LEVELS OF HEAVY METAL IN THE FILLET, GILLS AND LIVER OF *Clarias gariepinus* and *Parauchenoglanis fasciatus* in AHO STREAM, ILE-IFE

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ABSTRACT
Fishes are a good source of protein and are useful in evaluating the status of water pollution especially in the fresh water ecosystem. Cadmium, chromium, nickel and zinc levels in the fillet, gills and liver of *Clarias gariepinus* and *Parauchenoglanis* sp were assayed. Result showed that cadmium values ranged between 0.001 ppm-0.022 ppm, chromium ranged between 0.001 ppm - 0.010 ppm, nickel was found within the range 0.001 ppm - 0.011 ppm while zinc ranged between 0.001 ppm - 0.016 ppm. The concentration of chromium, zinc, copper and nickel in the fillet, gills and liver of the two fish species were low and within internationally accepted limit. Hence, fish species of Aho stream can be considered safe for human consumption.
Keywords: Aho stream, Opa reservoir, heavy metal, fish

INTRODUCTION

In recent years it has been observed that the aquatic ecosystem which is a gift of nature has been misused. The abuse of this gift has been majorly due to human activities such as indiscriminate discharge of wastes into water ways, mining activities, washing activities, discharge of industrial wastes and use of pesticides and inorganic fertilizers (Wittmann, 1979; FAO, 1992).These activities release toxic metals which are non-biodegradable and are environmental pollutants which had cytotoxic, mutagenic and carcinogenic effects in animals (More *et al.*, 2003). Metals such as copper, zinc, calcium, nickel, iron are essential for enzymatic and biological processes, but at high concentrations they become toxic. Other metals such as cadmium, mercury, chromium, lead have no biological role and are thus regarded as metals of environmental concern. However, several studies have indicated enhanced levels of both non-essential and essential heavy metal load in fish tissues and organs.

The continuous contamination of the aquatic ecosystem constitutes a menace to both aquatic flora and fauna, posing considerable setback to fisheries, either for commercial or recreational purposes (Nsikak, 2007). Aquatic organisms especially fishes being at the top of the aquatic food chain and as a primary consumer have been reported to accumulate heavy metals in their tissues several times above ambient levels (Canli and Atli, 2003). Fishes are therefore used to determine the pollution status of water, and are thus regarded as excellent biological markers of heavy metal in aquatic ecosystem (Rashed, 2001).This study seeks to establish the levels of heavy metal accumulation in *C. gariepinus* and *P. fasciatus* inhabiting Aho stream. *C. gariepinus* belongs to the family Clariidae and is the most cultured fish in Nigeria and indeed Africa (Garibaldi, 1996). It is prominently cultured for reasons of its good taste, fast growth rate, its hardiness, omnivore ability and can also withstand adverse environmental conditions (Olojo *et al*., 2005). *P. fasciatus* belongs to the family Claroteidae. It is an endangered species which is harmless and useful in fisheries.

MATERIALS AND METHODS

Study area

This study was carried out between May and October, 2010 at Aho streams, which are tributaries of Opa dam which is the only source of potable water for Obafemi Awolowo University community. It extends over Longitude 0038° 6' N - 0039° 2' N and Latitude 023° 2' E - 023° 6' E. The vegetation of the area is a lowland rainforest with thick canopies. Secondary forest is now becoming a dominant feature as a result of increased agricultural practices. The stream is surrounded by cocoa plantation, plantain vegetation and food crop farms. The area is characterized by two seasons which are the wet and dry seasons. The dry season extends from April to October while November to March marks the wet season. During the rainy season, the streams' water level rise and become turbid due to a high influx of water from the surrounding farmland.

Fish Sample collection

The parks and garden stream A and the cocoa farm stream B which are part of Aho streams were sampled on a weekly basis between May and October 2010. Fish samples were collected using traps with non-return valves which were made from

Eremozpatha sp plant. Ripe palm fruits were used as baits while the traps were put under sedges in the streams. Samples of fish caught were brought to the laboratory for identification using standard keys prepared by Reed *et al.* (1967) and Adesulu and Sydenham (2007). Standard morphometric parameters such as total length (cm), standard length (cm) and weight (g) of each fish specimen were measured and recorded.

