trace metals in water and their accumulation in *Oreochromis niloticus* fish organs was indicated in the present study. The present study showed that iron bioaccumulations in fish organs at areas under investigation were detected in the following descending order: kidney > liver > gills > muscles. It can be noticed that fish accumulate trace metals in fish organs with higher quantities than those found in ambient water and the permissible limits according to FAO, (1992). The increase of iron accumulation in fish organs in this study may be related to an increase in metal uptake by different organs. This observation is in agreement with that obtained by Ahmed, (2012). Yacoub, (2007) observed accumulation of iron ligand protein (hemosidrin) scattered in liver section of fish exposed to high iron concentration.

The present study showed that zinc accumulation in fish organs at areas under investigation were detected in the following descending order: Kidney > liver > gills > muscles. It can be noticed that fish accumulate trace metals in fish organs with higher quantities than those found in ambient water and the permissible limits were according to FAO, (1992). The highest value of Zn accumulation recorded during summer at Talkha station is anticipated to industrial effluents from Talkha Electricity Station as cited by Ibrahim and Mahmoud, (2005). Also, high accumulation of zinc in the kidney could be based on specific metabolic process and co–enzyme catalyzed reactions involving Zn taking place in the kidney as recorded by El-Sayed, (2015). However, relatively higher zinc concentration in the liver of fish may be due to the role of zinc as an activator of numerous enzymes present in the liver as recorded by Yacoub, (2007).

The present study showed that copper bioaccumulations in fish organs at areas under investigation were detected in the following descending order: Kidney > spleen > gills > liver > muscles. It can be noticed that fish accumulates trace metals in fish organs in quantity within the range of the ambient water and recommended permissible limit according to FAO, (1992) except for kidney. The elevation of copper concentration in the kidney may be due to the fact that fish kidney contains a cystine rich copper binding protein which is thought to have a detoxifying or storage function as recorded by El-Sayed, (2015). The increase of copper in kidney obtained from Talkha is anticipated to industrial, drainage and sewage effluents as recorded by Saad *et al.* (2012).

The present study showed that cadmium bioaccumulations in fish organs at areas under investigation were detected in the following descending order: muscles > liver > gills > kidney. It can be noticed that fish accumulates trace metals in most fish organs with higher quantities than those found in ambient water and lower than the permissible limits according to FAO, (1992). Generally, the obtained high level of cadmium accumulation in the studied organs of selected fish in the present study may be due to its strong binding with cystine residue of metallothionein, as mentioned by Tayel *et al*. (2008).

The present study showed that manganese accumulation in fish organs at areas under investigation were detected in the following descending order: gills > Kidney > muscles > liver. It can be noticed that fish accumulates trace metals in most fish organs obtained from Talkha station with higher quantities than those found in ambient water and the permissible limits according to FAO, (1992). These results are in agreement with (Ahmed, 2012) who interpreted such fact to high manganese concentration in water due to large amount of wastes discharged.

The bioaccumulation factors of studied metals in different organs of studied fish showed that the pollutants of investigated area induced diverse effect of some biochemical parameters and enzyme activities of these organs; this observation is in agreement with that reported by Authman and Abbas (2007).

The results indicated that the water and fish organs of investigated areas were polluted with heavy metals. These pollutants induced histopathological alteration of fish organs.

Histopathological alterations

The severe alterations in skin and muscles, in present study, may be attributed to the presence of heavy metals in the investigated areas which have mainly occurred due to both agricultural influx and sewage via surrounding cultivated land for El-Kanater station or hot water from electrical station and wastes from Talkha Ammonium Fertilizer Production. This finding is in agreement with that reported by El-Sayed (2015) and Saad *et al.* (2012) who attributed these observations to parasitic infection from sewage, inorganic fertilizers from agricultural wastes and industrial wastes.

The increase of heavy metals accumulation in fish organs plays an important role on the histopathological alteration of gills. This observation goes in line with that obtained by Ibrahim *et al*. (2009) and Ahmed (2007).

The histopathological alterations in the liver of studied fish could be a direct result to the effect of heavy metals from industrial wastes, the parasitic infection from sewage or to the inorganic fertilizers from agricultural wastes as recorded by Mahmoud and Abd El Rahman, (2017) and Ashry *et al.* (2013). Degeneration and necrosis of the hepatocytes may be due to metals. These results coincided with those of Authman and Abbas (2007) who stated that the liver has an important detoxification role of endogenous waste products as well as externally derived toxins as heavy metals. Accumulation of hemosidrin in liver cells may be attributed to rapid and continuous destruction of erythrocytes as recorded by Ibrahim and Mahmoud, (2005).

The obtained results revealed that kidney was found to be the most affected organ by heavy metals. This may be due to the fact that it is one of the principal site of detoxification in fish body .Similar to our findings are those reported by Tayel *et al*., (2013) who found that agricultural, industrial and sewage wastes had caused renal injury including degeneration and necrosis of renal tubules in kidney of fish living in different parts of the River Nile.

