Omdurman Islamic University Journal(OIUJ)
مجلة جامعة أم درمان الاسلامية
https://journal.oiu.edu.sd/index.php/oiuj
https://doi.org/10.52981/oiuj.v19i1.2955
2022; 19(1):266-274
ISSN: 5361-1858

Some heavy metal contents and enzymes in two fish species from two areas along the White Nile

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To cite this article:

Bassir, A. R. H. E.-, I. M. Alim, D., Yagoub Haroon Abdalla, M., Abaker Yahia Ahmed, S., & Abdrhman Ibrahim Adam, T. (2023). Some heavy metal contents and enzymes in two fish species from two areas along the White Nile. *Omdurman Islamic University Journal*, *19*(1), 266-274. https://doi.org/10.52981/oiuj.v19i1.2955

Abstract

The objective of the present study was to determine heavy metals and two enzymes of two fresh water fish namely: *Oreochromis niloticus* and *Synodontus schall* from two sites along the White Nile . Al-Dubaseen area was considered the site with high contamination where dumping of industrial effluents takes place and Al-Kalakla area was 5km south before the dumping area and considered area with less pollution. Twenty Fish samples from the two sites were transported to the laboratory for the estimation of the heavy metals Lead(Pb),Cadmium(Cd),Iron (Fe) ,Zinc(Zn) and two enzymes glutamic-pyruvic transaminase (GPT) and Glutamic-oxaloacetic transaminase (GOT) .Results revealed that both fish species accumulated Pb,Fe,and Cu above permissible levels whereas Cd and Zn levels were within permissible levels. Results also showed that gills in general accumulated more heavy metals than muscles in both studied species .The heavy metals pattern in both muscles and gills was Fe> pb>Cu>Cd>Zn. The enzymatic estimation showed that activity of the two enzymes showed elevated levels of GOT than GPT in both fish collected from both two sites.

Keywords: ***Oreochromis niloticus*, *Synodontis schall* ,Heavy metals, enzymes Pollution,**

1.Introduction:

The ever growing populations and expansion of industrialization are two major causes of incessant increase of pollutants in the aquatic ecosystems. Heavy metals are considered persistent toxicants in the aquatic bodies and accumulate in aquatic organisms such as fish that eventually pose both non-carcinogenic and carcinogenic human health risks (Yacoub,*et al*.,2021).

Mahboob *et al.* (2020) stated that aquatic pollutants have effects on biochemical activities of fish before any significant change in the external appearance and behavior of fish . Enzyme activities such as glutamic-pyruvic transaminase (GPT) and Glutamic-oxaloacetic transaminase (GOT) are liver specific enzymes that give a more understanding of liver and kidney damage that can be assessed within a short time (Ukazu and Chidumi,2021);moreover Gabriel *et al*.(2012)reported that alterations in the values of GOT and GPTT suggest tissue damage in some important organs such as liver, kidney, muscle and gill. Thus GPT and GOT enzyme activities are considered sensitive biochemical indicators before harmful effects occur in fish.Moreover their activities are considered useful biomarkers to determine aquatic pollution .

The objectives of this research were to determine the level of some heavy metals in the muscles and gills of two commercial fish ,*Oreochromis niloticus* and *Synodontus schall,* and compare them with permissible levels .As well estimate the activity of glutamic-pyruvic transaminase (GPT) and Glutamic-oxaloacetic transaminase (GOT) in both fish species .

2.Materials and methods:

Ten fresh fish specimens of *Oreochromis niloticus,* and ten *Synodontis schall* were captured from Al-Kalakla and Al-Dubaseen, areas along the White Nile , Khartoum State. The samples were washed with tap water and placed in plastic bags ,transported to the laboratory for analysis.

2.1.Heavy metals analysis:

Atomic absorption spectrophotometer (210VGP Buck Scientific) double beam manufactured by United States of America was used in measuring the concentration of Lead (pb),Cadmium(CD),Iron (Fe),Copper(Cu) and Zinc (Zn) in fish samples according to (AAS, 1994).The heavy metal analysis was done in triplicate and reported as mean heavy metal content in mg/L. of dry matter.

2.2.Enzymes activity levels:

Liver tissue after thawing were cut with razor, washed with distilled water and blotted with blotting paper. A weighed portion of liver was homogenized in 3 ml ice-cold saline (0.89% NaCl) solution for saline extract in a motor driven teflon glass homogenizer. The homogenate was centrifuged at 4,000 rpm (3,500 ×g) for 45 minutes at 5°C in a refrigerated centrifuge (DAMON/IEC DPR-6000) to get a clear saline supernatant. Aqueous liver extract in ice-cold saline was used for the estimation of enzymes like glutamate oxaloacetate transaminase (GOT), glutamate pyruvate transaminase (GPT), using uv -spectophotometer (Reitman, S. and Frankel, S., 1957).

