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Research Paper

Assessment of Heavy Metal Concentration and Proximate Composition In Tilapia (*Tilapia guineensis)* From Andoni River, Rivers State, Nigeria

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ABSTRACT
The proximate value and the concentration of some heavy metals in Tilapia guineensis from Andoni River were determined over a 3- month period. Fresh samples of the fish were purchased from fishermen and transported to the laboratory in an ice-chest container for analysis. Samples were analyzed following the analytical procedures specified by APHA and AOAC for heavy metals and proximate composition respectively. The result indicates that the concentration of heavy metals in descending order of magnitude are $Zn > Cr > Cu > Ni > Pb > Cd > As$, *and their mean values* $(\pm SE)$ *are respectively* $12.70 \pm 0.54 mg/kg, 3.26 \pm 0.06 mg/kg, 2.21 \pm 0.09 mg/kg, 1.92 \pm 0.26 mg/kg$ *and* $1.05 \pm 0.04 mg/kg, 0.82 \pm 0.44 mg/kg, 0.53 \pm 0.04 mg/kg$. *The results obtained for proximate composition are moisture (79.28%), protein (15.09%), carbohydrate (1.75%), fat (1.36%), fibre (1.27%) and ash (1.25%). The result showed that the concentration of lead, cadmium nickel and chromium are above their WHO stated limits and as such could pose a health risk to consumers. Similarly, the study revealed that T, guineensis is very rich in protein it is therefore recommended to consumers for their protein needs and particularly, to those with protein deficiency as a source of readily available and cheap animal protein. Consumers are however, warned to check the level (quantity) of consumption so as not to endanger their life.*

KEY WORDS: *heavy metal, proximate composition, tilapia, Andoni River*

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I. INTRODUCTION

Fish is one of the major sources of animal protein in the Niger Delta that is affordable and readily available. Also when compared to other protein sources like goat and cow meat, it's healthier and safer (Astawan and Ikan, 2004; Obot *et al*., 2016). In Nigeria, fish is eaten fresh and smoked and form a much cherished delicacy that cuts across socio-economic, age, religions and educational barriers (Adebayo *et al*., 2008).

Increased human activities through urbanization, population growth, industrialization and man's greed to ever exploit Mother Nature have seriously created threat to all kinds of life in form of pollution which has now become a global problem (Deepak *et al.*, 2009). Major problems of pollution, contamination and toxicity are associated with aquatic ecosystem (Abu & Godwin 2016). Several studies have indicated that highly toxic heavy metals are contaminants of natural water (Okafor & Opuene 2000; Ayejuyo *et al*., 2005; Azim *et al*., 2006; Abu & Godwin 2016). Heavy metals are regarded as serious pollutants of aquatic ecosystem because of their toxicity even at low concentrations and their ability to be incorporated into food chains and be concentrated by aquatic organisms (Shirlin, 2014). Fish is one of the major components of the aquatic habitat and it has been recognized as a good bio-accumulator of organic and inorganic pollutants, it also serves as bio-indicator of heavy metals in its habitat (King and Jonathan, 2003).

Over the last decade, studies have been conducted to examine the proximate composition and heavy metal content of a wide variety of commercially important and edible aquatic fauna. Some of these studies include investigations on Tilapia (Bombata-Fasturia *et al*, 2013), edible frog (Cagiltay *et al*, 2014); Daniel *et al*. (2016) and Oysters (Woke *et al*, 2016).

Andoni River is one of the most important rivers in the Niger Delta providing nursery and breeding ground for a large number of species including tilapia. The consumption of fishes from this Creek might therefore constitute a great threat to humans who directly or indirectly feed on them which could lead to health risk. It is therefore relevant to check the heavy metal burden (particularly as a result of the oil production activities in the area) in order to ascertain the quality of the water environment for the well-being of the biota. Thus making it inevitable for consumers of edible aquatic biota from the Andoni River to know the heavy metal body load as well as the nutritional value of the fishes (*Tilapia guineensis*) they are consuming.

II. MATERIALS AND METHOD

Description of the Study Area

The Andoni River is situated in Rivers State, South- South Nigeria. It is one of the longest rivers in Rivers State. Its geographical coordinates are latitude 4° 37.18′N and longitude 7° 23.10′E. The river transverses many villages and towns which are Inyong-orong, Iwoma, Asarama-Ija, Asarama, Uyeada, Egbomung, Dema, Ibotirem, Samanga, Ajakajak, and Ataba communities to mention but a few. It is a brackish water habitat which lies within the low land area of the Niger Delta with dense and thick mangrove and tropical rain forest vegetation.

