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Distribution of Heavy Metals in Bones, Gills, Livers and Muscles of (Tilapia) *Oreochromis niloticus* from Henshaw Town Beach Market in Calabar Nigeria

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Abstract: Two sets of samples of commercially important fish species *Oreochromis niloticus* of size 29 cm and 20 cm respectively were purchased from the Henshaw town beach market in Calabar, Calabar South Local Government Area of Cross River State, Nigeria in October 2007. The concentrations of five heavy metals (Pb, Zn, Cd, As and Hg) in their bones, gills, livers and muscles were determined using flame atomic absorption spectrophotometer. The result showed the heavy metal concentrations in the 29 cm size samples to be Pb (0.069 ppm) Cd (0.019 ppm) and Zn (0.103 ppm) in the bones. Pb (0.173 ppm) Cd (0.049 ppm) and Zn (0.257 ppm) in the livers. Pb (0.053 ppm) Cd (0.015 ppm) Zn (0.079 ppm) in the muscles Pb (0.133 ppm), Cd (0.038 ppm) and Zn (0.198 ppm) in gills. While the 20 cm size samples had Pb (0.067 ppm) Cd (0.019 ppm) and Zn (0.100 ppm) in bones. Pb (0.067 ppm) Cd (0.019 ppm) and Zn (0.099 ppm) in livers. Pb (0.062 ppm) Cd (0.017 ppm) and Zn (0.095 ppm) in muscles and Pb (0.153 ppm) Cd (0.044 ppm) and Zn (0.227 ppm) in gills. Arsenic and mercury were not detected in any of the samples. The result revealed the distribution of the heavy metal in both 29 cm and 20 cm size samples to follow the order Zn> Pb> Cd while the distribution of the heavy metals in the investigated parts (organs) is shown to follow the order livers > gills > bones > muscles for the 29 cm size samples. And Gills > Livers = bones > muscles in the 20 cm size samples. The result also revealed that the 29 cm size samples had higher concentrations of the heavy metals than the 20 cm size samples. The result also showed that the muscle of Tilapia is safer to consumed than the other parts investigated as it has been shown to contain the least concentrations of the heavy metals determined. This reveals the adverse health effect the people in the study area could be exposed to by the consumption of liver, gills and bones of Tilapia which have high levels of these heavy metals.

Key words: Tilapia, orechromis niloticus, heavy metals, pollution

INTRODUCTION

The events of mercury and cadmium poisoning through fish and shellfish in Minamata, Japan has brought about increase interest in researches in heavy metal contamination of aquatic ecosystem (Aweke and Taddese, 2004; Mason, 1996; Meyer, 1977 and Thayer, 1995). Heavy metals are normal constituents of the marine environment (Niebor and Richardson, 1980). Compared with other types of aquatic pollution, heavy metal pollution is less visible but its effects on the ecosystem and humans are intensive and very extensive (Edem *et al*., 2008). The bioaccumulation of heavy metal in tissues of marine organism is an indirect measure of the abundance and availability of metals in the marine environment (Kucuksezgin *et al*., 2006). Marine organisms are characterized by a greater spatial ability to accumulate metals compared to bottom sediments, for this reason fish are widely used as bio-indicator for aquatic or marine pollution by metals and have also been used to evaluate ecological risk (Szefer *et al*., 2006; Evans *et al*., 1993; Kucuksezgin *et al*., 2006; Chapman, 1992). Therefore chemical analysis of fish ensures dietary safety of the fish from a particular body of water (NOAA, 1988; Raoux *et al*., 1999).

The establishment of an export-processing zone in calabar has resulted in increase volume of waste generated by industries and other commercial activities in the area. These waste are directly or indirectly channeled into the rivers from which Henshaw town beach market gets its fish supply. *Oreochromis niloticus* (tilapia) is a benthic specie and is an important component of the diet of the people of calabar and its environ because it is available all year round. A number of studies have been carried out on the accumulation of heavy metals in fish and other sea organisms, water and sediments from Cross River system in the past (Asuquo *et al*., 1999; Asuquo, 1998; Asuquo, 2001; Etim and Akpan, 1991; Ntekim *et al*., 1993, Nwaedozie, 1998, David Oku *et al*., 2006; Edem *et al*., 2008). The result of these studies have shown high presence of heavy metals in the organisms studied. The aim of this study is to assess the distribution of the selected heavy metals in the muscles, bones, gills and livers of the most commonly found and consumed fish specie (Tilapia) sold in Henshaw town beach market. This is the first report to the best of our knowledge on the

distribution of heavy metals in tissues and organs of tilapia from this market.

MATERIALS AND METHODS

Sample collection and analyses: The fish samples used in this study were obtained from the fishmen at the Henshaw town beach market in the month of October, 2007. Two groups of fish samples were obtained.