Digestion and analysis of fish samples

Each fish specimen was split open to remove its liver and gills as well as to determine its sex by visual inspection (Roberts, 1989) while a 2 g piece of fillet was removed from its body. The liver, gills and fillet of each fish were kept frozen in separate labeled sample bottles until the time of analysis. Each sample of fish organ was transferred into a clean glass petri dish and dried in an oven at 60 °C for 10 hours while the liver samples were dried at 65 °C for 12 hours due to its high moisture content. The organ and tissue were wet-digested using Hydrochloric acid and concentrated Nitric acid following standard methods. Each of the filtrates was then analysed for Zn, Cd, Cr and Ni using ALPHA 4 Chem-Tech Analytical (Serial number 4200) Atomic Absorption Spectrometer (AAS).

RESULTS

Eleven specimens of *C. gariepinus* with a standard length (13.90 - 28.10 cm) weighing between (21.00 -159.00 g) and seven specimens of *P. fasciatus* whose standard lengths varied between 11.00 cm - 13.9 cm with weight ranging from18.0 g - 42.0 g were caught within the study period. The concentrations of heavy metals in the liver, fillet and gills of *C. gariepinus* and *P. fasciatus* are shown in Tables 1 and 2.

Table 1: Concentration of heavy metals (PPM) in the fillet, gills and liver of *P. fasciatus* caught in different locations on Aho stream

	Cocoa farm (stream A)			Parks and garden (stream B)		
Heavy metals	**Fillet**	**Gills**	**Liver**	**Fillet**	**Gills**	**Liver**
Cadmium	0.0075±0.00095	0.012±0.00066	0.009±0.00083	0.0055±0.00106	0.0055±0.00123	0.006±0.00100
Chromium	0.003±0.00174	0.004±0.00114	0.0045±0.00150	0.0045±0.00123	0.0035±0.00123	0.005±0.00100
Nickel	0.0045±0.00150	0.004±0.00114	0.0035±0.00150	0.005±0.00114	0.0035±0.00150	0.004±0.00134
Zinc	0.003±0.00134	0.005±0.00114	0.004±0.00174	0.0075±0.00106	0.01±0.00083	0.007±0.00100

Table 2: Concentration of heavy metals (PPM) in the fillet, gills and liver of *C. gariepinus* caught in different locations on Aho streams

	Cocoa farm stream A			Parks and garden stream B		
Heavy metals	**Fillet**	**Gills**	**Liver**	**Fillet**	**Gills**	**Liver**
Cadmium	0.0035±0.00213	0.0025±0.00213	0.006±0.00174	0.0065±0.00123	0.004±0.00134	0.005±0.00100
Chromium	0.0035±0.00213	0.0015±0.00213	0.004±0.00174	0.006±0.00100	0.0035±0.00150	0.0055±0.00106
Nickel	0.0065±0.00213	0.0045±0.00213	0.005±0.00134	0.008±0.00114	0.006±0.00114	0.0065±0.00106
Zinc	0.0065±0.00213	0.0095±0.00213	0.0045±0.00213	0.007±0.00100	0.015±0.00095	0.0085±0.00087

The distribution of heavy metals in all the fish organs follows the order: Gills > Liver > Fillet. Irrespective of the location of specimen collection and the organs assayed, cadmium values ranged between 0.0025 ± 0.00213 ppm - 0.012 ± 0.00066 ppm, chromium ranged between 0.0015 ± 0.00213

ppm - 0.006 ± 0.001 ppm, nickel was found within the range 0.0035 ± 0.0015 ppm - 0.008 ± 0.00114 ppm while zinc ranged between 0.003 ± 0.00134 ppm - 0.015 ± 0.00095 ppm. Low levels of cadmium, chromium, nickel and zinc at varying levels were recorded in *P. fasciatus* and *C. gariepinus* at the two stations sampled. On comparison with the WHO and FEPA recommended standards in food, cadmium, chromium, nickel and zinc were found to be below the threshold considered harmful to fishes.

