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Lead and Zinc Contamination in *Clarias Lazera* Fish from Local Markets at Khartoum State, Sudan

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Abstract

Background and Objective: Fishes have been found to be good bio-indicators of heavy metal contamination in aquatic ecosystems. These metals have many harmful impacts on human health. This study aims to assess Lead and Zinc contamination in *Clarias Lazera* fish from Local Markets at Khartoum State from April 2019 to December 2020.

Materials and methods: A descriptive cross-sectional laboratory based study, where sample size was (n=50); divided into two markets "Almourada market (n= 25) and Almarkazi market (n= 25)" were collected randomly and statistically. All data were processed and analyzed using the Statistical Packages for Social Sciences (SPSS).

Results: The results revealed that different concentrations of contamination levels of Lead and Zinc in all samples examined. The highest contamination (1.740 mg/kg dry weight) of Lead was found in sample taken from Almarkazi market, also Zinc was (5.280 mg/kg dry weight) in sample taken from Almourada market. The Maximum Permissible Limit stated by Codex Alimentarius Commission is (0.3 mg/kg dry weight for both Zinc and Lead), which mean that fish types investigated have exceeded the stated permissible level.

Conclusion: The study confirmed that the highest contamination of *Clarias Lazera* with Lead and Zinc in all of samples, which indicates the high contamination of river's water with heavy metals, thus consumption of these types of fishes poses significant health risks to consumers. It recommended investigating the sources and causes of heavy metals pollution through conducting further studies to detect other metals and studied other fish species.

Keywords: Lead, Zinc, Contamination, *Clarias Lazera,* Fish, Khartoum

Introduction

Fish accumulate toxic chemicals such as heavy metals directly from water, diet, and contaminant residues may ultimately reach concentrations hundreds or thousands of times above those measured in the water, sediment or food [1]. The accumulation of heavy metal in fish has been studied and will documented, however research has been generally focused on the muscle tissues, while the distribution pattern among other tissues, such as liver and gills have been mainly neglected [2]. Bio-accumulation of heavy metals is capable of leading to toxic levels on fish even when the exposure is low and the presence of heavy metals pollutant in freshwater environment is known to disturb the normal balance of the aquatic organism, and can accumulate high levels of metals through water and their food [3]. Fish are notorious for their ability to concentrate heavy metals in their muscles and thus plays an important role in human's nutrition. They need to be carefully screened to ensure that unnecessary high level of some toxic trace metals are not being transferred to humans through fish consumption [4]. Furthermore the contaminants also concentrate in some of the organs of fish and cause lethal and range of sub lethal defects [5].

Materials and Methods

This is descriptive cross-sectional laboratory based study, The sample size was 50 samples was determined according to the (Central Limit Theorem) which states that the sample mean follows approximately the normal distribution with mean and

standard deviation of the population from where the sample was collected. The sample size has to be large (usually n ≥ 30) [6].

Sample Techniques

Twenty fife grams of every fish muscles were tested to determine the level of Lead and Zinc, using Atomic Absorption spectroscopy device (210VGP Buck Scientific, manufactured by United States of America). Were Zinc (Zn) was analyzed using Hollow Cathode Lamp (HCL) in a Flame atomizer Atomic Absorption Spectrometry (AAS). Lead (Pb) was analyzed using Electrode Less Discharge Lamp (EDL) in the Flame atomizer AAS. The extract was aspirated directly into the atomic absorption spectroscopy machine, and the results were given as mg/kg dry weight, according to the formula:

Actual concentration (mg/kg) = **(C X V) / (W).**

Where:

C: - is the concentration of the element in the sample solution in mg/L.

V: - is the volume of the undiluted sample solution in ml.

W: - Weight of dried sample digested.

Data Analysis

Primary data were processed and analyzed using the Statistical Packages for Social Sciences (SPSS) and Microsoft Excel Worksheet (2010).

Results

Table 1: The maximum and minimum concentrations of lead and zinc in Local Markets Khartoum City

Market Name	Concentration mg/kg			
	Lead		Zinc	
	Max	Min	Max	Min
Almourada market	1.390	0.145	5.280	1.725
Almarkazi market	1.740	***0.060***	3.100	***1.540***

n= 50

The above table reveals that the maximum concentrations of lead and Zinc were (1.390 Mg/kg) and (5.280 Mg/kg), respectively, in Almourada market. It shows that maximum concentrations of lead and Zinc were (1.740 Mg/kg) and (3.100 Mg/kg), respectively, in Almarkazi market.

