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Determination of heavy metals in three species of fish (*Tilapia zilli, Synodontis nigrita* and *Clarias gariepinus)* from Tagwai dam.

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Abstract
The pollution of the aquatic environment with heavy metals has become a worldwide problem in recent years, due to their recalcitrant nature and most of them have toxic effect on living organisms The study was aimed at determining the concentration of some selected heavy metals namely; Manganese, Iron, Copper and Zinc (Mn, Fe, Cu and Zn) in Tilapia zilli, Synodontis nigrita and Clarias gariepinus from Tagwai dam using standard methods. sample were blended into fine powder and sieved for digestion. The levels of heavy metals were determined using atomic absorption spectrophotometer. The results revealed that Zinc has the highest concentration (33.61 and 64.49mg/kg) and Copper has the lowest concentration (2.78 and 2.70) in both Synodonits nigrita and Clarias gariepinus, and both follow the same trend in order of decreasing: Zn > Fe > Mn > Cu. While in Tilapia fish Iron has the highest concentration (38.98mg/kg) and Manganese has the lowest concentration (4.34mg/kg) and follows the trend in a decreasing order: Fe > Zn > Cu > Mn. All the concentrations obtained for these heavy metals analysis was below the maximum permissible limit recommended by international standard organization, hence they are safe for human consumption.
Keywords: *Spectrophotometer, Heavy metals; Tilapia zilli, Synodontis nigrita; Clarias gariepinus*

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I. Introduction

The pollution of the aquatic environment with heavy metals has become a worldwide problem in recent years, because they are recalcitrant to degradation and most often have toxic effect on living organisms (Mac Farlane and Burchett, 2000). Dinis and Fiusza, (2009), defined heavy metals as any metallic chemical element that has a relatively high density (superior to 5 g/cm^3); most of them are carcinogenic or toxic even at low concentration such as mercury (Hg), cadmium (Cd), Arsenic (as), and chromium (cr). Among environmental pollutants, Heavy metals are of particular concern, due to its potential toxic effect and their ability to bio-accumulate in aquatic ecosystems (Censi *et al.,* 2006). When these heavy metals are biomagnified in the food chain and get in contact with humans via food, drinking water and air,it may lead to several diseases. Fish samples can be considered as one of the most significant indicators in freshwater systems for the estimation of metal pollution level. The commercial and edible species have been widely investigated in order to check for those that are hazardous to human health (egum *et al.,* 2005). Heavy metals are implicated in neurological disorders especially fetus, which can lead to behavioral changes and impaired performance in IQ (intelligent quotient) test (Landner and Linderstrom, 1998).

The recalcitrant nature and long-term toxic effects of heavy metals including lead (Pb), nickel (Ni), Manganese (Mn), Zinc (Zn), cadmium (Cd) and chromium (Cr) to man as a result of consumption of organism obtained from polluted rivers has raised scientific and environments concerns (Kar *et al.,* 2008; Alaa and Werner, 2010; Oronsaye *et al.,* 2010; Javed and Usmani, 2011; Abdel-Baki *et al.,* 2011; Ekeanyanwu *et al.,* 2011; Olowoyo *et al.,* 2012; Kumar *et al.,* 2012).

In aquatic environment, larger animals such as fish have been exposed to heavy metals as a direct consequence of biomagnifications (Ekwanyanwu *et al.,* 2011; Javed and Usmani, 2011). The danger is that heavy metals even at low concentrations in fish and water have a particular significance in ecotoxicology and their toxic effects have been widely published for a number of water bodies (Obasohan, 2008; Kar *et al.,* 2008; Agatha, 2010; Oronsaye *et al.,* 2010; Abdel-Baki *et al.,* 2011; Javed and Usmani, 2011; Ekwanyanwu *et al.,* 2011). Ekwanyanwu *et al.,* (2011) reported a concentration of 0.13mg/kg Mn and 0.62mg/kg Cd in fish. FAO/WHO has however set recommended limits of individual elements in water and fish (WHO, 1989). Among aquatic species, fishes are the inhabitants that cannot escape from the detrimental effects of heavy mental pollution. This is because of their very intimate contact with water that carries the heavy metals in solution or suspension and also fish have to take in oxygen from water-by passing water over their gills. The gill particularly is therefore a potential site of absorption of heavy metals and can be considered as one of the most significant indicators in water systems for the estimation of metal pollution level (Rshed, 2001; Ekwanyanwu *et al.*, 2011). In fact, the transfer factor of heavy metals in fish gills in respect to water has been studied to give information on how these metals are transferred to fish from aquatic ecosystem (Kalfakakour and Akrida-Demertzei, 2000; Abdel-Baki *et al.*, 2011). It is worthwhile noting too that other fish organs including the muscles, liver and kidney have also been studied for heavy metal accumulation (Ozturk *et al.*, 2009; Begum *et al.*, 2009; Edem *et al.*, 2009; Ekwanyanwu *et al.*, 2011; Javed and Usmani, 2011).

