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

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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 highest contamination where dumping of effluents, Al-Kalakla area was 5km south before the dumping area and considered area with least pollution.

The fish species from the two sites were transported to the laboratory for the estimation of some heavy metals, and two enzymes. For enzymes the range was 28.33-86.66, the heavy metals ranged between 0.0124%-1.338%,

This investigation is an important measure towards the data needed to create information of the relationship between food type and biochemical composition.

Results showed that all the fish samples could be used as good sources of nutrition.

As the present study revealed that the fish species, there is need to investigate in detail the types of amino acids and fatty acids of the fish species found in these areas.

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

Introduction:

Fish provide a good source of readily digested high quality animal protein. Also fish plays important roles in the prevention and management of many human diseases such as heart disorders, neurological diseases, mood swings and when fish is substituted for beef, the nitrogen is utilized better resulting in a decreased excretion of uric acid in the urine (Thilsted and Roos, 1999 and Conquer and Holub, 2002).

Fish tissue is a good source of fats, proteins, vitamins and minerals and important component of balanced diet. Omega-3 and omega-6 fatty acids (FA), as well as fat-soluble vitamins are essential compounds of fish lipids and exclusively provided by the diet.

There is an evidence of beneficial effects of fish consumption (FAO, 2011) in relation to coronary heart disease (Mozaffarian and Rimm, 2006), stroke, age related muscular degeneration and mental health (Peet and Stokes, 2005). There is also convincing evidence of benefits in terms of growth and development, particularly for women during gestation and children during infancy for optimal brain development (Young and Conquer, 2005).

Materials and methods:

Fresh fish specimens of *Oreochromis niloticus*, and *Synodontis schall* were obtained for this study from Al-Kalakla and Al-Dubaseen, areas, Khartoum State. The samples were washed with tap water and samples of the flesh were taken for different analysis.

Heavy metals analysis:

Elements such as lead, cadmium, iron, copper and zinc were determined using Atomic Absorption Spectrophotometric method. The content were done in triplicate and reported as mean heavy metal content in mg/L. of dry matter.

Enzymes contents:

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 -spectrophotometer (Reitman, S. and Frankel, S., 1957).

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 . Duncan (1955).

Results and discussion:

Heavy Metals Content :

In edible parts (muscles):

Ever growing human activities continuously increase the amount of heavy metals in the environment, especially in aquatic ecosystem. Pollution of heavy metals in aquatic ecosystem reached alarming rates and has become an important worldwide problem. 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 .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 | <i>O.niloticus</i> | 0.295 | 0.065 | 1.340 | 1.12 | 0.012 |
| | <i>S.schall</i> | 0.259 | 0.042 | 1.090 | 0.117 | 0.013 |
| Al-Kalakla | <i>O.niloticus</i> | 0.290 | 0.060 | 1.328 | 0.120 | 0.013 |
| | <i>S.schall</i> | 0.243 | 0.040 | 1.100 | 0.117 | 0.012 |

In Gills :

The gill is the first organ to be exposed to water pollutants .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)

