ASSESSMENT OF HEAVY METALS CONCENTRATION IN SOME ORGANS OF NILE TILAPIA(*Oreochromis niloticus)*IN WAYA DAM, BAUCHI.

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ABSTRACT
The study was conducted in Waya dam, Bauchi state, Nigeria to determine the concentrations of heavy metals in bones, gills and muscle tissues of *Oreochromis niloticus*. Nine *O. niloticus* were obtained from fishers fishing in the dam in May, 2018. Fish tissues collected were digested with concentrated HNO_3 and H_2SO_4 according to standard procedures. Heavy metals concentrations (Fe, Cd, Cu, Zn, Pb and Ni) after digestion were analyzed using 210 VGP atomic Absorption Spectrophotometer. The result shows that gills had highest concentrations (1.590±0.767 mg/kg) of Fe and lowest concentrations (0.004±0.001 mg/kg) of Ni. Gills tissues had highest mean heavy metal load than bones and muscle tissues. Mean concentrations of Zn was highest (0.228±0.076 mg/kg) in gills and lowest (0.077±0.076 mg/kg) in bones. Mean concentrations of the heavy metals in *O. niloticus* tissues studied were of the order: Fe>Zn>Cu>Cd >Pb>Ni. The mean heavy metal concentrations obtained in the study indicated that the fish species was safe for human consumption. It is recommended to periodically monitor the concentrations of heavy metals in Waya dam and in similar water bodies in order to prevent possible related health hazards.

Keywords: Heavy metals, Spectrophotometer, Fish Tissues, Digestion, *Oreochromis niloticus*

INTRODUCTION
Fish plays a vital role in feeding the world's population and contributing significantly to the dietary protein of hundreds of millions of the populace (Ayo-olusi, 2014). The aquatic environment with its water quality is considered the main factor controlling the state of health and diseases in both cultured and wild species (Olusola and Festus, 2015). Malik *et al*.(2010) stated that, pollution of heavy metals in aquatic ecosystem is growing at an alarming rate and has become an important worldwide problem. This situation has arisen as a result of the rapid growth of population, increased urbanization and expansion of industrial activities, exploration and exploitation of natural resources, extension of irrigation and other modern agricultural practices as well as the lack of or poorly enforced environmental regulation (Idowu, 2004). An increase in agricultural and human activities in an area directly influences the quality of water. Fish in water bio-accumulate heavy metals through different gateways including intake of food and water, suspended particulate matter as well as metal ion exchange through gills and skin (Ibemenuga, *et al*., 2019). Heavy metals cause the mutation of fish inner organs, disturb immune reactions, change blood parameters, reduce an organism's adaptation qualities, vitality and resistance to diseases (Staniskiene, *et al*., 2006).

In Nigeria, the levels of toxic and non-biodegradable heavy metals in fish samples had been reported for some water bodies including River Niger, Onisha shelf, Anambra state (Ibemenuga, *et al.*, 2019), Njuwa Lake, Adamawa sate (Ibrahim *et al*.,2018), Coastal waters of Ondo state (Olusola and Festus, 2015). The target tissues of heavy metals in fish are metabolically active ones which accumulate high level of metals such as liver, kidney and gills, while muscles and skins accumulate less level of metals due to low metabolic activities (Ekpo *et al*., 2013).

The present study investigates the accumulation of iron (Fe), cadmium (Cd), lead (Pb), zinc (Zn), nickel (Ni) and cupper (Cu) in the gills, bones and muscles of *Oreochromis niloticus*, as well as levels of the temperature and pH of water in the dam.

MATERIALS AND METHODS

STUDY AREA

Waya dam is a medium sized earth dam located in Ganjuwa Local Government Area of Bauchi State, Nigeria. The dam is twenty five kilometers (25km) away from Bauchi town. It lies within latitude 10.30982^{o}N and longitude 9.84517^{o}E. It has a reservoir storage capacity of thirty million cubic meters (30cm^{3}). Its embankment has features which include width: 96m, crest width: 6m, crest length: 370m and elevation: 505m (Isma'ila, 2014). Subsistence and commercial fishing activities are carried out on the dam.

SAMPLING AND WATER QUALITY PARAMETERS

Samples of nine *O. niloticus* were obtained from fishers fishing in the dam in May, 2018. Temperature and pH were measured using Potable digital meter (Model: PH 009 (1) Pen type) within the sampling period.

PREPARATION AND ANALYSIS OF HEAVY METAL IN FISH TISSUES

The fish samples were washed and dissected to remove gills, bones and muscles. The tissues were thoroughly washed and placed in labeled plastic bottles rinsed with nitric acid. The tissues were oven dried at 105^{o}C, until dry and constant weight was obtained after which they were separately grinded with laboratory mortar and pistil.

DIGESTIONS

Grinded fish tissues collected were digested with concentrated HNO_3 and H_2SO_4 according to procedures recommended by AOAC (2002).

