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Seasonal variation of some heavy metals in tilapia fish organs in relation to water quality of lake Nasser and Balana sewage pond, Aswan, Egypt

A.Kamel[1], Mohamed E.F Toufeek[2] and Nehad M. Nagaty[1]
1. Department of Chemistry, Faculty of Science, University of Aswan
2. National Institute of Oceanography and Fishier, Egypt

ABSTRACT

In this study heavy metal concentrations of Fe, Pb and Zn in flesh and liver of tilapia fish were seasonally estimated in samples collected from Lake Nasser and Balana sewage plant at Aswan during 2013 and 2014. Also, water samples were obtained from the same investigated sites to measure the concentrations of the three investigated metals in addition to some physico-chemical parameters during the four seasons.

The results indicated that in most cases the investigated metal concentrations in fish organs from Balana sewage plant were higher than those of fish organs from Lake Nasser and the safety baseline according to WHO. Also, the levels of the investigated metals, chemical and physical water parameters were higher in Balana sewage plant than those in Lake Nasser and Balana Nile branch.

Key words: Lake Nasser, chemical and physical parameters, heavy metals, tilapia, sewage ponds.

INTRODUCTION

Water pollution is a serious environmental problem in the world. It is the degradation of the quality of water that renders water unsuitable for its intended purpose. Water pollutants can be broadly classified as major categories namely organic, inorganic, suspended solid and sediments, heavy metals, radioactive materials and heat (Botikin and Keller, 2008**).** The River Nile from Aswan to Delta Barrage receives wastewater discharge from 124 point sources, of which 67 are agricultural drains and the remainders are industrial sources (APRP, 2002). The Aswan high Dam reservoir extends for almost 500 km at final shape includes Lake Nasser in Egypt and Lake Nubia in Sudan (Elewa and Toufeek, 1997). Egypt has about 239 sewage plants along the Nile River in 2004. All of them use different domestic pollutant treatment processes. A lot of plants use oxidation pools for treatment process like Balana and Nasr El Nouba in Aswan. These plants usually were created by foreign aid due to its high cost in building.

Mostly the treated sewage wastewater has a lot of pollutant which can effect harmfully on environment (water, sediment and aquatic livings) and humans health (Moja, 2007). The pollutants present in treated wastewater usually are heavy metals and bacteria. The amount of these pollutants depends on the efficiency of the plant treatment processes and building.

The present study aimed to investigate the effect of heavy metals accumulation in tilapia fish organs collected from lake Nasser and Balana sewage pond at Aswan.

MATERIALS AND METHODS

Water samples were collected from Lake Nasser (east, west and center sites) and from Balana sewage plant pond ((Fig.1). Samples were collected seasonally from summer 2013 to spring 2014. Water samples from each site were collected from the subsurface (about 30 cm) by using polyvinyl Van Dorn plastic bottle (capacity 2L). Samples were kept in cleaned stoppered

plastic bottles. Some physico-chemical parameters were measured in each station during the samples collection. pH was measured using (HM-30G/40G/60G) and temperature by using ordinary thermometer. The conductivity (µmhos/cm) of water was measured by the conductivity meter model (Conductivity Meter-30G/50G/60G). Glass stoppered oxygen bottles for dissolved oxygen and biochemical oxygen demand were filled carefully with samples from selected layers and fixed immediately on the spots. Dissolved oxygen (mgl-1) was measured using winkler's method using azide modification of iodometric method. Determination of BOD and COD were done following standard methods (APHA, 1992). Determination of nitrate as µg/l was carried out by using the method of Silva *et al.* (2007). Ammonia was determined by using phonate method.

Water samples for the trace elements analysis were collected seasonally and kept in cleaned plastic bottle and preserved with 5 ml concentrated nitric acid on the spots and stored in refrigerator. The metal concentrations (Fe, Pb and Zn) were determined using Atomic Absorption (Perkin Elmer 3110 USA) with graphite atomizer HGA-600. Also, these heavy metals were estimated in fish tissues from Ballana wastewater treated pond.

