SOME STUDIIES ON THE EFFECT OF PREVAILING HEAVY METALS POLLUTION ON *ORECHROMIS NILOTICUS*

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ABSTRACT

This study was earned out in 2 private fish farms at Janaklies. Alexandria Governorate to investigate the residual effect of heavy metals pollution on *Orechromis niloticus* fish. 40 water samples and 40 *O. niloticus* fish samples ranging I 50-200 were collected. Heavy metals were estimated in water and fish. the results were evaluated according to the international standards of WHO and FAO. The results showed a positive correlation between the concentration of heavy metals in fish and it's concentration in water containing organic fertilizers. Some blood parameters, serum constituents and liver metabolites were non significantly decreased except serum glucose level and hepatosomatic index.

INTRODUCTION

Fish production has been considered one of the main sources of animal protein in developing countries including Egypt. Environmental pollution of water, soil and food becomes a threat to the existence of many plants and animals so it threat the survival of human.

Heavy metals were recognized as toxic substances due to their low rate of elimination from the consumer body either human or animal. Fish absorb heavy metals from water through gills, skin and digestive tract. Industrial and agricultural discharges, such as coal, oil combustions, phosphate fertilizers, plastics and pesticides were considered the main sources of heavy metal pollutants of water **WHO (1992); Marcel Galab (1997) and Wafa Eleraky *et al.*, (2003)**.

The aquatic environment including streams, rivers and lakes act as a reservoir for foreign organic chemicals which may be toxic to man and fish (**Bend *et al.*, 1980**).

This study was done to discuss the problem of water pollution with heavy metals and its residual effect on fish and on blood profile.

MATERIAL AND METHODS

Water and Fish samples were collected from two private farms during the period of fish growing, 1st farm received artificial feeding plus organic fertilizers and inorganic fertilizers, while, the second farm not received artificial feeding , organic or inorganic fertilizers, both two fish farms were stocked with *Oreochromis niloticus* fish and supplied with fresh water.

1-Determination of heavy metals:

a-Water samples:

Water samples were preserved by addition of 1 ml concentrated nitric acid per liter (1:1) until time of analysis. Water samples were analyzed according to method described by **APHA (1989)**. Water samples were filtered through 0.45 μ membrane filter. the filtrate was collected for measurement of lead, cadmium, Copper and zinc, in water using air/acetylene flame atomic absorption spectrophotometer (Unic CAM 696 AA spectrometer)

b-Fish samples:

Twenty fish samples of *Oreochromis niloticus* were obtained from each farm, the fish body weight ranged from 150 - 200 gram , each fish sample was represented by one gram offish flesh and digested according to the method described by **Finerty *et al.*, (1990)** .The obtained solutions were analyzed by using Air/Acetylene fame atomic absorption spectrophotometer (Uni CAM 696 AA Spectrometer).

2- Determination of some blood and serum parameters:

Serum and blood samples were collected from 20 fish from the examined cultured *O.niloticus.* and 20 fish from control aquarium that received dechlorinated tap water. The blood were taken over a heparinized vials by severing the caudal peduncle of fish (**Dabrowska *et al.*, 1989**).

The erthrocyte counts were determined by a double hacmocytometer using the method of **Wintrobe (1934)**.

Haemoglobin content was estimated by the method of **Van Kampen and Zifstra (1981)**, Serum protein was determined according to **Josphon and Gyllensward (1975)**, Serum glucose was estimated according to **Trinder (1969)**, Serum lipids were determined according to **Zollner and Kirch**

(1962), Liver glycogen was estimated according to **Handel (1965)**, while total lipids in liver were determined according to **Bligh and Dyer (1959)**.

RESULTS AND DISCUSSION

Fish had been regarded as a desirable nutritional source of high quality protein, minerals and vitamins.

Recently, a great attention had been paid extensively to the possible danger of environmental pollution offish farms.

Lead is unknown to be essential for the maintenance of biological systems and the general view is to decrease exposure to lead as possible, lead retained in the organs for a long time, being a dangerous cumulative poison (**Allcroft. 1951**).

Permissible limit of lead in water according to **WHO (1984)** is 0.05 mg/L (Table. 1). accordingly, the level of lead in waiter obtained from 1st farm and 2nd farm exceeded this limit. lead levels in the examined water samples are recorded in Table (2).

