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ASSESSMENT OF METAL CONCENTRATIONS IN PERIWINKLE (*Tympanotonus fuscatus*) AND BIVALVE (*Egeria radiata*) FROM THE CROSS RIVER, SOUTH EASTERN NIGERIA.

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ABSTRACT

Heavy metals (Fe, Cd, Cu, Pb, Zn, Cr) concentrations were analyzed on samples of *Tympanotonus fuscatus* and *Egeria radiata* obtained from the Cross River at Itu Bridge-head between August and October 2013, using Atomic Absorption Spectrophotometer. The concentrations of Fe, Pb, Cd, Cu and Zn were low in both organisms throughout the period of study. Chromium (Cr) concentration of 0.027± 0.001 mg/kg was detected only in August while no trace of the metal was detected in September and October. The mean contents of the metals did not show any significant ($P<0.05$) difference in both organisms while *T. fuscatus* had a significantly higher ($P<0.05$) mean Cd concentration than *E. radiata*. From the low levels of metal concentrations, consumption of both organisms from the study area would pose no risk to their consumers.

Key Words: Heavy metals, *Tympanotonus fuscatus*, *Egeria radiata*, Cross River, Itu Bridge-head.

1. INTRODUCTION

Growing social concern about environmental quality has been observed globally, in recent years. The term 'heavy metal' refers to any metallic element that has a relatively high density and is toxic or poisonous at low concentrations. Metals are non-biodegradable and are considered as major environmental pollutants capable of causing cytototic, mutagenic as well as carcinogenic effects in animals. Metals such as Copper (Cu) and Zinc (Zn) are essential for the metabolism of fishes and shellfishes while some others such as Lead (Pb) and Cadmium (Cd) have known roles in biological systems (Moraes *et al.*, 2003). Despite these advantages, they tend to accumulate in the animal tissues in elevated concentrations and later threaten human life when consumed. Aquatic organisms have the capacity to accumulate heavy metals from various sources such as sediments, soil erosion and run-off, air depositions of dust as well as aerosol and discharges of waste water. Metals are generally introduced into the aquatic environment through many routes, such as atmospheric deposition, erosion of geological matrix or anthropogenic activities caused by industrial effluents, domestic sewage and mining wastes (Mitra *et al.*, 2010). The discharge of these wastes without adequate treatment often contaminates the environment with pollutants, including metals, many of which bioaccumulate in the tissues of resident organisms such as fishes, oysters, crabs, bivalves and several types of molluscs, to mention but a few. Consequently, these metals end up in the human tissues as he eats the contaminated organisms. Bivalves have been used by several authors as indicators of aquatic pollution (Otchere, 2003; and Kljakoviz *et al.*, 2007) mainly because they are widely distributed globally, easy to handle, sessile, filter feeders that have the ability to accumulate high concentrations of metal without metabolizing them appreciably (Gunter *et al.*, 1999; Nasci *et al.*, 1999; Oliver *et al.*, 2002), provide a time-integrated indication of environmental contamination (Regoli, 1998) and can concentrate pollutants in the ambient water (El-shenaway, 2002). Similarly, *T. fuscatus* serve as good biological indicators of pollution (Fernandes, 1997; Soto *et al.*, 1997). These organisms are known to accumulate most of the contaminants at much higher levels than those found in the water column. *T. fuscatus* has long been regarded as good bio-indicators and bio-monitoring subjects which are abundant, and readily found in many aquatic ecosystems. Besides, they are known to be highly tolerant to many pollutants and can exhibit high accumulation of metals. Eventhough shell fishes are of high economic value not much scientific information has been provided for them, especially *T. fuscatus* and *E. radiata*. These shell fishes are delicacies just like the prawns in West Africa and in Nigeria in particular, where they are highly cherished by both the low-and high- income earners. Despite this, not much attention appears to be given to the quality of their meat despite the hazardous nature of their habitats. It is for this reason that the present study has been embarked upon.

2. MATERIALS AND METHODS

2.1 Study Location

Samples for the present study were obtained from the Itu Bridge-head at Ayadehe, a fishing location along the Cross River, which is about 52 km, away from Calabar, the capital city of Cross River State, and less than 20 km away from Uyo, the capital city of Akwa Ibom State. The Cross River is located in the South-east of Nigeria and is surrounded by amphibious mangrove species of *Rhizophora*. The area serves as a spawning as well as feeding ground for *T. fuscatus* and *E. radiata*.