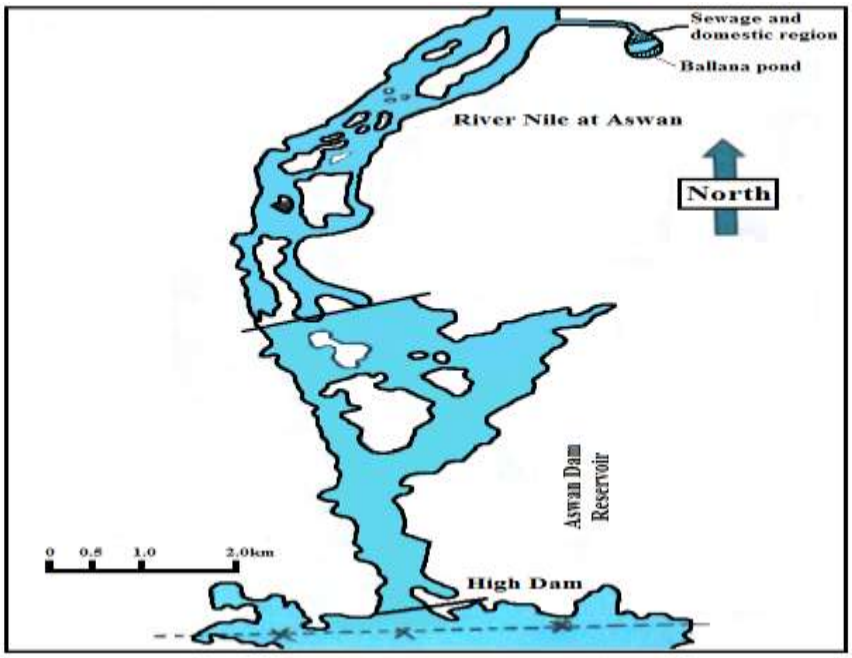

Fig. 1: Sites surveyed during the study at Lake Nasser in addition to Ballana pond.

RESULTS AND DISCUSSION

The physical parameters in water:

1- Water temperature:

Temperature is an important factor in the aquatic environment since it affects directly or indirectly on the survival and distribution of the aquatic organisms at any stage in addition to their growth rate development, activity, reproduction processes and susceptibility to diseases. It also influences all physical and biological transformations in aquatic environment (Dallas and Day, 2004).The seasonal variation of temperature values of water of Lake Nasser and Balana sewage pond were represented in Table (1).The temperature for

Lake Nasser fluctuated between(17.75and 25.89°C), the maximum values recorded during summer, while minimum values were measured in winter. The trend in temperature at Balana pond showed the same pattern and the temperature ranged from (20.2 and 26.3°C). The maximum values recorded during summer, while the minimum values were measured in winter. The temperature has indirect effect on the amount of phytoplankton, the main source of food for most fish. The decrease or increase of temperature affected directly the concentration of dissolved oxygen (Yacoub, 1999).The changes in water temperature were responsible for oxygen content, growth rate, and susceptibility to diseases; that leading to bad and harmful effects on fish life (Siliem, 1993). The range 25°C to 32°C was measured as the best range for most of fresh water fish (Yacoub, 1999).

Table (1): The seasonal variation of physical parameters for Lake Nasser and Balana sewage pond water

Area of study	parameter	Season				Mean± SD
		Summer	Autumn	winter	Spring	
Lake Nasser	Temp.	25.89	23.07	17.75	22.97	22.42±3.39
Balana pond		26.3	23.0	20.2	24	23.38±2.53
Lake Nasser	EC (µS/cm)	230.33	193.67	213.33	225.5	215.71±16.34
Balana pond		859.3	1037.5	1049.3	912.51	964.65±93.61
Lake Nasser	TDS (mg/l)	153.56	129.11	142.22	150.33	143.8±10.43
Balana pond		535.1	686.88	632.93	608.61	615.88±63.01
Lake Nasser	TSS (mg/l)	4.69	6.26	2.83	3.86	4.41± 1.4
Balana pond		110.73	100	189.03	107	126.69±41.8

2- Electrical conductivity (EC):

It was found that the greater the concentration of ions in natural waters, the higher the conductivity. So, conductivity is approximately proportional to salinity and total dissolved solids (Abd El-Hady,2014). The seasonal variation of conductivity values for Lake Nasser and Balana sewage pond were represented in Table (1).The conductivity values for lake Nasser fluctuated between (230.33 and 193.67µS/cm), the highest recorded for summer, while the lowest value during autumn. Although for Balana pond conductivity values fluctuated between (1049.3 and 859.3µS/cm), the highest recorded for winter, while the lowest value was during summer. The relative decrease in the EC values was recorded during the summer season for fish pond coincidences. This could be attributed to the uptake of dissolved salts by phytoplankton as a result of continuous mixing of water column or due to the lack of soluble salt in the region (Malinsky-Rushansky and Legand, 1996). Generally, the increase of electrical conductivity values in Lake Nasser during summer was due to the elevation of total dissolved solids (Kumar and Bahadre, 2009) as well as the presence of domestic and agricultural wastes containing high amount of inorganic and organic constituents (Abdel Satar and Elewa, 2001).