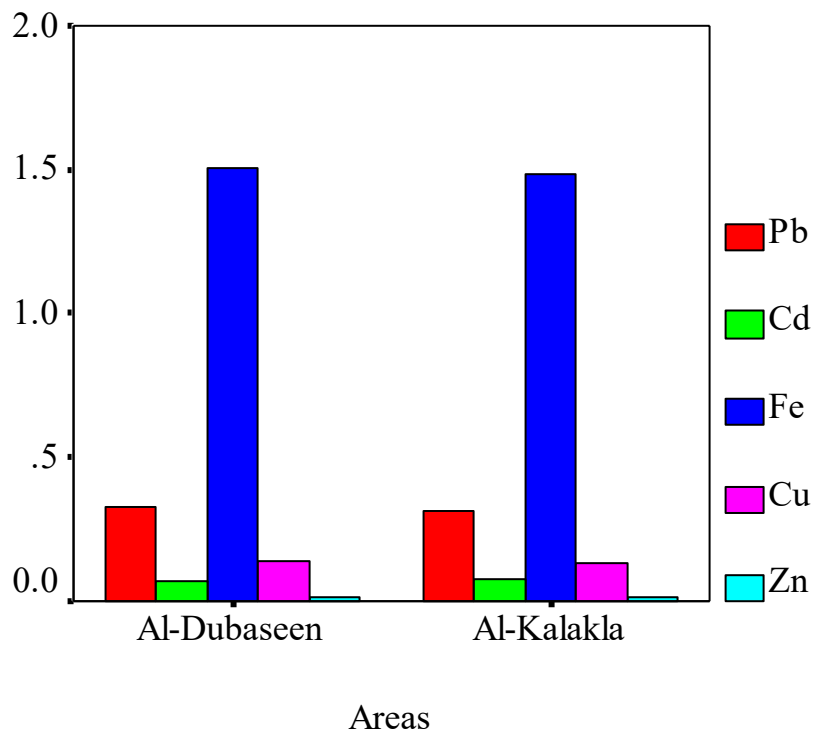


Fig (1) Heavy metals concentrations in *O. niloticus* gills from both Al-Dubaseen and Al-Kalakla areas

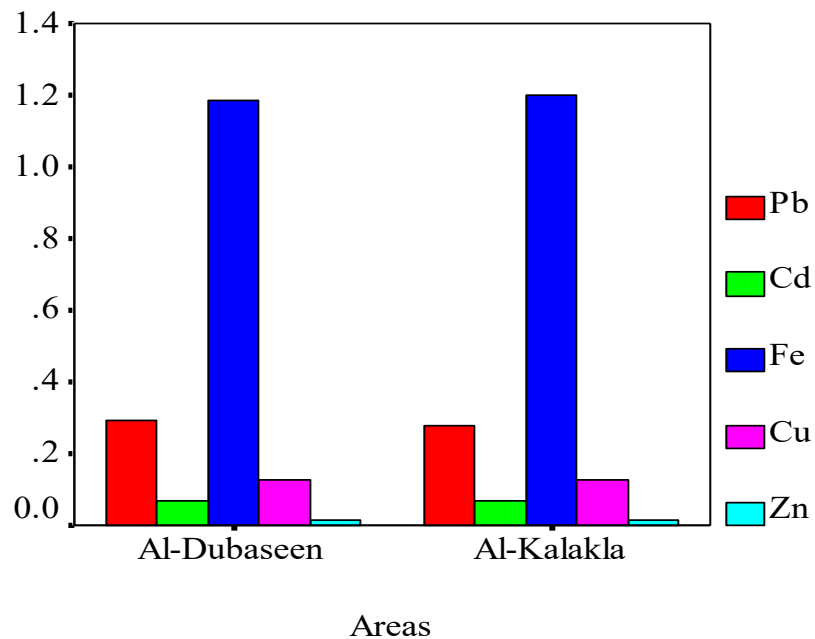


Fig (2) Heavy metals concentrations in *S. schall* gills from both Al-Dubaseen and Al-Kalakla areas

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 $Fe > Pb > Cu > Cd > Zn$.

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).

