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Screening of Some Heavy Metal in Fish (*Tilapia nilotica*) Muscles at Rabak locality, in White Nile Sudan State

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Abstract

This paper aims to test and screen the concentration of some heavy metals (Cd, Cu, Zn and Pb) in Tilapia Nilotic fish in Rabak locality at the White Nile State, Sudan. Thirty samples of fish muscle were collected and analyzed by Atomic Absorption Spectrophotometer (AAS) in the National Research Center laborites, Khartoum. The results were revealed average concentrations of heavy metals in all fish samples of Zn, Cu, Pb and Cd 3.305, 0.685, 0.498, 0.075 mg/Kg respectively. The results showed that the lead (pb) was above the local and national standards, whereas, the three others heavy metals (Cd, Cu and Zn) were within the normal range of standards. There were no significant differences between the different investigated metals ($P<0.05$). In conclusion some trace elements can cause toxicity (Lead, Cadmium) to fish and this leading to public health hazard by consumption of meat fish.

Introduction

Heavy metals are considered the most important form of pollution of the aquatic environment because of their toxicity and accumulation by marine organisms (**Malik, 2014)**. The concentration of heavy metals in the fish from the River water has shown that the metal concentration found in the fish samples were higher than the range of maximum acceptable limits as per WHO (1993). The various industrial outlets which

drain into the river is a probable source of the heavy metals in the rivers, leading to severe deleterious effect in humans, fish and plants (**Sen *et al.*, 2011)**. Various national and international agencies have determined the recommended range of heavy metals permissible to human health (**Singh *et al.*, 2014)**. Fish as a food is consumed by many animal species, including humans. Three quarters of the Earth are covered by water, so fish has been an important part of the diet of humans in almost all countries in the world since the dawn of time. Fish is one of the cheapest sources of animal proteins and availability and affordability is better for fish in comparison to other animal protein sources. Fish serves as a health-food for the affluent world owing to the fish oils which are rich in polyunsaturated fatty acids (PUFAs), specifically omega-3 PUFAs and at the same time, it is a health-food for the people in the other extreme of the nutrition scale owing to its proteins, oils, vitamins and minerals and the benefits associated with the consumption of small indigenous fishes (Panda, 2015).

The pollution of the aquatic environment with heavy metals has become a worldwide problem during recent years, because they are indestructible and most of them have toxic effects on organisms (MacFarlane and Burchett, 2000).

Heavy metal concentrations in aquatic ecosystems are usually monitored by measuring their concentrations in water, sediments and biota (Camusso *et al*., 1995)

Metals, such as iron, copper, zinc and manganese, are essential metals since they play important role in biological systems, whereas mercury, lead and cadmium are toxic, even in trace amounts. The essential metals can also produce toxic effects at high concentrations. Only a few metals with proven hazardous nature are to be completely excluded in food for human consumption. Thus, only three metals, lead, cadmium and mercury, have been included in the regulations of the European Union for hazardous metals (EC, 2001).

High concentrations of heavy metals affected the growth and development of fish during early life stages such as hatching, larval development and juvenile growth because they were more sensitive during these stages than during mature stages. Evidently, fish form the link for the transfer of toxic heavy metals from water to humans (Ashraf ***et al.,*** 2010**)**. The harmful effect of trace elements when consumed above the recommended limit can be toxic (acute, chronic or sub-chronic), and heavy metals can be neurotoxic,

carcinogenic, mutagenic or teratogenic. Fishes are considered to be most significant biomonitors in aquatic systems for the estimation of metal pollution level (**Rashed, 2001**).The aim of this study was screening of heavy metal concentrations of cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn) in fish, at Rabak locality, White Nile State, Sudan.

Materials and methods

Study area

The study was carried out during 2020 in the Rabak locality in White Nile State, Sudan.

Collection of samples

A total of 30 samples of fish from Rabak central fish market were collectedin ice plastic bag and transferred to National Research Center, Khartoum, in refrigerator car (20 ^{o}C) for analysis of some heavy metals.

Preparation and treatment of samples

The samples were weighed with a sensitive scale. The samples were chopped with stainless steel knife to protect any possible contaminations. The muscles were cut to small pieces to facilitate the burning process. The sample was placed in an oven at 550 °C for 8 hours in a heat-resistant crucible. Then all muscles samples were left to cool until the next morning. Addition of 20% Hcl to each sample We prepare HCL acid 20%. Added to the 5 ml of acid HCl 20% is sample for digestion. Filtration (what man 45 paper) and addition of 25 ml of distal water for liquefying sample. The sample were red by Atomic Absorption Spectrophotometer (Perkin-Elmerin, 1996).