3- Total dissolved solid (TDS):

Jamabo (2008) reported that excessive concentration of suspended and

dissolved solid might be harmful to aquatic life, the harmful effect may include killing or reduction in their growth rate as well as reduction in the abundance of food available to fauna, they added that TDS levels in excess of 1200 mg/l are unlikely to support good fresh water fisheries. The seasonal variation of TDS values for Lake Nasser and Balana sewage pond were represented in Table (1). The TDS values for lake Nasser fluctuated between (153.56 and129.11 mg/l), the highest recorded was recorded for summer, while the lowest value was during autumn. Although for Balana pond values fluctuated between (686.88 and 535.1 mg/l), the highest value was recorded for autumn, while the lowest value was during summer. The presence of excessive solids in water may be due to agricultural activities and geological parameters (Kasthuri *et al.*, 2005).The minimum value was recorded during summer in Balana sewage pond which may be attributed to the uptake of nutrient and other dissolved minerals by phytoplankton and algae (Abdel-Kariem, 1998).In contrast, TDS concentration was high during spring and autumn in supply and fish sewage pond due to the presence of bicarbonates, carbonates, sulphates and chlorides of calcium (Deepali *et al.*, 2001).

4- Total suspended solid (TSS):

The seasonal variation of TSS values for Lake Nasser and Balana sewage pond were represented in Table (1).The TSS values for lake Nasser fluctuated between 6.26 and2.83 mg/l,the highest value was recorded for autumn, while the lowest value was during summer. Although for Balana pond, TSS values fluctuated between 189.03 and 100 mg/l, the highest recorded for winter, while the lowest value was during autumn. Javed and Usmani (2012) founded that TSS in ponds using sewage water in fish raising is approximately 200mg/l. In the present study, the result of TSS in sewage of Balana pond was near that recorded in the present study. Hussein and El-Shafi (2005) reported that TSS for Lake Nasser was 2.1 mg/l which is near from the present results for Lake Nasser. Suspended particulate matter concentrations can vary extremely at high flow stages (Spott and Guhr, 1996). This may explain the high value of TSS in summer in Lake Nasser.

Chemical parameters:

1- Hydrogen Ion Concentration (pH values):

Measurement of pH is one of the most important and frequently used as test for water chemistry. The seasonal variation of pH values for Lake Nasser and Balana sewage pond were represented in Table (2). The pH values for lake Nasser fluctuated between 8.53 and 7.4, the highest recorded for winter, while the lowest value was recorded during autumn. Although for Balana pond values fluctuated between 8.61 and 8.17, the highest value was recorded for winter, while the lowest value was during summer. In sewage fish pond it was observed that sewage water was slightly alkaline in nature during the study period. The results was due to photosynthetic assimilation of inorganic carbon (Kumara and Belageli, 2008) or due to bacterial uses of hydrogen ion and making water alkaline (Greenberg, 2001). The pH value of water is the resultant effect of many chemical and biochemical reactions and it is considered as an index of pond productivity (USEPA, 2009). According to Meade (1989),the value of pH in which Tilapia fish can survive is between 6 to 9, this means that the results are accepted to fish survival.

2- Dissolved Oxygen (DO):

The analysis of DO is a key test in water pollution and wastewater. It is also essential to allow aerobic microorganisms to stabilize any biodegradable organic material

present. The seasonal variation of dissolved oxygen values for Lake Nasser and Balana sewage pond were represented in Table (2). The DO values for lake Nasser fluctuated between 6.67 and3.33 mg/l, the highest value was recorded for winter, while the lowest one was during summer. Although for Balana pond DO values fluctuated between 6.97and 5.78 mg/l, the highest value was recorded for winter, while the lowest value was during summer. The oxygen content of a water body is mainly controlled by the decay of organic substance, the oxidation of the nitrogen compounds NH_4^+ and NO_2^-, the photosynthetic aeration of the water by plants, and oxygen demand by soil sediments (Metcalf and Eddy, 2003).The high concentration of DO is due to high photosynthesis with abundance of phytoplankton. The highest average value of Do was obtained in winter due to the photosynthetic rate that reached its maximum extent and the blooming of phytoplankton during the cold seasons and also due low water level in the pond (Abdel-Satar& Elewa, 2001). The minimum value of DO was recorded in summer in different stations and the decreasing DO was a result of consumption through decomposition of organic matter. Also, the rise of water temperature diminished of the solubility of atmospheric oxygen (Metcalf and Eddy, 2003). According to Meade (1989) the value of DO in which Tilapia fish can survive is 5mg/l, this means that the present results are accepted to fish survival.