2.2 Sample Collection and Preparation

Samples of *T. fuscatus* and *E. radiata* were collected monthly, from fishermen at the sampling site from August to October 2013, and transported in an ice chest, to the Department of Pure and Applied Chemistry for the relevant analyses. Before analyses, the flesh of the samples were carefully removed from their shells and thoroughly washed with clean, uncontaminated water before rinsing with distilled water to avoid any form of contamination. The samples were then thoroughly dried before grinding with laboratory pestle and mortar, into a fine, powdery form before analyzing them for metal contents.

2.3 Heavy Metal Analysis

The following metals Copper (Cu), Lead (Pb), Iron (Fe), Zinc (Zn), Cadmium (Cd) and Cromium (Cr) were analysed in mg/kg with the help of Atomic Absorption Spectrophotometer according to APHA, (2005). Before the determination of each metal, 10 ml of solution from the stock sample was taken and its volume adjusted to 100cm^3 with deionised water. The above-named metals were then analysed spectrophotometrically, in triplicate.

3. RESULTS

The concentration of metals in the tissues of *T. fuscatus* is shown in Fig. 1 while that of *Egeria radiata* is shown in Fig. 2. Similarly, the comparison of the different metals in both *T. fuscatus* and *E. radiata* is shown in Table 1. Iron concentration was generally low in *T. fuscatus* throughout the study period. Values ranged from 0.039 ± 0.001 mg/l in August, to 0.075± 0.001mg/l in October. Cadmium was only detected in the first month of study, during which 0.009± 0.001 mg/l was recorded while there was no trace of the metal in September and October. Copper concentration followed a similar trend like iron, with the least value (0.039 ± 0.001 mg/l) detected in August while the highest value (0.072 ± 0.001 mg/l) was recorded for October. Lead (Pb) concentration on the other hand, was lowest in September (0.005± 0.002 mg/l) while higher values (0.006 ± 0.001 mg/l and 0.016± 0.001 mg/l) were recorded for August and October, respectively. For Zinc (Zn), the highest value (0.019 ± 0.001 mg/l) was recorded for August while values dropped to 0.007 ± 0.001 mg/l in September but rose to 0.037± 0.001 mg/l in October. No trace of Chromium (Cr) was recorded throughout the study. Similarly low metallic values were also recorded for *E. radiata* in the course of the study. Iron concentrations ranged from 0.049 ± 0.001 mg/l in September, to the highest value of 0.127 ± 0.002 in August. Cadmium (Cd) concentration value of 0.006 ± 0.00 mg/l was detected in August while there was no trace of the metal in September and October. Copper concentration followed a similar trend like iron with the least value (0.031 ± 0.002 mg/l) being recorded for September, while the highest value (0.045 ± 0.001 mg/l) was recorded in August. Like other metals, lead (Pb) recorded very low values ranging from 0.003 ± 0.001 mg/l to 0.012 ± 0.002 mg/l throughout the study period. From the comparison of the mean values of metals in both *T. fuscatus* and *E. radiata* (Table 1), mean iron (Fe) content did not differ significantly ($P > 0.05$) in the tissues of the organisms while *T. fuscatus* showed a significantly higher ($P < 0.05$) mean Cd concentration in the tissues than *E. radiata*. Furthermore t-test analysis for compared comparison indicates that mean concentration of Pb, Cr, and Cu did not differ significantly ($P > 0.05$) in the tissues of both organisms.