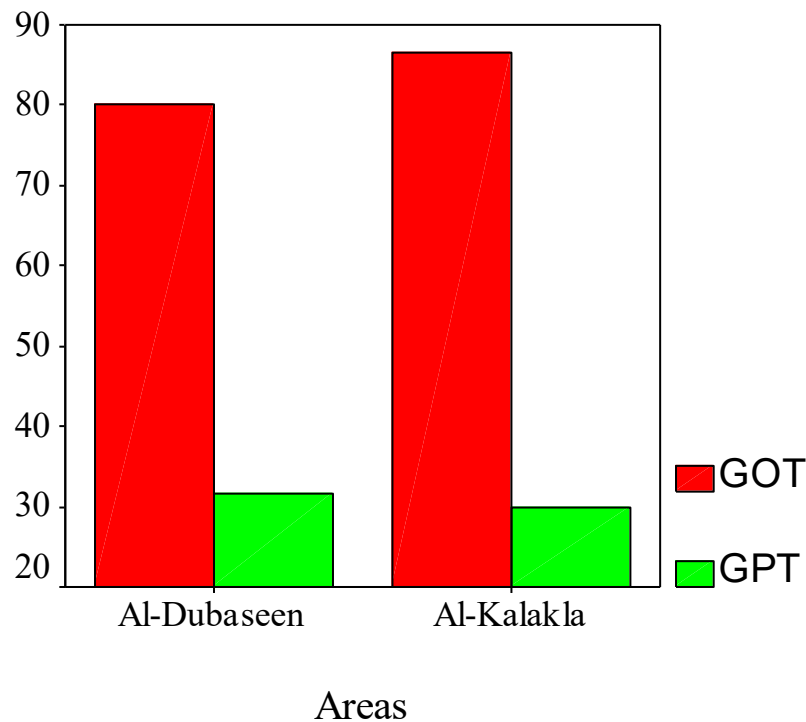


Fig (3) : Enzymes levels of *O. niloticus* liver from Al-Dubaseen and Al- Kalakla areas

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

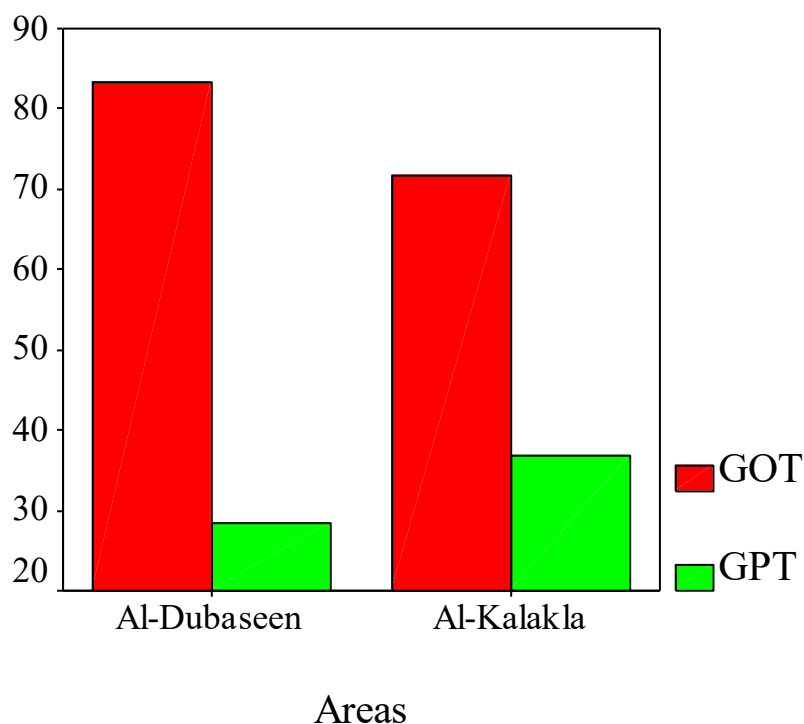


Fig (4) Enzymes contents of *S. schall* liver from Al-Dubaseen and Al- Kalakla areas

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 concentration of heavy metals varies with variation in fish species.

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. 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 that in the different parts of fish. The pattern of heavy metals content in edible muscles was

Fe> Pb>Cu>Cd>Zn in both species. Similar results was observed by (Abdulali *et al* 2012).

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

Conclusion and Recommendations:

The results of the present study showed that the different examined fish species are good sources of protein.

In addition to this the result revealed the proximate composition values obtained would be useful to help the consumers in choosing fish based on their nutritional values.

In conclusion, the results of this study can be used in the studies on human nutrition and food composition.

Environmental laws must be enforced and applied effectively, to protect the environment.

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