Water pollution with lead resulted in accumulation of lead in fish in concentrations exceeded the permissible limit intended by **Egyptian Organization for Standardization and Quality Control "E. 0. S. Q. C." (1993)** (Table. 1). The highest concentrations of lead were recorded in fish collected from 1st farm followed by 2nd Farm. These figures are parallel to the levels of lead in the examined water samples.

The high lead findings in the present study may be due to these farms subjected to water from motor cars (high gasoline combustion), industrial discharges or agricultural discharges as super phosphate fertilizers, which considered one of the primary sources of lead poisoning in fish in Ugypt. These findings coincide with those reported by **Nabawi *et al.*, (1987)**.

Cadmium is a accumulative poison. It has found in air. food. soil. plants and water (**Commission of the European Communities, 1978**).

Our results revealed that, the mean concentration of cadmium in water of the 2 farms, exceeded the permissible limit of **WHO (1984)** (0.001 mg/L). Similarly, the mean tissue cadmium levels in fish exceeded the permissible limits indicated by **FAO / WHO (1992)** (0.05 mg/L).

A correlation between cadmium levels in water and tissue residues in fish were observed, where the highest concentrations of cadmium in water and in fish were existed in 1st farm that received organic fertilizers followed by 2nd farm. The high cadmium level in water and fish should be considered with a great care because many studies revealed that cadmium had a

significant role in the incidence of some diseases e.g . diabetes mellitus (**Merali and Sighal, 1977**).

Copper is an essential element, having a role in formation of erythrocytes, release of tissue iron and development of bone, CNS and connective tissue. **WHO (1984)** set a guide line value for Copper in whaler to be 1mg/ L. Accordingly Copper level in examined water samples obtained from 1s1 farm exceeded tins limit, while the copper not detected in 21KI farm. The high water Chopper level in 1s1 farm was parallel to a high fish copper level. At the same time this elevated level ol 'copper is still under the permissible limit as shown in Table (1).

The estimated levels of zinc in water of 2 farms (Table. 2) were under the permissible limits which intended by **WHO (1984)** (Table. 1) also (table. 2) indicated that, tissue zinc residue in fish is also under the accreted limit (50 ppm) indicated in Table (I). However there, was a correlation between zinc concentration in water and its residues in fish.

The obtained results of Chopper and zinc in Table (2) revealed that copper and zinc accumulation in fish w'-ere not so remarkable. These findings coincided with **Heth *et al.*, (1966)** and **Clark (1989)** who stated that although fish from areas known to be contaminated, contain higher concentrations of Chopper and zinc than those from uncontaminated areas. Copper and zinc do not generally accumulate in food chains and do not make any hazard toxicity to man.

Table (3) cleared that, the erythrocyte counts, haematocrit value haemoglobin content in blood .

Niloticus fish reared in polluted water was non significantly decreased in comparing with fish reared in fresh water, this may be attributed to haemolysis of red blood cells caused by water compounds (**Mazher *et al.*, 1987**).

Also Table (3) showed that the serum protein and lipids of polluted O.N. fish were non significantly decreased. Our results nearly similar to **Kandil (1987)**.

Glucose concentration was significantly increased in polluted O.N. fish. This may be attributed to the high activation of glycolesis process (conversion of liver glycogen to blood glucose) and tins raises the concentration of glucose in the blood. Similar observation were also found by **Hilmy *et al.*, (1987)**.

Table (3) showed that the values of protein, lipid, glycogen and water content in the liver of O.N. fish reared in polluted water were non significantly decreased. The same observations were also found by **Kandil (1987)**. While hepatosomatic index was increased significantly, this may be attributed to increasing size and weight of the liver due to concentrated of heavy metals.

In the present study the elevated values of some heavy metals in water and muscular tissues of *O. niloticus* resulted from environmental pollution. Therefore tlie preventive measures intended for minimizing the pollution of water and raw Fish with such metals should be undertaken .including sanitary protection of surface water from these pollutants, minimizing the use of phosphates for land fertilization as possible and regular analysis of water and raw fish for these pollutants and tlie results should be evaluated according to the international guide lines as a fruitful advisc to delay pollution of water.

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Table (I): Recommended international levels of heavy metals in water and fishes.