Table (2): The seasonal variation of chemical parameters for Lake Nasser and Balana sewage pond water.

Area of study	parameters	Season				Mean± SD
		Summer	Autumn	winter	Spring	
Lake Nasser	pH	7.6	7.4	8.53	8.28	7.9±0.51
Balana pond		8.17	8.19	8.61	8.4	8.3± 0.2
Lake Nasser	DO (mg/l)	3.33	5.35	6.67	4.88	5.06± 1.38
Balana pond		5.78	6.11	6.97	6.55	6.35±0.52
Lake Nasser	BOD (mg/l)	1.5	2.17	1.87	2.17	1.93± 0.32
Balana pond		75.93	90.95	150.74	102.62	105.06±32.35
Lake Nasser	COD (mg/l)	2.467	3.96	10.16	7.733	6.08±3.51
Balana pond		89.93	109.63	200.94	120.93	130.36 ±48.8
Lake Nasser	NH^{4+}(µg/l)	116.83	42	44.17	303.33	122.58±131.18
Balana pond		2043	2132	2932	2391	2374.5±399.9
Lake Nasser	NO_3^- (mg/l)	0.287	0.313	0.426	0.383	0.35±0.062
Balana pond		5.93	3.56	8.93	3.821	5.56±2.5
Lake Nasser	PO_4^{3-} (µg/l)	144.67	58	54.27	67.67	81.15±42.72
Balana pond		2732	2390	1495	3519	2534± 838.587

3- Biochemical Oxygen Demand (BOD):

Biological oxygen demand measured the dissolved oxygen consumed by the present microorganisms to stabilize any biodegradable organic matter, microorganisms, metabolize the complex unstable molecules of pollutants e. g.

proteins, carbohydrate, lipid, into CO_2 and H_2O as a simple stable in organic compounds. Microorganisms utilize either aerobic or anaerobic oxidation pathway according to the allowed conditions (APHA, 1992).The seasonal variation of BOD values for Lake Nasser and Balana sewage pond were represented in Table (2).The BOD values for lake Nasser fluctuated between 2.17 and1.5mg/l, the highest recorded BOD value was at spring, while the lowest value was during summer. Although for Balana pond BOD values fluctuated between 150.74 and 75.93 mg/l, the highest value was recorded at winter, while the lowest value was during summer. A maximum value of BOD was during autumn and spring in Lake Nasser due to the high DO concentration.The high BOD value in supply and fish pond is related to the domestic sewage water discharging with its content of organic matter and bacteria (Yacoub, 1999) and effects of agricultural runoff and decomposition of organic matter. Also, Al-Afify (2006) reported that the increase of BOD values may be due to greater organic load pollution due to untreated domestic sewage in water.

4- Chemical Oxygen Demand (COD):

The chemical oxygen demand is the total amount of oxygen required to oxidize all the organic matter completely in a site to CO_2 and H_2O.The seasonal variation of COD values for Lake Nasser and Balana sewage pond were represented in Table (2).The COD values for lake Nasser fluctuated between 10.16 and2.4 mg/l, the highest value was recorded at winter, while the lowest value was during summer. Although for Balana pond COD values fluctuated between 200.94 and 89.39 mg/l, the highest value was recorded for winter, while the lowest value was during summer. The optimum COD level for aquaculture should be less than 50 mg/l according to Meade (1989) who reported that COD values in fish pond must be not more than 25 mg/l. In the present study the values of Lake Nasser was accepted to fish survival but in case of Balana sewage pond it was not accepted according to Meade (1989). The high values of COD were recorded in winter and followed by spring for Lake Nasser, this may be due to the high oxygen values recorded in the same season. While the high value of COD in spring may be attributed to the flourishing play by plankton (Tayel, 2003). The high values of COD may be attributed to the presence of high content of organic matter during autumn and the death of microorganisms, especially in cold months and attributed to the effect of pollution by sewage, industrial wastes and agricultural wastes. Also, the high values of COD may be attributed to the increase in water temperature which facilitates the decomposition of abundant organic matter leading to increase the COD values (Abdo, 2002). The minimum value of COD during summer may be attributed to the low level of organic matter and the clarity (Tayel, 2003).