CONCLUSION

In conclusion, the concentrations of the studied metals in investigated water areas were in the following order Fe > Mn > Zn > Cu > Cd. These metals accumulated in selected organs (muscles, gills, liver and kidneys) of the studied fish. The accumulations of these metals in such organs of the studied fish exceeded their presence in water and their permissible limits. It was found that the accumulations of these metals in these organs of the studied fish (*O. niloticus*) induced many histopathological alterations in such organs.

REFERENCES

Abou El-Gheit, E.N.; Abdo, M.H. and Mahmoud, S.A. (2012). Impact of blooming phenomenon on water quality and Fishes in Qarun Lake, Egypt. Int. J. Environ. Sci. Engineer., 3: 11 – 23.

Ahmed, N.A.M. (2012). Biochemical studies on pollution of the River Nile at different stations of Delta barrage (Egypt). Ph.D. Thesis, Agric. Fac., Benha Univ., Egypt.

Ahmed, N. A. M. (2007). Effect of River Nile pollution on *Clarias gariepinus* located between El-Kanater El-Khayria and Helwan. M. Sc. Thesis, Agric. Fac., Zagazig Univ., Egypt

APHA (1998). Standard methods for the examination of water and waste water, 20th Edition. America Public Health Association, Washington, D. C, pp. 1-1-10-161.

Ashry, M.A.; Mahmoud, S.A. and Abdel-Rahman A.A.S. (2013). Histopathological studies on the hematopoietic organs of *Clarias gariepinus* in relation to water quality criteria at different localities in the River Nile. Nat. and Sci., 11 (8):78-88.

Authman, M. and Abbas, H. (2007). Accumulation and distribution of copper and Zinc in both water and some vital tissues of two fish species (*Tilapia zillii* and *Mugil cephalus*) of Lake Qarun, Fayoum Province, Egypt. Pak. J. Biol. Sci., (10), 2106 - 2122.

Bernet, D.; Schmidt, H.; Meier, W.; Burkhardt-Olm, P. and Wahi, T. (1999). Histopathology in fish: Proposal for a protocol to assess aquatic pollution. J. fish Dis., (22), 25-34.

Elewa, A.A.; Shehata, M.B.; Mohamed, I.F.; Badr, M.H. and Abdel-Aziz, G.S. (2009). Water quality characteristics of the River Nile at Delta Barrage with special Reference to Rosetta branch. Glob. J. Environ. Res., 3(1): 1-6.

EL-Naggar, A.M.; Mahmoud, S.A. and Tayel, S.I. (2009). Bioaccumulation of some heavy metals and histopathological alterations in liver of *Oreochromis niloticus* in relation to water quality at different localities along the River Nile, Egypt. World J. Fish and Marine Sci., 1(2), 105-114.

El-Sayed, R.M. (2015). Effect pollutants on *Oreochromis niloticus* on fish inhabiting the water of River Nile–Damietta Branch. M.Sc. Thesis, Faculty of Women for Art., Science and Education, Ain Shams Univ., Egypt.

El-Sayed, S. (2011). Physicochemical studies on the impact of pollution up on the River Nile branches, Egypt. M.Sc. Thesis, Sci. Fac., Benha Univ, Egypt.

FAO (1992). Committee for inland fisheries of Africa; Report of the third session of the working party on pollution and fisheries. Accra, Ghana. 25-29 November 1991. FAO Fisheries Report No 471. Rome, FAO, 43 p.

Goldberg, E.D.; Koide, M.; Hodge, V.; Flegel, A.R. and Martin, J.U.S. (1963). Mussel watch: 1977-1978 results on trace metals and radionuclides. Estuar. Coastal Shelf Sci. (16), 69-93.

Ibrahim, S.A and Mahmoud, S.A. (2005). Effect of heavy metals accumulation on enzyme activity and histology in liver of some Nile fish in Egypt. Egypt. J. Aquat. Biol. and Fish., 9(1): 203-219.

Ibrahim, S.A.; Tayel, S.I.; Mahmoud, S.A. and El-Kasheif, M.A. (2009). Impact of the carbamate pesticide Sevin on hematology and histology of teleost fish (*Oreochromis niloticus*). Glob. Veterin., 3(3): 196-203.

Kadry, S.M.; Marzouk, M.S.; Amer A.M.; Mauna M.I.; Azmy M.H. and Hamed H.S. (2012). Vitamin E as antioxidant in female African catfish *(Clarias gariepinus)* exposed to chronic toxicity of atrazine. Egypt. J. Aquat. Biol. and Fish, ; 16 (2): 83-98.

Kadry, S.M., Tayel, S.I.; Afify, M.F.H. and El-Sayed, R.A. (2015). Eco-histopathological studied on *Oreochromis niloticus* fish living in Damietta Branch in Egypt. World J. Pharm. Sci., 3(5): 815-825.