Metal	Permmisible Limits in water	References	Permmisible Limits in fish	Country and References
Lead (Pb)	0.050 p.p.m	WHO (1984)	0.1 mg/Kg	Fgypt: Egyptian Organization for Standardization and Quality Control 'E. O. S. O. C. ' (1993).
			0.5 p.p.m	FAO/WHO (1992)
			2.0 mg/Kg	England: (MAAFF.1979)
			4.0 µg/g	NewZeland. In : Julshamn
			5.0 µg/g	Spain: Boletin Odcial del Estado (1 99 1). In: Sehuhmacher and Domingo (1996).
Cadmium (Cd)	0.005 p.p.m	WHO (1984)	0.05 p.p.m	FAO / WHO (1992)
			0.1 mg/g	Egypt: 'E. O. S. O. C. ' (1993).
			1.0 µ/g	Spain: Boletin Ofcial del Estado (1991). In: Sehuhmacher and Domingo (1996).
Copper (Cu)	1.000 p.p.m	WHO (1984)	20.0 p.p.m	Food Stuffs, Cosmetics and Disinfectants (1972).
			20.0 µg/g	pain: Boletin Oficial del Estado (1991). In: Sehuhmacher and Domingo (1996).
Zinc (Zn)	5.000	WHO (1984)	50.0 p.p.m	Food Stuffs, Cosmetics and Disinfectants (1972).
			50.0 mg/Kg	England: Food Standard Committee "FSC." In: Eromosele et al. (I 995)

Table (2): Heavy metals in water and *O. niloticus* Fish (Mean ± S.E)

Sources of samples	Lead		cadmium		Copper		Zinc	
	water	Fish	water	Fish	water	Fish	water	Fish
	p.p.m		p.p.m		p.p.m		p.p.m	
Fish farm received fertilizers	0.71 ± 0.20	2.14 ± 0.35	0.56 ± 0.06	0.484 ± 0.04	1.3 ± 0.06	2.6 ± 0.3	3.5 ± 0.3	7.55 ± 1.2
Fish farm Not received fertilizers	0.56 ± 0.3	1.30 ± 0.06	0.03 ± 0.07	0.38 ± 0.04	ND	0.85 ± 0.13	0.23 ± 0.15	0.70 ± 0.20

ND : Not determined ^ Increasing * : Decreasing

Table (3): Blood parameters, serum analysis and liver rnetabolites of *O.niloticus* fish reared in polluted water.

Item	Fresh water (Control)	Polluted water
Bood parametcrs:-		
Erythrocyte counts miliion/m^3	1.692±0.115	1.299±0.130
Haematocrit value %	37.99±1.39	29.86±1.90
Haemoglobin content gm/l00ml	6.91 ±0.33	4.33±0.79
Serum analysis:-		3.33±0.76
Protein (gm/l00ml serum) Lipid (gm/l00ml serum)	4.99±0.88	2.66±0.36
Glucose (mg/100 ml serum)	3.21±1-0.66	95.50±<8.99
	81.66±6.33	
		1.8.66±l,40
Liver metabolites:-	19.3.1 ±1.30	2.33±0.44
Protein (gm/l00grn tissue)	3.99±0.33	2.66±0.55
Lipid (gm/100 gm tissue)	3.33±0.18	51.13±2.10
Glycogen (gm/100 gm tissue)	56.19±1.9	
Water content (gm/100 gm tissue)	1.30±0.31	
Hepatosomatic index		2.88±3.36

الملخص العربى

دراسة تأثير تلوث المياه بالمعادن الثقيلة على اسماك مزارع البلطي النيلي

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أجريت هذه الدراسة في مزرعتين تابعتين للقطاع الخاص في منطقة جناكليس التابعة لمحافظة الإسكندرية لدراسة مشكلة تلوث المياه بالمعادن الثقيلة و مدى تأثير هذه الملوثات على أنسجة تلك الأسماك.

تم تجميع 40 عينة من الماء من الزرعتين و في نفس الوقت تم تجميع 40 عينة من اسماك البلطي النيلي عددها 40 سمكة يتراوح وزن كل منها بين 150- 200 جرام من تلك المزارع.

بعد تحضير العينات الخاصة بالمعادن الثقيلة و تجهيزها تم اختبار تلك الملوثات في المياه و الأسماك.

نتائج هذه الدراسة تم تقييمها على حسب المعدلات العالمية الموضوعة و المحددة بمنظمة الصحة العالمية و منظمة الأغذية و الزراعة.

أوضحت نتائج هذه الدراسة وجود ارتباط إيجابي بين معدل ترسيب المعادن الثقيلة في عضلات البلطي النيلي و معدل تركيزها في المياه و أيضا أوضحت نتائج هذه الدراسة زيادة معدل تركيز المعادن الثقيلة في الأسماك و الماء المزود بالمخصبات الطبيعية.