5- Ammonia (NH_4^+):

The most commonly occurring nitrogenous pollutant is ammonia, which is a characteristic product of aerobic break down of organic matter (**Winkler and Manoranjon, 1989**). The seasonal variation of ammonia values for Lake Nasser and Balana sewage pond were represented in Table (2).The maximum value of the averages for ammonia of Lake Nasser was recorded during spring (303.33 µg/l), while the minimum value was recorded in autumn (42 µg/l). Although the average value of ammonia in fish pond ranged between the maximum values (2932µg/l) during winter and the minimum value (2043 µg/l) during summer. The values of ammonia concentration for summer in sewage ponds may be attributed to the actively of

denitrifying bacteria which are much higher in water especially under an aerobic condition (Abdel-Hamid *et al.,* 1992). The high values of ammonia in winter and spring is correlated with high values in chemical and biochemical oxygen demand which indicated that ammonia is one of the results of the decomposition of organic matter at the bottom. This accounts for the fact that in autumn, (high temperature) free ammonia increases with depth (Yacoub, 1999)..

6- Nitrate (NO_3^-):

Nitrate is an essential nutrient for many photosynthesis autotrophies, and can be taken as growth limiting nutrient in some cases (APHA, 1992).The seasonal variation of Nitrates values for Lake Nasser and Balana sewage pond were represented in Table (2).The nitrates values for lake Nasser fluctuated between 0.42 and0.28 mg/l, the highest value was recorded for winter while the lowest value was during summer. Although for Balana pond, the maximum values (8.93 mg/l) was during winter and the minimum value (3.56 mg/l) during autumn. The high values of NO_3^- concentration in Lake Nasser during the year express the discharge of sewage amount and properties (Al-Afify, 2006). The lowest values of nitrate concentration was recorded during autumn in sewage pond and in case of Lake Nasser during summer and this may be due to the sedimentation of the adsorbed nitrate ions with the silt (Tayel, 2003). The low nitrate concentration may be due to the anaerobic condition, resulting from the incomplete oxidation of ammonia or reduction into nitrite by denitrifying bacteria (Al-Afify, 2006).

G: Orthophosphates (PO_4^{3-}):

The cycling of phosphorus within lakes and rivers are a dynamic and complex involving in adsorption and precipitation reactions, interchange with sediments and uptake by aquatic biota (Mesnage and Picot, 1995).The seasonal variation of orthophosphates values for Lake Nasser and Balana sewage pond were represented in Table (2).The average of the values during the year in Lake Nasser were ranged between the maximum value (144.67 µg/l) during summer and the minimum value (54.27 µg/l) during winter. The annual averages values of orthophosphates in fish pond ranged between the maximum values (3591 µg/l) were during spring and the minimum value (1495µg/l) during winter. The minimum orthophosphate value for Lake Nasser and sewage pond was recorded during winter and it is due to the uptake of phosphorus by alga, bacteria, phytoplankton and zooplankton (Fried *et al.,* 2003).The maximum value was recorded at sewage pond in spring, which may be due to increasing the rate of the mineralization process by microorganisms (Andersoon *et al*., 1988). Also, the decrease in the phytoplankton population in water leads to the reduction of the uptake of PO_4^{3-} and increase its concentration in water (Shaaban-Desouki *et al*., 1993).

Heavy metals concentration in water:

1. Iron (Fe^{3+})*:*

Because of the low toxicity of iron to humans, iron in sea food and fresh water fishes, does not constitute a hazard to human consumers (Hassouna, 1996). At high concentration, iron (II) is toxic for most organisms (Delince, 1992).The seasonal variation of iron values in water samples from Lake Nasser and Balana sewage pond were represented in Table (3).The Iron concentration of water from Lake Nasser ranged from the maximum value (200.47µg/l) during spring and minimum value (116.34 µg/l) during summer.

The Iron concentration of Balana fish pond ranged from the maximum value

(453.5µg/l) during summer and minimum value (107.5 µg/l) during spring. The low value of iron is probably due to that iron removed from water either as carbonate or as sulphides. Which mean that the relative decrease in iron value in supply pond and fish pond during autumn due to the removal of Fe as iron sulphide (FAS) from water to sediment (Taileret *et al.*, 2000).