Heavy metals concentrations(Fe, Cd, Cu, Zn, Pb and Ni) after digestion were analyzed using 210 VGP atomic Absorption Spectrophotometer at the Faculty of Engineering, Abubakar Tafawa Balewa University Bauchi.

STATISTICAL ANALYSIS

Data of fish samples were presented as mean ± standard error (SE) and analyzed with SPSS version 25 (SPSS, IBM.2017).

RESULTS

Table 1: Temperature and pH of Waya Dam (May, 2018).

Portions	Temperature	pH
Upper	36.9	6.5
Middle	35.3	6.0
Tail	37	5.9

Waya dam water temperature values recorded in the month of May, 2018 were Upper (35.3^{o}C), Middle (36.9^{0}C) and Tail (37^{0}C) (Table 1). The pH values were 6.5, 6.0 and 5.9 for Upper, Middle and Tail portions of the dam respectively.

Table 2: Mean ± SE of heavy metals concentration (mg/kg) in some tissues of *Oreochromis niloticus* from Waya dam, Bauchi (May, 2018).

Tissue	Fe	Cu	Zn	Pb	Cd	Ni
Bones	0.273±0.767	0.058±0.030	0.077±0.076	0.013±0.003	0.005±0.006	0.006±0.001
Gills	1.590±0.767	0.013±0.030	0.228±0.076	0.009±0.003	0.013±0.006	0.004±0.001
Muscles	0.250±0.767	0.001±0.030	0.170±0.076	0.007±0.003	0.018±0.006	0.005±0.001

Iron concentration ranged from 0.250±0.767 mg/kg in muscles to 1.590±0.767 mg/kg in gills. Copper concentration was from 0.001±0.030 mg/kg in muscles to 0.058±0.030 mg/kg in bones .Concentration of Zinc was from 0.077±0.076 mg/kg to 0.228±0.076 mg/kg in gills while Lead ranges from0.007±0.003 mg/kg in muscles to 0.013±0.003 mg/kg in bones. Cadmium ranged from 0.005±0.006mg/kg in bones to 0.018±0.006mg/kg in muscles and Nickel ranged from 0.004±0.001mg/kg in gills to 0.006±0.001mg/kg in bones. However, Iron was the most accumulated metal while the least was Nickel.

DISCUSSION

Waya dam water temperature values recorded in the month of May, 2018 were 35.3^{o}C, 36.9^{0}C and 37.0^{0}C for upper, middle and tail portions of the dam respectively (Table 1). The temperature recorded in the tail water may be suitable for fish growth and reproduction. Temperature affects the distribution, health, and survival of aquatic organisms (CWT, 2004). The water temperature range in Waya dam is within the range of 10^{o}C - 50^{o}C for river and dam water meant for domestic purposes and fish culture in tropical waters (WHO, 1984; Huett, 1977). The water pH values of Waya dam in May, 2018 were slightly acidic(5.94 - 6.5), This may be as a result of horticultural activities prominent around the dam that might have led to run off of fertilizers into the dam water. The lowest value of pH was recorded at the tail portion (5.94) of the dam. Aquatic organisms accumulate heavy metals from water and food either by absorption or ingestion (Ibemenuga *et al*. (2019). Fish bio-accumulate heavy metals, thus act as good bio-indicators of pollution (Ibemenuga, 2013). In the tissues of *O. niloticus* studied, the metals were bio-accumulated to varying levels. Iron was present in fish tissues in the highest concentration while Nickel in lowest quantity (Table 2). Ibrahim and Sa'id (2010) and Monday and Nsikak (2007) recorded highest concentration of Zinc in the muscles of Tilapia species they studied.

Gills tissues had higher mean metal load than bones and muscles tissues. Jobling (1995) attributed the high accumulation of heavy metals in gills tissues to the metallothionein proteins which are synthesized in liver and gills tissues when fishes are exposed to heavy metals and detoxify them. Cadmium and Lead are toxic non-essential heavy metals even at low concentrations and have no known biological functions (Bernad, 2008 and Tchounwou *et al*., 2012).

In this study mean concentration of Zinc was highest (0.228±0.076mg/kg) in gills and lowest (0.077±0.076mg/kg) in bones unlike Ibemenuga *et al*. (2019) who reported that mean concentration of Zinc was highest in the intestine and lowest in the muscle. Goel (2006) observed that fish and other organisms that respire through the gills can absorb metals through their respiratory surfaces. However, the mean metal concentrations obtained in the study indicated that the tissues are safe for human consumption as the heavy metals concentration in the tissues of *Oreochromis niloticus* studied were below the permissible limit according to FAO (2003).

CONCLUSION

The results obtained in the study, indicated that Waya dam was contaminated to varying levels of heavy metals. Gills were the highest metal accumulated tissue followed by bones and then muscles. Heavy metals concentration in the tissues of *Oreochromis niloticus* studied were below the permissible limits; therefore, the fish species is safe for human consumption.

RECOMMENDATIONS

It is recommended to be periodically monitoring the concentration of heavy metals in Waya dam and similar water bodies in order to prevent health hazards.

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