2.3.Data analysis:

The descriptive statistics (mean, standard deviation) were conducted while statistical significance of differences ($P \leq 0.05$) was determined by analysis of variance (ANOVA) with SPSS .

3.Results and discussion:

The study investigated Lead(Pb) ,Cadmium(Cd),Iron (Fe),Cupper (Cu) and Zinc(Zn) concentrations in gills , muscles of two commercially important fish species from Al-Dubassen Bridge area and Al-Kalakla area in Khartoum state . The Nile Tilapia *O.niloticus* and *S. schall* were selected because they are the most commonly found fish in the study area.

3.1.1.Heavy Metals Content in edible muscles :

Results showed that both fish collected from the two sites contain heavy metals more than accepted levels as shown in Tables (1 and 2).

Table (1): Permissible levels and Mean heavy metal concentrations (mg\L) in *O .niloticus* muscles collected from Al- Dubaseen and Al-Kalakla areas.

Area	Heavy metals (mg\L)				
	Pb	Cd	Fe	Cu	Zn
Al-Dubaseen	0.295	0.0645	1.338	1.1215	0.0124
Al-Kalakla	0.2895	0.06	1.3275	0.12	0.0125
Permissible levels (FAO 1984)	0.02	0.5	0.8	0.015	1.0

O.niloticus recorded high levels of Pb , Fe, Cu and Zn collected from both sites while Cd was found in concentrations within the permissible levels as shown in Table (1). Likewise *S.schall* showed the same results as *O.niloticus* (Table2).

Table (2) Permissible levels and Mean heavy metal concentrations (mg\L) in *S. schall* muscles collected from Al- Dubaseen and Al-Kalakla areas

Area	Heavy metals (mg\L)				
	Pb	Cd	Fe	Cu	Zn
Al-Dubaseen	0.259	0.05	1.0945	0.1165	0.01135
Al-Kalakla	0.2425	0.042	1.1015	0.1175	0.0116
Permissible levels (FAO 1984)	0.02	0.5	0.8	0.015	1.0

Comparing heavy metal concentrations in both fish collected from both sites, results showed that both species collected from Al -Dubaseen have higher concentrations of heavy metals than fish collected from Al-Kalakla except for Zn in *O.niloticus* as shown in Table 3.

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The pattern of heavy metals content in edible muscles was Fe> pb>Cu>Cd>Zn in both species from Al-Dubaseen area .

Table(3): Mean Heavy concentrations (mg/kg) in muscles of *niloticus* and *S.schall* collected from Al-Dubaseen and Al- Kalakla areas

Site	Species	Pb	Cd	Fe	Cu	Zn
Al-Dubaseen	*O.niloticus*	0.295	0.065	1.340	1.12	0.012
	S.schall	0.259	0.042	1.090	0.117	0.013
Al-Kalakla	*O.niloticus*	0.290	0.060	1.328	0.120	0.013
	S.schall	0.243	0.040	1.100	0.117	0.012

3.1.2.Heavy Metals Content in gills :

The gill is the first organ to be exposed to water pollutents .In this study accumulation of heavy metals in gills of the two species collected from both Al- Dubaseen and Al-kalakla are showed in figures (1-2)