Mahmoud, S.A. and Abd El Rahman, A.A. (2017). Eco-Toxicological Studies of Water and Their Effect on Fish In El Manzalah Lake. Res. J. Pharm. Biol. Chem. Sci., 8(2): 2497-2511.

Saad, S.M.M.; El- Deeb, A.E.; Tayel, S.I., Al- Sheri, E. and Ahmed, N.A.M. (2012). Effect of heavy metals pollution on histopathological alterations in muscles of *Clarias gariepinus* inhabiting the Rosetta branch, River Nile, Egypt. Animal Biotechnology, pp. 79-88.

Saad, S.M.M.; El-Deeb, A.E.; Tayel, S.I. and Ahmed, N.A.M. (2011). Haematological and histopathological studies on *Clarias gariepinus* in relation to water quality along Rossetta branch, River Nile, Egypt. J. Exp. Bio. (Zool.); 7(2): 223-233.

Tayel, S.I.; Ahmed, N.A.M. and EL-Hossiny, M.A. (2014). Impact of diffused pollution on histological and hematological properties of *Mugil cephalus* and *Mugil capito* collected from lake Manzalah, Egypt. Int. J. Environ. Sci. Engineer., 5: 51-67.

Tayel, S.I.; Ibrahim, S.A. and Mahmoud, S.A. (2013). Histopathological and muscle composition studies on *Tilapia zilli* in relation to water quality of lake Qarun, Egypt. J. Appl. Sci. Res.; 9(6): 3857- 3872.

Tayel, S.I.; Yacoub, A.M. and Mahmoud, S.A. (2008). Histopathological and haematological responses to freshwater pollution in the Nile catfish *Clarias gariepinus*. J. Egypt. Acad. Soc. Environ. Develop., 9 (4): 43- 60.

WHO (1993). Guidelines for drinking-water quality.2nd ed. Contents :V. I. Recommendations. WHO library cataloguing in publication date, Geneva. I-129.

Yacoub, A.M.; Mahmoud, S.A. and Tayel, S.I. (2008). Health status of *Oreochromis niloticus* in fish farm irrigated with drainage water in El-Fayoum Province, Egypt. Egypt. J. Aquat. Res.; 34(1): 161-175.

Yacoub, A.M. (2007). Study on some heavy metals accumulated in some organs of three River Nile fishes from Cairo and kalubia Governorates. Afr. J. Biol. Sci., 3: 9-21.

ARABIC SUMMARY

التأثيرات المرضية للسموم البيئية على سمكة البلطي النيلي القاطنة لمياه فرع دمياط، نهر النيل، مصر.

صفاء إسماعيل محمد طايل[١]، سعاد أحمد محمود[١]، نصر أحمد محمد أحمد[١]
أمينة عبد المنعم شحاته عبد الرحمن[٢]
١.معمل أمراض الأسماك، المركز القومي لعلوم البحار و المصايد، القاهرة، مصر.
٢. قسم علم الحيوان، كلية البنات للآداب و العلوم والتربية، جامعة عين شمس، القاهرة، مصر.

أجريت الدراسة الحالية بمحطتي القناطر الخيرية وطلخا، فرع دمياط، نهر النيل. تم تحديد تركيزات المعادن الثقيلة (الحديد، والزنك، والنحاس، والكادميوم والمنجنيز) في الماء بالإضافة إلى قياس تركيزها في الأعضاء التالية: العضلات، والخياشيم، والكبد، والكلى في أسماك البلطي النيلي بشكل موسمي خلال عام 2016. أيضا، تم دراسة التغيرات النسيجية في الأعضاء نفسها من أسماك البلطي خلال العام نفسه. أظهرت النتائج التي تم الحصول عليها زيادة في تركيزات المعادن الثقيلة في المياه التي تم جمعها من المحطتين محل الدراسة، وكان تركيز هذه المعادن كالآتي: الحديد> المنجنيز> الزنك> النحاس> الكادميوم. كما أدى تراكم هذه المعادن في الأعضاء المختارة من الأسماك المدروسة إلى حدوث تغيرات نسيجية. وشملت التغيرات النسيجية تحطم ونخر في الخلايا، ونزيف، وتحلل خلايا الدم الحمراء مع وجود الهيموسيدرين بالإضافة إلى وجود أشكال طفيلية وفرط تنسج الأعضاء. وقد لوحظت هذه التغيرات في الأعضاء الأربعة في المحطتين خلال فترة الدراسة ولكن بدرجة حادة في محطة طلخا أكثر منها في محطة القناطر الخيرية، وأيضا خلال المواسم الحارة. لذا، فمن الضروري معالجة المياه الملوثة قبل تصريفها في فرع دمياط لحماية الأسماك والبشر من أخطار التلوث.