Statistical analysis

All the statistical analyses were computed with SPSS program. The recorded data were subjected to One-way analysis of variance (ANOVA) to assess the influence of different variables on the concentrations of heavy metals in the fish tested. ANOVA for each fish's was performed separately using variables.

Results and discussion

All the analyzed fish samples contained detectable concentrations and standard deviation of total Cd, Cu, Pb and Zn (Table 1). The average concentrations of heavy metals in all fish samples were in the order of Zn, Cu, Pb and Cd 3.305, 0.685, 0.498, 0.075 **(**mg/kg**)** respectively.

Table 1. **Descriptive measurements of contaminated samples of Heavy Metal (mg/kg) in *Tilapia nilotica* from Rabak locality at White Nile State**

Metal	Average	S D	Minimum	Maximum
Cd	0.075	0.05	0.02	0.179
Cu	0.685	0.64	0.149	3.726
Pb	0.498	0.23	0.196	1.058
Zn	3.305	1.51	1.723	9.662

Table 2 showed Cadmium found in fish Nile tilapia of 0.075 mg/kg. The obtained Cd values are below the EC and FAO limits of 0.1 mg/kg (FAO, 1983). The threshold for acute cadmium toxicity would appear to be a total ingestion of 3–15 mg. Severe toxic symptoms are reported to occur with ingestions of 10– 326 mg. Fatal ingestions of cadmium, producing shock and acute renal failure, occur from ingestions exceeding 350 mg (NAS-NRC, 1982). On the other hand, mercury was detected in all studied fish in the range of 0.014–0.055 mg/kg. These values are fortunately below the permitted limit of 1.0 mg/kg (EC, 2001) in the edible portion.

Copper contents of samples 0.685 mg/kg for fish Nile tilapia in table 2. Although, copper is essential for good health but very high intakes can cause health problems such as liver and kidney damage (Agency for Toxic Substances and Disease Registry, 2004). The maximum copper concentration for meat and meat products has been proposed 0.90–30 mg/d1 person. The copper concentrations obtained from this study were lower than those recorded by Canli and Atli (2003).

Table 2 showed Lead was present in range of 0.49 mg/kg in fish Nile tilapia. The obtained results are in not agreement with that obtained by Demirezen and Uruc (2006), their results ranged from 11.5 to 13.5 mg/kg in fish species from Turkey. However, the obtainted results of lead in the samples exceeds the permissible levels; 0.4 mg/kg (EC,

2001) and 0.5 mg/kg (FAO, 1983). Lead causes renal failure and liver damage in humans (Luckey and Venugopal, 1977).

The obtained results showed that the zinc contents of samples 3.305 mg/kg (table). 2. According to Bartik and Piscac (1981), normal concentrations of zinc in meat samples were 35–45 mg /d1 so it appears that most investigated samples in this study contained normal levels of zinc.

Table2: Standard level of heavy metal concentration for human consumption

Heavy metals	Cd (mg/kg)	Cu (mg/kg)	Pb (mg/kg)	Zn (mg/kg)	references
Results	0.075	0.685	0.498	3.305	
European Commission	0.05	-	0.4	-	EC 1881, 2006
FDA RI	0.01	-	2	40	(Suyanto et al 2010)
FAO	0.1	-	0.5	-	(FAO, 1983)
LAEA-407	0.18	3.28	0.12	-	Wyse et al., 2003
EC, 2001	1.0	-	0.4	-	EC, 2001

It is noticed that in table 3 heavy metal concentrations of cadmium (Cd), copper (Cu), lead (Pb) and zinc (Zn) in fish contents in the meats were significantly ($p < 0.05$).

Table 3: Analysis of the concentration of some heavy metals in fish (n=30) Iin White Nile State.

Heavy metals	Parameters	Sum of Squares	DF	Mean Square	F	Sig.
Zn	Between Groups	64.330	27	2.383	3.055	0.276
	Within Groups	1.560	2	0.780		
	Total	65.890	29			
Pb	Between Groups	1.484	27	0.055	15.564	0.062
	Within Groups	0.007	2	0.004		
	Total	1.491	29			
Cu	Between Groups	11.534	27	0.427	4.842	0.185
	Within Groups	0.176	2	0.088		
	Total	11.710	29			
Cd	Between Groups	5.350	27	0.198	2.066	0.378
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	Within Groups	0.192	2	0.096		
	Total	5.542	29			

Inclusion the majority levels of trace metals in fish Nile tilapia found naturally in White Nile State, Rabak, Sudan. The obtained results suggested that significant differences existed in the concentrations of fish. Cd, Cu and Zn levels in all samples were within fish Nile tilapia safety criteria, while Pb concentration in 0.498 of fish Nile tilapia samples exceeded according to the criteria.

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