The Andoni river plays significant role in the life of the populace of the various communities around the river and beyond .Thus, it is very important to the majority of the people of Andoni because they depend solely on the river as their main source of livelihood, as they carry out their fishing activities and other activities such as commercial boating and dredging of sand etc.

There are many activities going on along the river which are capable of polluting it. These activities include but not limited to the use of explosives and chemicals in fishing, disposal of house hold and construction wastes, illegal refinery activities, and open defecation.

A reconnaissance visit was paid to the study area during which fish sales points were identified and *Tilapia guineensis* adopted for the study as a result of its economic importance. Fish samples purchased directly from fishermen were carefully washed and stored in ice chest containers before transporting to the laboratory for analysis.

Laboratory Method

Concentrations of selected heavy metals including Zinc (Zn), Lead (Pb), Copper (Cu), Cadmium (Cd) Chromium (Cr) and Arsenic (As) were determined using Atomic Absorption Spectrophotometer (Unicam 969, Analytical Technology Inc., Cambridge, United Kingdom). Analysis was based on the procedures of Standard Method (APHA, 2015).

III. RESULT AND DISCUSSION

Table 1: Mean concentration of heavy metals (± SE, n = 4 m*g/kg*) in tissues of Tilapia from Andoni River

	Heavy Metal Concentration (*mg/kg*)						
Sample	**Zinc**	**Lead**	**Copper**	**Cadmium**	**Nickel**	**Chromium**	**Arsenic**
Tilapia	12.70±0.54	1.05±0.04	2.21±0.09	0.82±0.44	1.92±0.26	3.26±0.06	0.53±0.04
RSME	-	3	3.0	0.5	5	0.	-
WHO	30	0.5	3.0	0.5	0.05	3	-
						0.6	

The table above shows Mean and Standard Errors of heavy metal concentration in Tilapia from Andoni Rivers and their permissible limits.

The figure below shows that moisture content (79.28%) was highest, followed by protein (15.09%), carbohydrate (1.75), fat (1.36), fibre (1.27%) and ash content (1.25) which is the least.