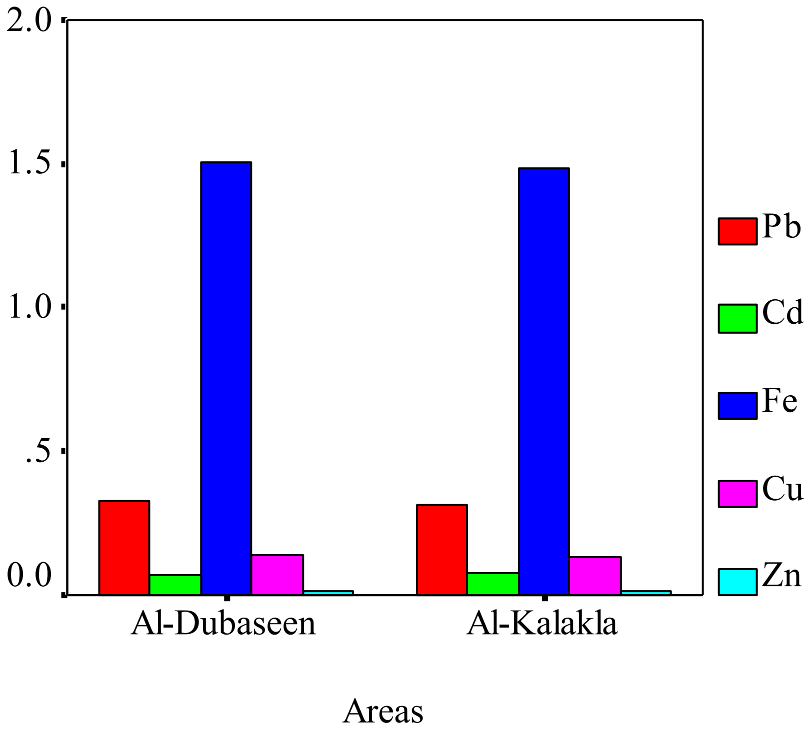
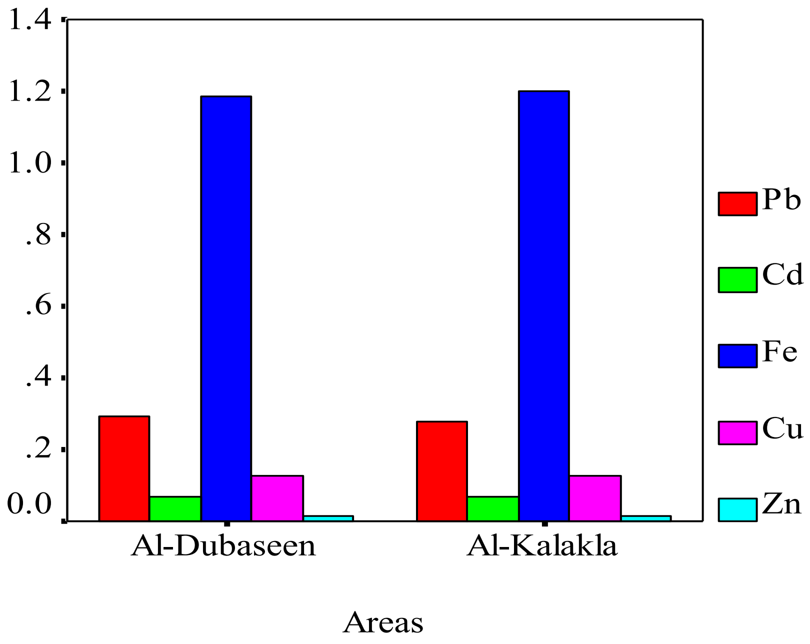


Fig (1) Heavy metals concentrations in *O. niloticus* gills from both Al-Dubaseen and Al-Kalakla areas



Fig(2) Heavy metals concentrations in *S. schall* gills from both Al-Dubaseen and Al-Kalakla areas

Results showed that both fish collected from both sites contained concentrations higher than permissible levels as shown in Figures (1-2) Content of heavy metals in the gills of both species collected from both site showed a pattern of Fe> Pb>Cu>Cd>Zn.

3.2.GPT and GOT Activities :

Glutamic- oxaloacetic transminase (GOT) and glutamic- pyruvate transminase (GPT) activities were determined in both *O.niloticus* and *S.schall* collected from Al-Dubaseen and Al-Kalakla areas. Results showed that GOT was higher and GPT was lower in *O.niloticus* collected from Alkalakla area as shown in Figure (3).

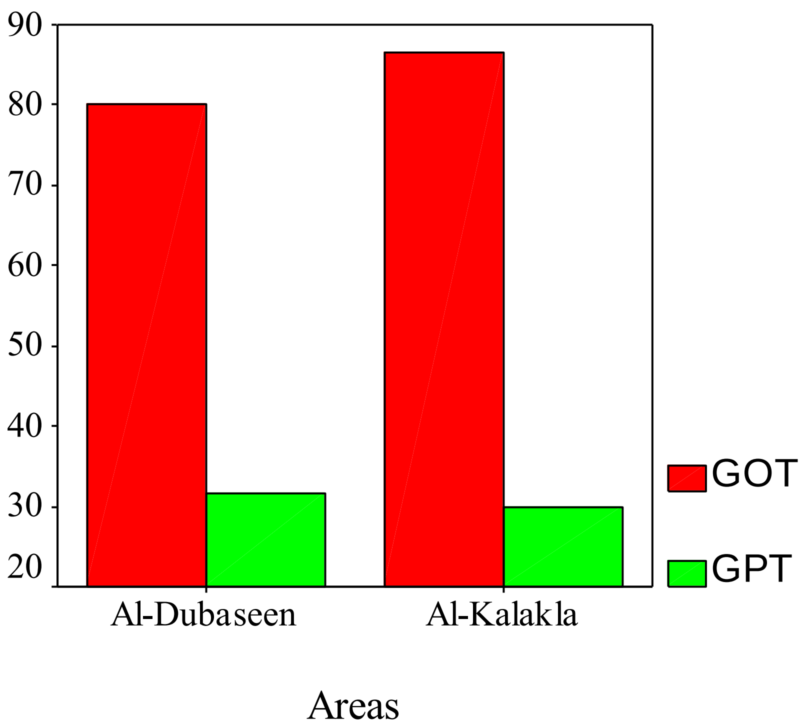


Fig (3): Enzymes levels of *O. niloticus* liver from Al-Dubaseen and Al- Kalakla areas

S.schall collected from Al-Dubaseen also showed higher level of GOT and lower level of GPT than the ones collected from Al-Kalakla as shown in Figure (4).