In general, the seasonal average concentrations showed noticeable increase of iron during winter for Lake Nasser than other seasons, which may be attributed to the low water level due to the drought period(Milllero *et al.*, 1991).

Table (3): The seasonal variation of heavy metals values (µg/L) in water samples from Lake Nasser and Balana sewage pond.

Site	parameter	Season				Mean± SD
		Spring	winter	Autumn	Summer	
Lake Nasser	**Iron (µg/L)**	200.467	317.51	167.7	116.343	
Balana pond		107.5	361.97	250.86	453.5	200.51±85.34
Lake Nasser	**lead (µg/l)**	11.17	9.7	8.33	10.78	293.46±149.11
Balana pond		2.01	1.52	1.01	5.2	9.97±1.5
Lake Nasser	**Zinc (µg/l)**	42.51	75.93	15.64	16.97	2.44±1.89
Balana pond		31.033	50	102.6	132.6	37.76±27.11

2: lead (pb^{2+}):

Lead is usually found in low concentrations in natural waters because lead containing minerals that are less soluble in water (Ravichandran and Jayaprakash, 2011).The seasonal variation of lead values in water samples from Lake Nasser and Balana sewage pond were represented in Table (3).The annual lead values of Lake Nasser ranged from the maximum value (8.33 µg/l) during winter and minimum value (11.17µg/l) during summer.

The maximum value of lead concentration for Balana fish pond was recorded in summer (5.2 µg/l), while the minimum value (1.01µg/l) was recorded in autumn. The low values of lead concentration was during winter and autumn in Lake Nasser which may be attributed to the drought period, whereas, the water levels decreased and the degradation of most aquatic organisms and organic matter would be increased (Ibrahim and Tayel, 2005). The relative higher in lead concentration during summer in the sewage pond may be due to regeneration of lead from decaying planktonic creatures (Bardarudeen *et al.*, 1996).The high concentration of lead may be attributed to the industrial wastes inflow, atmospheric inflow of dust containing car exhaust and increase in density of boats and ships, which discharge their effluents directly to the Nile (similar to Nasser Lake) adding high amount of lead in both the dissolved and particulate phases (Ibrahim and Tayel, 2005).

3- Zinc (Zn^{2+}):

Zinc is commonly found in the earth's crust, and natural releases to the environment can be significant. In addition, zinc is one of the most widely used metals in the world. The major industrial sources of zinc include electroplating, smelting and ore processing, and drainage from both active and inactive mining operations (Mirenda, 1986).The seasonal variation of zinc values

for Lake Nasser and Balana sewage pond were represented in Table (3).The annual Zinc averages of Lake Nasser ranged from the maximum value (75.93µg/l) during winter and minimum value (15.64 µg/l) during autumn. While, the maximum value of zinc concentration for Balana fish pond was recorded in the summer (132.6 µg/l), while the minimum value (31.03µg/l) was recorded in winter. The decrease of Zn values in Lake Nasser and Balana branch water was during spring due to precipitation of Zn to bottom sediment as zinc carbonate or zinc oxide, while the minimum values in autumn is related to discharged of zinc as sulphide (Toufeek,1993). Also, the organic matter enrichment in the sediment increases the deposition of sediment (Elewa *et al.*, 1990).

Heavy metals in the fish flesh of Tilapia (*Oreochromis-niloticus*):

1-Iron:

The Seasonal variations of total average concentration of iron in fish flesh and liver (µg/g) in Balana sewage pond and Lake Nasser represented in Table(4)**.**The annual iron averages of Balana sewage pond of fish flesh ranged from the maximum value (2307.017µg/g) during winter and minimum value (306.926 µg/g) during autumn. While the maximum value of iron concentration for Lake Nasser fish flesh recorded in the summer (1.86 µg/l), while the minimum value (0.572µg/l) recorded in winter. The maximum iron value of flesh in Lake Nasser fish is detected during summer > autumn > spring > winter while the values of liver is during summer > autumn > winter >spring.InBalana sewage pond fish, the maximum value of fish flesh observed during winter > spring >summer > autumn. For liver, the values is much higher spring > winter > autumn >summer. Iron toxicity causes hemorrhagic gastroenteritis, diarrhea, vomiting, convulsions, liver necrosis and death due to hepatic coma (Khallaf*et al.*, 1998).According to (FAO,1992) and (WHO,1989), the value of fish flesh of iron for Lake Nasser is accepted although but Balana sewage fish, the values exceed the accepted range

Table(4): Seasonal variations of total average concentration of iron in fish flesh and liver (µg/g) in Balana sewage pond and Lake Nasser.