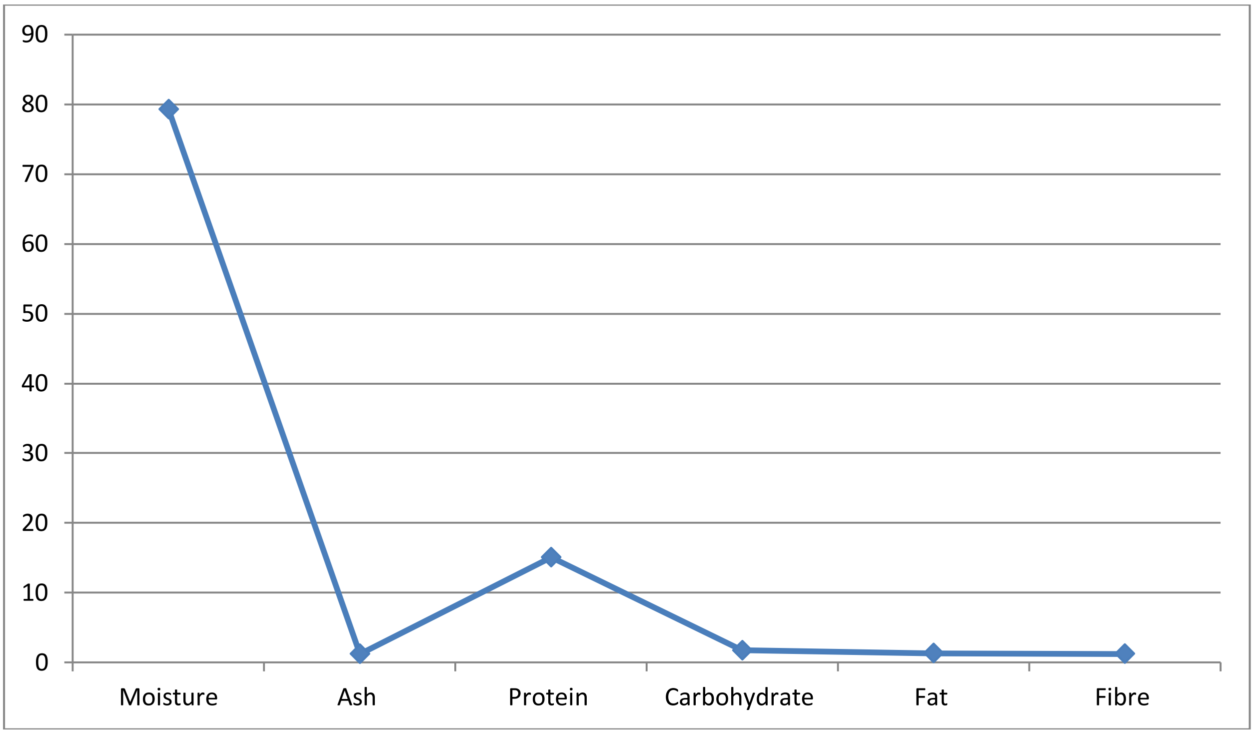

Fig 1. Proximate Composition of *Tilapia guineensis* from the Andoni River

The mean concentration of Zinc (Zu) 12.70mg/kg is lower than the range of 84.76 to 136.9mg/kg reported by Yilmaz (2009), the 77.47mg/kg observed by Wangboje & Ikhuabe (2015) and also that of Farombi *et al*., (2007), who reported the mean value 19.05mg/kg of Zinc in the kidney of *Clarias gariepinus*. Though, it is significantly higher than the 0.54mg/kg recorded in *Tilapia zilli* by Akan *et al*., (2009) from Lake Chad Nigeria, and 0.13-20.1ug/g of Zinc revealed in the tissue of *R. Kanagurta* by Vijayakumar *et al*., (2011), the mean value of zinc observed in *T. guinensis* in this investigation fell within World Health Organization (WHO) and RSME standard.

The mean concentration of Lead (1.05mg/kg) in this investigation is in agreement with the 0.37 – 1.63mg/kg reported by Abu and Nwokoma (2016). But is higher than the range of 0.17 – 0.23mg/kg gotten in fish tissue from Sombreiro River by Wokoma (2014), 0.039 – 0.009mg/kg reported by Bob-Manuel *et al*., (2015) and the 0.00 – 0.01mg/kg recorded by Adata *et al*., (2016) in Tilapia fish from Kaa water in Ogoni land Rivers State. It is however lower than the 3.40 mg/kg recorded in the liver of *Claria gariepinus* by Farombi *et al*. (2007). The mean value of lead recorded in this study is higher than the permissible limit stipulated by WHO but falls within that of Rivers State Ministry of Environment (RSME).

The mean concentration of Cadmium 0.74kg/mg, 0.6mg/kg and 0.038mg/kg reported respectively by Ekweozor *et al*. (2017), in the muscle of *O.niloticus* from Okujuagu-Ama creek, Farombi *et al.*, (2007) recorded in the kidney of *Clarias gariepinus* from, Ogun River Nigeria and Edem *et al*., (2009) in the gill of *Oreochomis niloticus* are all lower than the 0.82 mg/kg recorded in the present study. But is lower than the 2.43 – 10.73mg/kg recorded in *(Ilissha africana*) by Obot *et al*. (2016). However, it is higher than the permissible limits of WHO and Rivers State Ministry of Environment (RSME). The observed mean concentration of Nickel (1.92±0.26mg/kg) in this investigation is within the permissible limits of the Rivers State Ministry of Environment but above that of the World Health Organization. The mean nickel concentration fell within the reported ranges of 0.28 – 2.89mg/kg and 0.201 – 2.327mg/kg in *Psuedotolithus elongatus* and *Clarias gariepinus* as reported by Wokoma, (2014) and Bob-Manuel *et al*., (2015) respectively. But lower than 3.69± 0.54mg/kg found in the tissues of *Chrisichthyes nigrodigitatus* from Sombreiro River by Wokoma (2014), and the range of 17.0 – 90.23mg/kg reported by Obot *et al*. (2016) in *Ilisha africana* from the lower Cross River estuary both in the Niger Delta. It is however slightly higher than the range of 0.56 – 1.86 ppm revealed in the heart of *Claria gariepinus* by Babatunde *et al*., (2012).

The mean concentration of Chromium 1.243 – 3.689mg/kg reported by Bob-Manuel *et al*., (2015) in organs of *Clarias gariepinus* from Okilo Creek, Rivers State, Nigeria is in parity with that (3.26mg/kg) recorded in this investigation. However, it is higher than the1.22±0.70mg/kg found in *O.niloticus* by Ekweozor *et al,* (2017) from Azuabie Creek in Rivers State, the range of 0.16 – 0.86ug/g recorded in *K. axillaris* by Vijayakumar *et al*., (2011) and the mean of 0.094mg/kg recorded in Catfish by Orosun *et al*., (2016). Though, the mean value of Cr revealed in the tissue of *T. guineensis* is lower than that of Obot *et al*., (2016) who reported a range of 12.88 – 21.18mg/kg in *Ilisha africana* and that of Saeed, *et al.* (2014) who reported a mean value of 70.5±0.74mg/kg from Tembi River, it is nonetheless higher than the stated permissible limits of RSME and WHO.