4. DISCUSSION

Knowledge of metal concentrations in aquatic organisms is important for the proper management of aquatic environment and with the general concern about their impact in the aquatic environment. Heavy metals are among the commonest environmental pollutants whose occurrences in water and biota indicate the presence of natural or anthropogenic sources (Papafilippaki *et al*., 2007 & Ndome *et al*., 2014). The accumulation of metals such as Iron, Copper, Lead, Zinc, Cadmium and Chromium in the test organisms could be from the sediments which may enter the aquatic environment through atmospheric deposition, erosion, or due to anthropogenic activities. However, the concentrations of metals in the test organisms were relatively low in the present study, suggesting less risk to their consumers. The concentrations of Cd, Pb and Cr in *T. fuscatus* and *E. radiata* were not significantly ($P > 0.05$) different in all three months of study except for Zn, Cu and Fe. It is a known fact that the discharge of metal-containing contaminants into the sea through rivers and streams results in the accumulation of pollutants in the marine environment, especially within *T. fuscatus* and *E. radiata* (Balkas *et al*., 1982). Thus, shellfish and their products can be used for monitoring potential risk to man because these are directly consumed by large human populations in many parts of the world. However, some shellfish by virtue of their mobile nature, are not fair indicators of aquatic contamination, but their regular consumption by man makes it absolutely necessary to monitor their heavy metal contamination to avoid health risks arising from their consumption. Of the six metals studied in the present work, Zn, Fe, and Cu are essential elements while Pb, Cr, and Cd are none essential to organisms. Results of this study indicate low levels of bioaccumulation in the tissues of the investigated organisms. Besides, results have shown the levels of the investigated metals to fall within acceptable limits of World Health Organization (WHO 1998). Consumption of *T. fuscatus* and *E. radiata* from the study area may therefore, cause any risk to their consumers.

CONCLUSIONS

Heavy metal pollutions which have been reported in many parts of the world have posed ever-increasing problems in aquatic ecosystems and their biota globally. There is an urgent need to set up objective programmes and policies aimed at effectively combating heavy metal pollution of aquatic ecosystems. In the present study, the recorded low levels of metals indicate that Cross River at the study area was not contaminated by heavy metals. However, it is important to note that continuous consumption of these shellfishes even at low levels of metal contamination could pose serious health risks. For this reason, there is need for continuous assessment of aquatic environments as well as their edible biota, for heavy metal contamination.

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Table 1: Comparative mean content of metals in *T. fuscatus* and *E. radiata* from the Cross River

Metal	Results presented as mean± SEM	
	T. fuscatus	*E. radiata*
Fe	0.062[a] ± 0.012	0.080[a] ± 0.024
Cd	0.003[a] ± 0.003	0.002[b] ± 0.002
Pb	0.009[a] ± 0.004	0.036[a] ± 0.004
Cr	0.000[a] ± 0.000	0.009[a] ±0.009
Cu	0.057[a] ± 0.010	0.036[a] ± 0.004
Zn	0.048[a] ± 0.022	0.041[a] ± 0.013

* Values with the same letters did not show any significant difference ($P > 0.05$)