n= 50

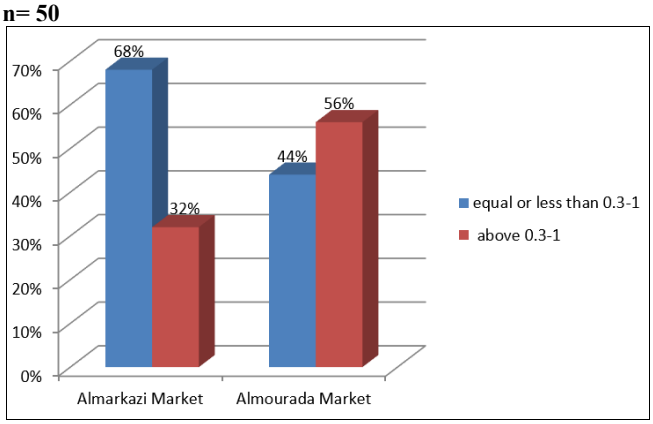

Fig 1: Concentration levels of lead in fish species detected in local markets, Khartoum State

n= 50

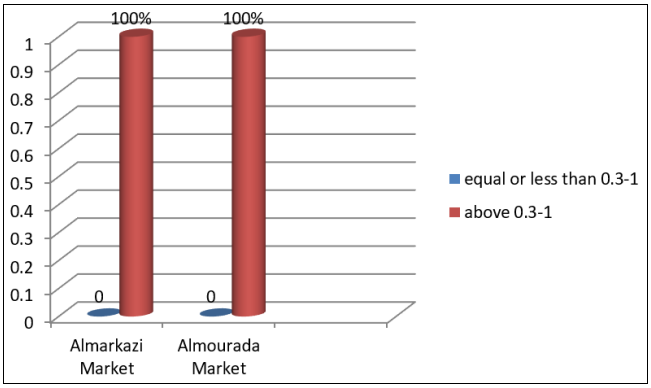

Fig 2: Concentration levels of zinc in fish species detected in local markets, Khartoum State

Table 3: Maximum permissible level of Lead and Zinc in fish and acceptable daily intake according to international standards in local markets, Khartoum State

Standards	Maximum Permissible level (MPL); (mg/kg dry weight)		Acceptable daily intake (ADI); mg/kg body weight/day	
	Lead (Pb)	Zinc (Zn)	Lead (Pb)	Zinc (Zn)
Codex, (2018).	0.3	0.3-1	0.002	0.050
FAO/WHO, (2011)	0.02	1.0	?	?*
EU, (2006)	0.30	?	?	?

Note: (?) refer to data not available

Discussion

The results showed that the maximum concentration of lead observed was 1.390 mg/kg, in *Clarias lazera* detected at Almourada market, which exceeded the 0.30 mg/kg (MPL) determined by [7]. These levels therefore constitute an immediate hazard to both aquatic fauna and human consumer. This finding was different from result obtained by [8]. Who detected 0.0145 mg/kg lead (WHO standard, (2011); below 0.02 mg/Kg). Also different from the result carried by [9]. Lead was still below the detectable limits.

In this study (44%) samples of *Clarias lazera* detected at Almourada market revealed levels (0.145 mg/kg) of lead, below 0.3 mg/kg (MPL) determined by CAC, (2018). This result disagreed with result obtained by [10] who reported that the concentration of lead in fish collect from Merowe Dam on the River Nile, North Sudan was 0.720 mg/kg, higher than the permissible limit.

Thirty two percentage of samples of *Clarias lazera* detected at Almarkazi market revealed (1.740 mg/kg) levels of lead exceeding the (MPL) determined by [7]. These high concentrations could be attributed to agricultural, industrial and residential effluent [11]. Agreed with what was obtained by [12], who found that the maximum concentration of lead was 0.673 mg/kg, higher than the 0.02 mg/Kg, [13] also agreed with what was reported by [10], who reported the concentration of lead in fish collect from Merowe Dam on the River Nile, North Sudan was 0.720 mg/kg.

In this study the minimum concentration of lead in *Clarias lazera* detected at Almarkazi market was 0.060 mg/kg, below the Codex standard, this result similar to result obtained by [14], who found 0.080 mg /kg at Athi River.

The study demonstrated that all samples (100%) of *Clarias lazera* at Almourada and Almarkazi markets revealed levels of zinc at range (5.280-1.725) and (3.100-1.540mg/kg)

respectively, exceeding the 0.3 mg/kg, (MPL) determined by [7]. High concentrations of zinc through food, can affect health, even for a short time, this was also confirmed by [10]. This result different from result obtained by [8] who found that zinc showed levels (0.2762-0.0403mg/kg), situated well within recommended limits 1.0 mg/Kg [13], in all samples of (*Clarias lazera*) collected from the three markets (Almourada, Jebel Aulia and Almarkazi).

Conclusions

The study confirmed the high contamination of fish (*Clarias lazera*) by Lead and Zinc in all of samples, which indicates high contamination of river's water by these heavy metals.

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Ethical Consideration

Ethical approval was taken from the appropriate management authority; The General Department of Health Affairs and Ministry of Health Khartoum State. And from University of Khartoum- Faculty of Public and Environmental Health, Ethical permission to carry out study was obtained prior data collection from local authorities.

Abbreviations

AAS	Atomic Absorption Spectrometry
ADI	Acceptable Daily Intake
AOAC	Association of Official Analytical Chemist.
CAC	Codex Alimentries committee
EDL	Electrode Less Discharge Lamp
EU	European Union
FAO	Food and Agricultural Organization
HCL	Hollow Cathode Lamp
MPL	Maximum permissible level
Pb	Lead
WHO	World Health Organization
Zn	Zinc

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