Area of study	organ	Season			
		Spring	winter	Autumn	Summer
Lake Nasser	Liver	3.158	4.25	3.877	4.56
Balana pond		5361.69	3081.68	2561.994	1748.7
Lake Nasser	Flesh	0.624	0.572	1.76	1.86
Balana pond		2131.723	2307.0	306.926	679.153

2-Lead:

Lead is considered to be one of the most dangerous elements in ecology and aquatic ecosystem because of its increase in water and accumulation in sediment and fish muscles as well as food chain. Lead easily contaminated with water, sediment and fish from different sources of pollution e.g. sewage, domestic, agriculture and industrial wastes (Bastos and Nefussi, 1986). The Seasonal variations of total average concentration of lead in fish flesh and liver

(µg/g) in Balana sewage pond and Lake Nasser represented in Table(5).The average concentration of lead in fish flesh of *Tilapia* were from(0.450to 0.15733 µg/g) for Lake Nasser and from (5.482 to 0.06µg/g) Balana sewage pond during the study. The average concentrations of lead in liver of *Tilapia* were from (1.245to0.704 µg/g) for Lake Nasser and (4.481to166.163µg/g) Balana sewage pond during the study. For all seasons, The results in the present study revealed that the fish muscles contained lower concentration of metals compared to other organs, the same patter n observed by(Aldoghachi *et al.,* 2016).As well as, in Balana sewage pond during summer and autumn, followed the same pattern. The level of lead in fish flesh of Lake Nasser was highest value observed during autumn > summer > winter > spring. and for liver arrange in the following order; autumn > summer > spring > winter .

Table (5): Seasonal variations of total average concentration of lead in fish flesh and liver(µg/g) in Balana sewage pond and Lake Nasser.

Area of study	organ	Season			
		Spring	winter	Autumn	Summer
Lake Nasser	**Liver**	0.9425	0.704	0.884	1.245
Balana pond		166.163	148.467	5.317	4.4813
Lake Nasser	**Flesh**	0.1573	0.275	0.450	0.382
Balana pond		5.484	3.468	0.0917	0.0618

Also, in Balana sewage pond the concentration of lead, for flesh and liver during spring is the maximum followed by winter > autumn > summer. For sewage pond, lead accumulation in fish tissues is proportional to the water ambient concentration, (Tao *et al.,* 1999) but the rate of its depuration is dependent on the overall body concentration (Wang and Fisher, 1997). According to (FAO,1992) and (WHO,1989), the value of fish flesh of lead for Lake Nasser is accepted. While in Balana sewage fish lead values during summer and autumn is accepted but for winter and spring exceed the limits.

3.Zinc:

Fish can accumulate zinc from both the surrounding water and from their diet (Eisler, 1993). Although zinc is an essential element while at high concentrations it can be toxic to fish, cause mortality, growth retardation and reproductive impairment (Sorenson, 1991). Zinc is capable of interacting with other elements and producing antagonistic, additive or synergistic effects (Eisler, 1993). The Seasonal variations of total average concentration of zinc in fish flesh and liver(µg/g) in Balana sewage pond and Lake Nasser represented in Table(6).The total average concentration of zinc in fish flesh of *Tilapia* were from (8.6810 to 5.909 µg/g) for Lake Nasser and (66.272 to 24.19 µg/g) for Balana sewage pond during the study. During the period of study, the highest value for Lake Nasser was observed in liver then flesh. As well as, in Balana sewage pond during summer and autumn, followed the same pattern. For fish flesh of Lake Nasser, the metal zinc maximum value observed during autumn > summer > spring > winter and for liver is summer > autumn > spring> winter.

Table (6): Seasonal variations of total average concentration of zinc in fish flesh and liver (µg/g) in Balana sewage pond and Lake Nasser.