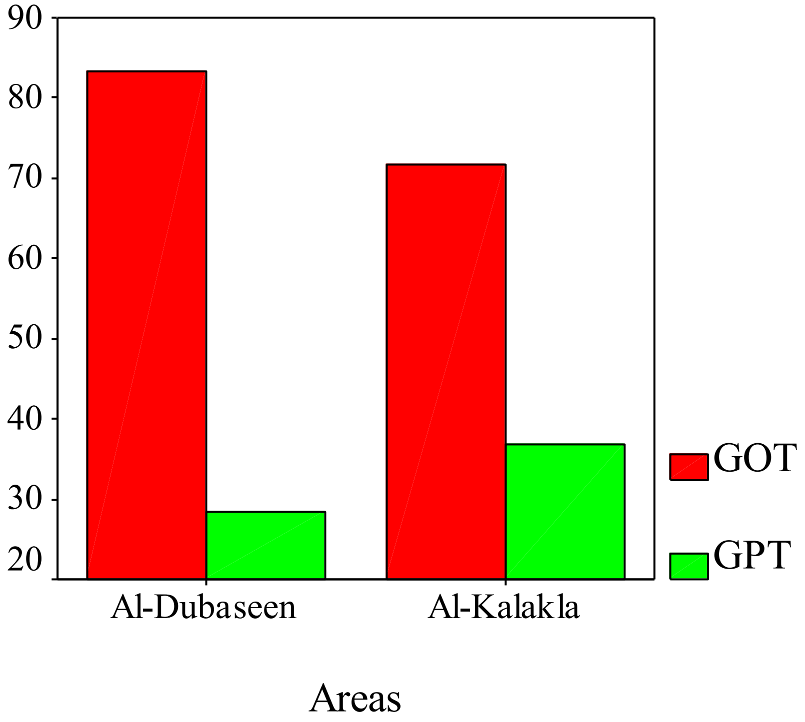


Fig (4) Enzymes contents of *S. schall* liver from Al-Dubaseen and Al- Kalakla areas

For heavy metals the highest values were in *O. niloticus* from Al-Dubaseen area.
This study indicates that heavy metals concentration in different fish species differs, this in line with opinion of Atuanya *et al* (2011) that stated that concentration of heavy metals varies with variation in fish species.
This investigation showed that different fish species contained different concentrations of a certain metal in their different organs . In agreement with these findings, Kalay, *et al* (1999) reported that different fish species accumulate metals in their tissue in significantly different values. Canli and Atli, (2003) reported that levels of heavy metals in fish vary in various species. This can be attributed to factors such as metal concentration, age, size, physiological status, habitat preferences, feeding behavior of the different fish species.

In general among the two studied organs in the two fish species the gills accumulated the highest concentrations of all studied heavy metals. This finding agreed with that of Al-Weher (2008) working with Cd, Cu and Zn. Fish are exposed to waterborne heavy metal fractions when taking in considerable amount of water in the process of respiration and osmoregulation. Therefore gills serve as the important route of heavy metal exposure from surrounding water. The large surface area of gills further facilitates the adsorption of heavy metals onto the surface of gills during respiration (Dallinger *et al* 1987); Reynders *et al*., 2006; Di Giulio and Hinton, 2008). Fish muscle is the edible part of fish and frequently employed in assessing health risks in relation to fish consumptions. The concentrations of Pb , Cd, Fe, Cu and Zn in fish muscle tissues examined in this study were well situated within the permissible limits of (FAO, 1984). Results showed pattern of heavy metals content in edible muscles was Fe> pb>Cu>Cd>Zn in both species. Similar results was observed by (Abdulali e *t al* 2012).

For Glutamic- oxaloacetic transminase (GOT) and glutamic- pyruvate transminase (GPT),results showed that GOT was higher and GPT was lower in *O.niloticus* collected from Alkalakla area.

4.Conclusion and Recommendations:

The study showed that fish species collected from the two sites contained varying concentrations of heavy metals and the degree of their accumulation varied between the two species . The accumulation rate of heavy metals in the muscles and gills of tilapia fishes were in the following order Fe> pb>Cu>Cd>Zn. It was concluded that fish muscles of the two species bioaccumulate heavy metals in concentrations that could be unsafe for human consumption . It was concluded that changes in the physiology composition of the fish were revealed by elevated enzyme activities in this study. Accordingly monitoring of heavy metal along the White Nile is recommended in view of the possible risks to health of consumers. It is also recommended that environmental laws should be enforced and applied effectively, to protect the aquatic ecosystems.

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