Fish play an important role in human nutrition and therefore need to be carefully and routinely screened to ensure that there are no high levels of heavy metals being transferred to man through consumption. The aim of this study was to Determine the possible contaminant level of three species of fish from Tagwai dam by selected heavy metals.

II. Materials And Methodology

SAMPLE COLLECTION

Nine individual species of the following fish samples were purchased from the fishermen at Tagwai dam and brought to the laboratory in an iced chamber for physicochemical evaluations.

Tilapia fish (*Tilapia zilli)*

Catfish (*Synodontis nigrita)*

Catfish (*Clarias gariepinus*).

SAMPLE PREPARATION

The fish samples were oven dried at 150^0C until constant weight of the sample were achieved. The samples were weighed and blended to powder with mortar and pestle, and kept in a dried labeled container.

DIGESTION OF SAMPLES

Weight of 2.0g prepared samples was poured into 100 cm^3 beaker. 10cm3 of prepared nitric acid-perchloric acid in the ratio (10:4) was added to the sample, and left overnight at room temperature. On the next day, the sample and the acid mixture was placed in a water bath set at 100^oC and the content was allowed to boil for about 2hours until the fish samples were dissolved. The digests were then allowed to cool, then filtered with filter paper, transferred to 25 cm^3 volumetric flasks and made up to mark with 1% Nitric acid (FAO, 1983). The digests were then transferred into the labeled plastic bottles and kept for the instrumental analysis.

ANALYSES OF SAMPLES

The well labeled digests in the plastic bottle were taken for the metal analysis with atomic absorption spectrophotometer (BUCK Scientific model 210 VGP).

III. Results And Discussion

The results for the concentration of selected heavy metals were tabulated as follow

Table 1: Concentrations of *Tilapia zilli*

Id No	mg/kg Mn	mg/kg Fe	Mg/kg CU	mg/kg Zn
T1	2.88	65.38	3.75	27.36
T2	6	46.75	5.13	5.13
T3	3	22.75	3.88	25
T4	4.25	34.25	3.5	37.38
T5	4.57	18.82	5.38	25.51
T6	8	93.13	6.75	39.38
T7	3.88	85.63	5	42.13
T8	3.5	2	5.25	32.38
T9	2.75	2.25	3.25	38

Table 2 : Concentrations of *Synodontis nigrita*

Id No	mg/kg Mn	mg/kg Fe	mg/kg Cu	mg/kgZn
S1	2.63	11.51	1.82	22.51
S2	5	35.63	2.63	33.5
S3	3	24.25	2.88	40. 25
S4	3.38	25.13	1.75	46.75
S5	5.38	72.13	3.38	43.88
S6	2.01	15.32	3.57	21.82
S7	1.88	23.13	4.5	40.75
S8	2.38	8.75	1.75	32.75
S9	4.38	5	2.88	43

Table 3: Concentrations of *Clarias gariepinus*

Id No	mg/kg Mn	mg/kg Fe	mg/kg Cu	mg/kg Zn
C1	3.13	2	2.63	50
C2	3.01	20.13	2.13	65.88
C3	4.25	55.13	2.88	82.25
C4	4.5	41.88	2.63	67.63
C5	3.63	27.75	2.25	46.75
C6	2.63	16.88	2.5	49
C7	3.88	25.19	3.07	62.19
C8	4.75	40.13	2.88	82.88
C9	3.75	41.88	3.5	71.75

Table 4: Mean Concentrations (Mg/Kg) of Heavy Metals in Fish Samples

Sample	**Concentration of heavy metals**			
	Mn	Fe	Cu	Zn
Tilapia zilli	4.34±1.62	38.98±32.80	4.73 ±1.10	32.80±6.48
Synodontis nigrita	4.38±3.15	22.51±18.67	2.78±0.93	33.61±9.91
Clarias gariepinus	3.67+0.64	28.75+14.84	2.70+0.44	64.49+12.71
MPL	5.5	43	30	100

MPL: maximum permissible limit

IV. Discussion Of Results

Table 1, 2 and 3 show the results for the concentration of heavy metals in *Tilapia zilli, Synodontis nigrita* and *Clarias gariepinus.* The concentration of Mn, Fe, Cu, and Zn in *Tilapia zilli* were 2.75 – 8.00mg/kg, 2.00 – 93.12mg/kg, 3.25 – 6.75mg/kg and 25.00 – 42.13mg/kg dry weight respectively while the concentration of Mn, Fe, Cu and Zn in *Synodontis nigrita* was 1.88 – 5.38mg/kg, 5.00 -72.13mg/kg, 1.75 – 4.50 mg/kg and 21.82 – 46.75kg/kg dry weight respectively and the concentration of Mn, Fe, Cu and Zn in *Clarias gariepinus* was 2.63 – 4.75mg/kg, 2.00 – 55.13mg/kg, 2.13 – 3.50mg/kg and 4.6.75 – 82.88mg/kg dry weight.