Area of study	organ	Season			
		Spring	winter	Autumn	Summer
Lake Nasser	Liver	8.397	7.837	9.667	10.527
Balana pond		255.467	417.11	343.384	112.847
Lake Nasser	Flesh	6.698	5.909	8.689	7.398
Balana pond		24.188	19.799	66.274	46.285

In Balana sewage pond fish organs, the concentration of Zinc in flesh is arranged in the following order autumn >summer >spring >winter, liver is winter> autumn> spring> summer. In sewage Balana ponds fish contaminated with the metal higher than fish in Lake Nasser which revels the amount of contamination by the metal in different environment. The high value of liver than flesh as the liver being a storage organ actively removes accumulated metals from the other tissues (Maiti and Banerjee, 2012).According to (FAO, 1992) and (WHO,1989), the value of fish flesh of zinc for Lake Nasser is accepted. In case of Balana sewage fish values during summer and autumn exceed the limits but for winter and spring values accepted.

Conclusion:

Based on the results obtained from analysis of physical and chemical parameters and heavy metals in water in three locations, Lake Nasser and Balana sewage plant's pond the following. can be concluded :

1. The physical, chemical parameters and heavy metals of Lake Nasser is accepted according to WHO, E.M.H and EEAA for drinking purposes and human consuming. According (Meade,1989), Lake Nasser water quality is suitable for fish growth. For Balana sewage fish pond, water quality is harmful to fish life.
2. The heavy metal concentration in water of Lake Nasser and Balana station fish pond was in the following orders (Fe> Zn >Pb).
3- The heavy metals levels in flesh of fish from Lake Nasser was accepted according to WHO and FAO for human consuming, but they were high in fish from Balana sewage and exceeded the permissible limits.
4- In Balana sewage pond, the metal distribution in fish's flesh was Fe>Zn>Pb, while for lake Nasser fishes it was Zn>Fe>Pb. For liver in Balana pond fishes, the distribution of metals is Fe>Zn>pb, while it was Zn>Fe>Pb in fish liver from lake Nasser.

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Seasonal variation of some heavy metals in tilapia fish organs in relation to water quality of lake Nasser and Balana sewage pond, Aswan, Egypt

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التغيرات الموسمية لبعض المعادن الثقيلة في أسماك البلطي وعلاقته بنوعية مياه بحيرة ناصر وحوض الصرف الصحي في بلانة، أسوان، مصر

علي كامل خلف الله[1] محمد الصديق فؤاد توفيق[2] ، نهاد محمد نجاتي[3]

1 - كلية العلوم- قسم الكيمياء- بجامعة أسوان

2 - معهد بحوث البحار والمحيطات 3- باحثة في جهاز شئون البيئة-وزارة البيئة

المستخلص

تهدف الدراسة إلي تحليل الخواص الفيزيائية والكيميائية والعناصر الثقيلة (حديد، زنك ، رصاص) للمياه التي يعيش فيها سمك البلطي في أحواض محطة الصرف الصحي ببلانة ومقارنتها بخواص مياه بحيرة ناصر ورؤية مدي تأثير خواص المياه علي الأعضاء الداخلية للسمكة . وتهدف أيضا المقارنة بين البيئة الملوثة بمياه الصرف الصحي وبيئة بحيرة ناصر. كما تشمل الدراسة مقارنة بين تراكم العناصر الثقيلة مثل (حديد , زنك ، رصاص) في أعضاء السمك (الكبد واللحم) الذي تم اصطياده من حوض الصرف الأخير بمحطة بلانة مع نفس أعضاء السمك الذي تم اصطياده من بحيرة ناصر.

وقد أظهرت النتائج أن:

1 - الخواص الفيزيائية والكيميائية والعناصر الثقيلة لمياه بحيرة ناصر جيدة ومناسبة بيئيا لأسماك البلطي تبعا لمنظمة الصحة العالمية بينما أحواض الصرف الصحي فى بلانه غير مناسبة لنمو الأسماك نمو طبيعي.

2 - ترتيب تركيزالعناصر الثقيلة في مياه بحيرة ناصروحوض الصرف الصحي حسب الأتي حديد> زنك > رصاص.

3 - بالنسبة للأسماك التي تم اصطيادها من بحيرة ناصر؛ وجد أن نسبة العناصر الثقيلة في لحم السمك مناسب للاستهلاك الآدمي حسب منظمة الصحة العالمية بينما لحم السمك الذي تم اصطياده من حوض الصرف الصحي غير مناسب للاستهلاك الآدمي بأضعاف القيمة المسموح بها طبقا لمنظمة الصحة العالمية.

4 - ترتيب العناصر الثقيلة في لحم السمك الذي تم اصطياده من البحيرة هو زنك>حديد> رصاص بينما السمك الذي تم اصطياده من حوض الصرف الصحي هو زنك>حديد>رصاص.