Group A consist of ten (10) fishes of size 29 cm and Group B consist of ten (10) fishes of size 20 cm. They were washed with the river water and were immediately transported in an ice-box to the laboratory for subsequent analysis for the Heavy Metals (HM) contents. The samples were analyzed compositely. The tissues were homogenized and approximately 5-7 g of the homogenate were then digested as follows. I.0 g of the powdered samples (muscles, bones, livers and gills) were placed in a 100 ml round bottom flask with ground glass joint and mineralized under reflux using a mixture of 6 ml HNO_3, 2.0 ml HClO and 4 ml H_2O_2. The digestion procedure lasted for about 6 h to obtain a clear solution. The digests were prepared in triplicate and carefully transferred with their respective washing into a 25 ml volumetric flask and diluted to volume. The digests were then analyzed for Pb, Zn, Cd, As and Hg using a flame atomic absorption spectrophotometer (BUCK SCIENTIFIC, MODEL 210 VGP, USA) with aqueous calibration standards prepared from the stock standard solutions of the respective elements (Buck SCIENTIFIC) as was reported by Aweke and Taddese (2004).

RESULTS AND DISCUSSION

The result of the analysis (Table 1 and 2) showed the heavy metals concentrations in the 29 cm size samples to be Pb (0.069 ppm) Cd (0.019 ppm) and Zn (0.103 ppm) in bones.

Pb (0.173 ppm) Cd (0.049 ppm) and Zn (0.257 ppm) in livers. Pb (0.053 ppm) Cd (0.015 ppm Zn (0.079 ppm) in muscles. Pb (0.133 ppm), Cd (0.038 ppm) and Zn (0.198 ppm) in gills. While the 20 cm size samples had Pb (0.067 ppm) Cd (0.019ppm) and Zn (0.100ppm) in bones. Pb (0.067 ppm) Cd (0.019 ppm) and Zn (0.099 ppm) in livers. Pb (0.062 ppm) Cd (0.017 ppm) and Zn (0.095 ppm) in muscles and Pb (0.153 ppm) Cd (0.044 ppm) and Zn (0.227 ppm) in gills. Arsenic and mercury were not detected in any of the samples. The result revealed the distribution of the heavy metal in both 29 cm and 20 cm size samples to be Zn> Pb> Cd while the distribution of the heavy metals in the investigated parts (organs) is shown to follow the order liver> gills> bone> muscles for the 29 cm size samples and this result tallies with that of Aweke and Taddese (2004). The heavy metal distribution in the 20 cm size samples followed the order, Gills> Liver = bones> muscles This observed trend clearly reveals organ specific accumulation of the

Table 1: Concentration of heavy metals (ppm) in the organs of Tilapia (group A: 29 cm sample size)

Sampled organs	Pb	Zn	Cd	As	Hg
Gills	0.133	0.198	0.038	Nd	Nd
Muscles	0.053	0.079	0.015	Nd	Nd
Livers	0.173	0.257	0.049	Nd	Nd
Bones	0.069	0.103	0.019	Nd	Nd

Table 2: Concentration of heavy metals in organs of Tilapia (ppm) (Group B; 20 cm sample size)

Sampled organs	Pb	Zn	Cd	As	Hg
Gills	0.153	0.227	0.044	Nd	Nd
Muscles	0.062	0.095	0.017	Nd	Nd
Livers	0.067	0.099	0.019	Nd	Nd
Bones	0.067	0.100	0.019	Nd	Nd

heavy metals in Tilapia obtained from the calabar river system from where the fishes was caught. The result showed that Zn had the highest concentration of all the heavy metals determined in the range of 0.257 ppm in livers to 0.079 ppm in muscles followed by Pb with the range of 0.173 ppm in livers to 0.053 ppm in muscles while Cd has the least concentration among the metals with the range 0.049 ppm in livers to 0.015 ppm in muscles for the 29 cm size samples. In the 20 cm size samples Zn also has the highest concentration of all the metals studied with the range of 0.227 ppm in gills to 0.095 ppm in muscles and also followed by Pb with the range of 0.153 ppm in gills to 0.062 ppm in muscles. Cd also has the least concentration in the range 0.044 ppm in gills to 0.017 ppm in muscles. The result showed that the concentrations of all the heavy metals studied were highest in livers followed by gills, bones and muscles for 29 cm size samples. For the 20 cm size samples, the gills were shown to have the highest concentrations of all the heavy metals, followed by livers and bones with equal amounts of the metals and muscles with the least concentrations of metals. The result also revealed that among the organs, liver and gills were found to accumulate the highest amount of all the metals indicating the importance of these organs as bio-indicators to study levels of heavy metals in general and Zn in particular in Tilapia.

The 29 cm size samples were also observed to have the higher concentrations of the heavy metals.

The result also showed that the muscles of Tilapia are safer for consumption than the other parts (organs) investigated (livers, gills and bones) as they contain the least amount of the heavy metals determined. This reveals the adverse health effect the people in the study area could be exposed to by the consumption of the gills livers and bones of Tilapia as it happens to be the most preferred and heavily consumed fish in human diet in the study area.

Conclusion: Heavy metal concentrations in the organs of Tilapia *(Orechromis niloticus)* follows the order

Zn > Pb > Cd and their distribution in the organs follow the pattern liver > Gills > bones > muscles for the 29 cm size samples and gills > liver = bones > muscles for 20 cms size samples. The concentrations of As and Hg values were not detected in all the samples studied. The result of this study reveals the adverse health effect the people in the study area could be exposed to by the consumption of the gills, livers and bones of Tilapia which have been shown to accumulate high concentrations of heavy metals as it happens to be the most preferred and heavily consumed fish in human diet in the study area.

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