Table 4 shows the mean concentration of the selected heavy metals (Mn, Fe, Cu and Zn) with their maximum permissible limits in *Tilapia zilli, Synodontis nigrita and Clarias gariepinus*.

The mean concentration of Mn found in *Tilapia zilli, Synodontis nigrita* and *Clarias gariepinus* was 4.3mg/kg, 4.38mg/kg and 3.67mg/kg respectively, with *Synodontis nigrita* having the minimum mean concentration of 4.38mg/kg and *Clarias gariepinu* with the minimum mean concentration of 3.67mg/kg. All the mean concentrations of Mn in all the fish samples were below the maximum permissible limit 5.5mg/kg (WHO, 1989).

The mean concentration of Fe found in *Tilapia Tilapia zilli*, *Synodontis nigrita* and *Clarias gariepinus* were as follow 3.8mg/kg, 22.50mg/kg and 28.75mg/kg, with the maximum mean concentration 38.98mg/kg found in *Tilapia zilli* and the minimum mean concentration 22.50mg/kg found in *Synodontis nigrita*. All the mean concentration of Fe found in all these fish samples were below the maximum permissible limit 43mg/kg (WHO, 1989) of Fe in fish. The mean concentration of Cu found in *Tilapia zilli*, *Synodonits nigrita* and *Clarias gariepinus* were 4.73mg/kg, 2.78mg/kg and 2.70mg/kg respectively, with the *Tilapia zilli* having the maximum mean concentration of 4.73kg/kg and the *Clarias gariepinus* having the minimum mean concentration of 2.70mg/kg. All these mean concentrations of Cu found in all the fish samples were below the maximum permissible limit 30mg/kg specified by Malaysian Food Acts 1983 (Malaysian Food and Drug Regulation 1985). Copper as an essential element promotes the activities of certain enzyme system in the body. Although, it may be toxic when ingested by man and animals in a large amount. The concentration of copper in *Tilapia zilli and Clarias* nigrita obtained I this study is low when compared with that obtained in river Benue (9.99mg/kg and 5.89mg/kg) and the concentration of copper in *synodontis nigrita* obtained in this study is also low when compared to that obtained in Ogun lake (14mg/kg).

The mean concentration of Zn found in *tilapia zilli synodonits nigrita* and *clarias gariepinus* was 32.80mg/kg, 33.61mg/kg and 64.49mg/kg respectively, with maximum mean concentration 64.49mg/kg found in *Clarias gariepinus* and *Tilapia zilli* having the minimum mean concentration 32.80mg/kg. Report of high concentrations of Zn were also highlighted in the same environment by earlier workers (Mitra and Choudhury, 1992; Mitra and Choudhury; Mitra, 1998). All these mean concentrations were below the maximum permissible limit 100mg/kg specified by NAFDAC. Carbonell and Tarazona, (1994) concluded that different tissues of aquatic animals provided and / or synthesize non exchangeable binding sites resulting in different accumulation levels, which may be the reasons why different fish samples accumulate different concentrations of the heavy metals. In *Tilapia zilli* the trends of heavy metals was: Fe>Zn > Cu>Mn; *synodonits nigrita* the trends of the heavy metals was; Zn >Fe> Mn> Cu while *clarias gariepinus* had Zn >Fe> Mn> Cu in order of their concentration

V. **Conclusion**

This work was carried out to cheek the selected heavy metals (Mn, Fe, Cu and Zn) concentrations in the fish samples (*Tilapia zilli. Synodontis nigrita and Clarias gariepinus)* from Tagwai dam. It was observed that various heavy metals analyzed were below the maximum permissible limit specified by World health organization and Food and Agricultural organization. Hence, the fish sample analyzed were safe for human consumption.

VI. Recommendation

I recommend that more work should be carried out on the fish samples in Tawai dam at different seasons so as to check the variation and the difference in the concentrations of the suspended heavy metals at the different seasons, and to further ascertain the safety of the sea foods for human consumption.

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