Cadmium concentration in the organs of *C. gariepinus* and *P. fasciatus* varied in relation to the sampling stations. At stream A, *P. fasciatus* had a high concentration of cadmium in the gills at 0.012±0.00066ppm while the least concentration of 0.0055 ± 0.00106 ppm was found in the fillet at stream B. In *C. gariepinus,* cadmium had a minimum concentration of 0.0025 ± 0.00213 ppm in the gills at stream A while the highest concentration of 0.0065±0.00123ppm was found in the fillet at stream B. Fish species in the cocoa farm stream tends to bioaccumulate cadmium more than the fish species collected from parks and garden.

In *P. fasciatus* and *C. gariepinus*, a minimum concentration of chromium at 0.003 ± 0.00174 ppm in the fillet and 0.0015 ± 0.00213 in the gills was observed respectively. A maximum concentration of 0.005 ± 0.001 ppm was observed in the liver of *P. fasciatus* while at 0.006 ± 0.001 ppm, chromium bioaccumulated most in the fillet of *Clarias gariepinus.* However, fishes at parks and garden showed a higher concentration of chromium when compared to those caught from the cocoa farm. The highest concentration of nickel was observed in the fillet of *Clarias gariepinus* and *P. fasciatus* at 0.008 ± 0.00114 ppm and 0.005 ± 0.00114 ppm respectively, while the minimum concentration (0.0035 ± 0.0015 ppm) was found in the liver and gills of *P. fasciatus* at the two sampling stations. Among the two sampling stations, nickel bioaccumulated more in fishes from parks and garden. In *P. fasciatus* and *Clarias gariepinus,* zinc had a high concentration of 0.01 ± 0.00083 ppm and 0.015 ± 0.00095 ppm respectively in the gills with a minimum concentration in the fillet of *P. fasciatus* and the liver of *Clarias gariepinus*. Fishes at parks and garden had higher concentrations of zinc in their bodies than the fish species from cocoa farm.

DISCUSSION

The high concentration of zinc recorded in gills of *Clarias gariepinus* and *P. fasciatus* as well as cadmium in the gills of *P. fasciatus* in this study agreed with the reports of Arellano *et al*. (1999), Tao *et al*. (2000) and Bols *et al.(*2001) that the gills are vital respiratory and osmoregulatory organ in fishes. Gills have been found to accumulate metals due to their close proximity with the environment as the blood vessels on the gill filament present a large exposed surface area to the water environment (Rehwoldt *et al*., 1976). Fillet, a tissue which comprises of fish skin and muscle is generally considered to bioaccumulate heavy metals with the least concentrations when compared to the gills and liver (Yilmaz, 2005; Yilmaz *et al*., 2007).This is also in conformity with the result obtained in this study as low concentrations of zinc in the fillet of *P. fasciatus* as well as low levels of cadmium in the fillet of *P. fasciatus* was observed. However, high concentrations of cadmium and chromium in the fillet of *C. gariepinus* as well as high nickel concentrations in the fillet of both *C. gariepinus* and *P. fasciatus* could be attributed to metal complexion with the mucus on the skin of the fish which is impossible to remove completely before the analysis (Yilmaz, 2005). The liver being a primary organ for storage and detoxification of metal toxicants as well as an organ where the specific metabolic and enzyme-catalysed processes related to each heavy metal takes place could account for a high concentration of chromium in the liver of *P. fasciatus*. This was also evident in the findings of Heath (1991) and Seymore *et al.* (1994).

CONCLUSION

The result of this investigation showed that the fishes of Aho stream had low concentrations of cadmium, chromium, nickel and zinc and is considered safe for consumption.

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