The mean concentration of Copper (Cu) 2.21mg/kg is lower than the mean of 5.31±0.55mg/kg reported by Wokoma (2014) gotten in the tissues of *Psuedotolithus elangatus* from Sombreiro River, Niger Delta, and the mean of 4.29ppm reported by Upadhi *et al.*, (2013) in *Tilapia zilli*. But Cr value in this study is higher than the value of 1.19ppm reported by Aliyu *et al.*, (2015) in Kaduna Metropolis, Nigeria and the 0.54mg/kg reported by Adeyeye & Ayoola (2012) in the liver of *Tilapia zilli* from Eko-ennde dam Nigeria. However, Cu concentration in *T. guineensis* as revealed by this investigation is below the permissible limits of WHO and the Rivers State Ministry of Environment.

The mean concentration of Arsenic (As) observed in the tissue of *T. guineensis* in this work (0.53mg/kg) is higher than the range of (0.13-0.20mg/kg) recorded in *Ilisha africana* by Obot *et al.* (2016) from lower Cross River Estuary, Nigeria as well as the range of 0.02 – 0.28 found in gills of Grey Mullet by (Stancheva *et al.*, 2013).

The proximate analysis revealed that the moisture content of *T. guineensis* is 79.28% which is comparatively higher than the 73.925% and 72.07% observed in brackish and freshwater tilapia (*O. niloticus*) respectively by Olaniyi *et al., (*2016). It is however comparative to the 79.50% reported by Adefemi (2011) but is significantly higher than moisture content of 5.26% reported by Ikape, *et al.*, (2018) in proximate and macro element composition of four fish species from lower River Benue Makurdi, Benue State. The mean Ash content of 1.25% gotten in this present study is slightly lower than 1.37% recorded by Nurnadia *et al.*, (2011) as well as the 1.30% reported by Adejonwo *et al.*, (2010) on proximate composition of wild brackish *Tilapia guineesis* collected from Victoria Island Lagos. Similarly, the 10.20% reported by Moses *et al.*, (2018), the 2.73% detected in *I. fuscatus* by Davies & Jamabo (2016) and the 2.13% recorded in mangrove oyster from Lagos lagoon by Akinjogunla *et al.*, (2017) are all higher than that reported in this present investigation. The protein composition of 15.09% obtained in this study is slightly lower than 15.82% reported by Davies and Jamabo (2016), but lower than the 18.65% and 18.63% reported respectively by Adejonwo *et al.*, (2010) and Nurnadia *et al.*, (2011). However, it is higher than the 13.33% recorded by Akinjogunla *et al.*, (2017).

The mean carbohydrate content of 1.75% recorded in this investigation is far below the value 49.6% reported by Woke *et al.*, (2016) and lower than the 2.43% reported by Akinjogunla *et al.*, (2016) in *Crassosrea gasar* from Lagos lagoon as well as the range of 2.7 – 4.4% recorded in *C. rhizopherae* by Martino & Gracinda (2004). But the value obtained in this study is higher than the 0.84 – 1.14% reported by Shemishere *et al.*, (2018). The fat content of 2.21% obtained in *C. gasar* by Akinjogunla *et al.*, (2016) and 2.09% reported by Nurnadia *et al.*, (2011) are both higher than the observed value of 1.36% in this investigation. The fibre content detected in this study is higher than the 0.52% reported by Akinjogunla *et al.*, (2017), but lower than 18.22% reported by Woke *et al.*, (2016) in *C. gasar* collected from Andoni River.

IV. CONCLUSION

The analysis of proximate composition and heavy metals concentration of *Tilapia guineensis* from Andoni River revealed that the fish is highly nutritious with a high protein content which makes it good for consumption. However, the result also shows that *Tilapia guinensis* from the Andoni River has a high body load of some heavy metals (lead, cadmium, nickel and chromium) as their concentrations exceed the permissible limit set by the World Health Organization and or Rivers State Ministry of Environment (RSME) consumers are therefore advised to exercise restraint in the consumption of this fish (*T. guineensis*) from the Andoni River so as to avoid potential health hazards.

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