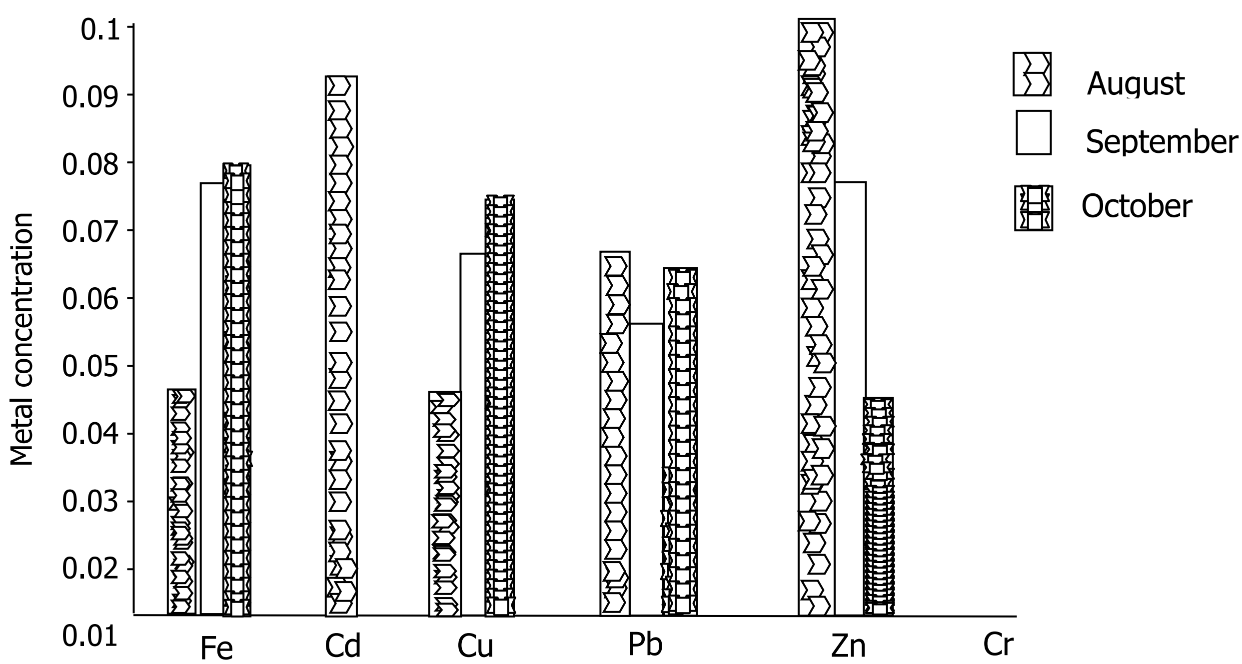

Figure 1: Metal concentration in *Tympanotonus fuscatus* between August and October, 2013.

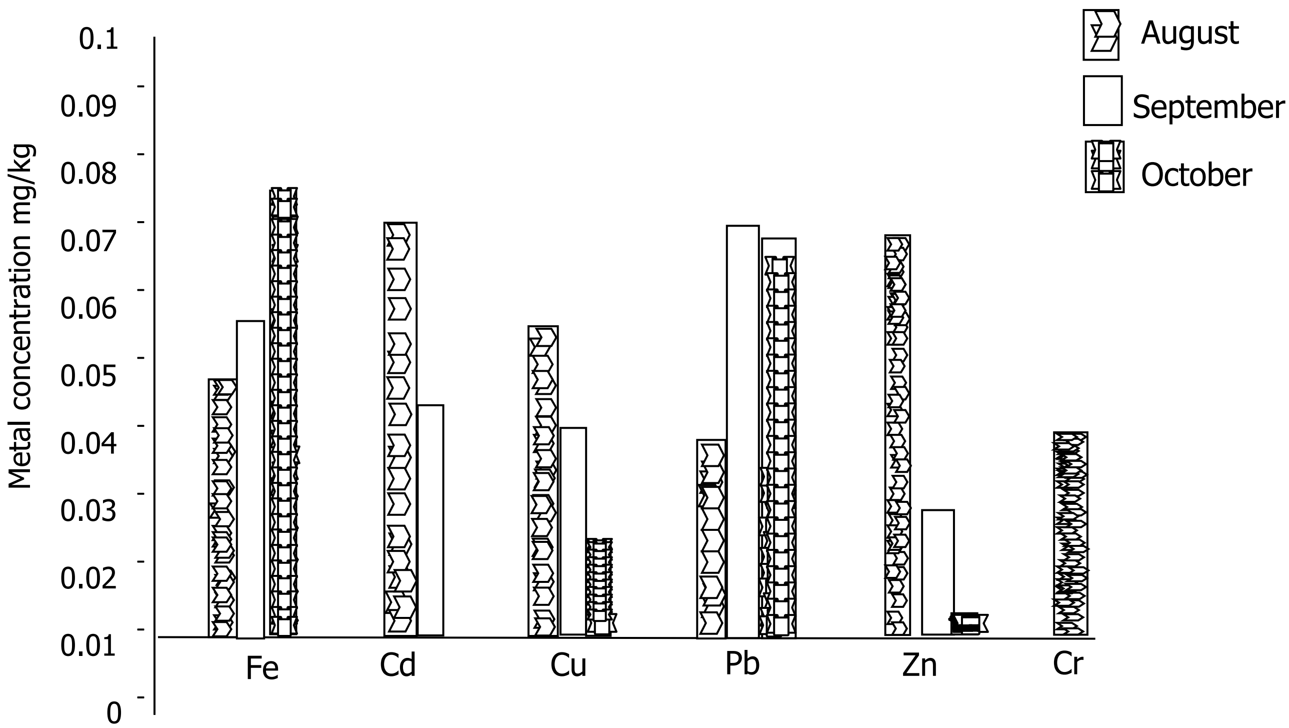

Figure 2: Metal concentration in *Egeria radiata* between August and October (2013)

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