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Research Article

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Levels of Heavy Metals in Tissues of Periwinkle (*Tympanotonus fuscatus*) in River Nun Estuary Around, Niger Delta, Nigeria

Gijo, Ayebapreye Harry[1], Wodu, Ebizimor[2]

[1]Department of Biological Sciences, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria
[2]Department of Biochemistry, Niger Delta University, Wilberforce Island, Bayelsa State, Nigeria

Abstract Heavy metal concentration in *Tympanotonus fuscatus* that were collected from the mangrove swamps of the Nun River estuary in the Niger Delta were analyzed in September, 2019. The samples were evaluated using Atomic Absorption Spectrophotometer (AAS). The concentrations ranged from 0.27mgkg^{-1} to 0.59mgkg^{-1}, 1.57mgkg^{-1} to 3.27mgkg^{-1}, 0.12mgkg^{-1}, 0.22mgkg^{-1} and 0.83mgkg^{-1} to 1.12mgkg^{-1} for Cadmium (Cd), Lead (Pb), Copper (Cu) and Zinc (Zn), respectively. The hierarchy in the heavy metal concentration in *T. fuscatus* from all the three sampling stations indicated that Pb>Zn>Cd>Cu but Hg was not detected. There is need to advocate environmental surveillance of the creeks in order to achieve good sediment quality and contamination-free *T.fuscatus* for safe human health.

Keywords Heavy Metal, Concentration, Nun River and *T. fuscatus*

Introduction

Heavy metals are stable contaminants persistent in coastal waters and sediments. They are significant pollutants because of persistence and bioaccumulation problem. Fossils, mining, municipal sewage and waste disposal are among the sources of these toxic metals. The use of fertilizers and herbicides also contribute to the metal content of the environment. Diet remains the major route through which most metals enter the body. Thus, it is imperative that humans know the toxic metals present in food stuff they consume daily [1]. Although living organisms required trace amount of some heavy metals, any excess can be harmful to animals [2]. Tsai *et al.*, [3] have reported severe complications resulting from exposure to high dose of high density metals mainly lead and mercury. These complications may include abdominal pain, bloody diarrhoea and kidney failure.

Heavy metals can bioaccumulate in benthic organisms, sometimes getting to levels that constitute hazard to consumers' health. This implies that sea foods such as *Tympanotonus fuscatus* is an important pathway to heavy metal exposure.

The river Nun estuary in the Niger Delta has been exposed chronic aquatic pollution due to artisanal refinery activities and other anthropogenic sources of pollution. The contamination of sediments and benthic organisms such as *Tympanotous fuscatus* by heavy metals, even in small concentrations, may lead to serious health problems. Thus the aim of this study is to investigate the levels of high density metals in the tissue of Periwinkles (*T. fuscatus*) in the river Nun estuary around Akassa, Bayelsa State.

Materials and Methods

Study Area

The investigation was conducted at Akassa, a settlement in the south-most tip of Nigeria where the Nun River estuary links the Atlantic Ocean. The vegetation at the fringes of the estuary are predominantly mangroves. The estuary has many mudflats, which are ideal habitats of periwinkles.

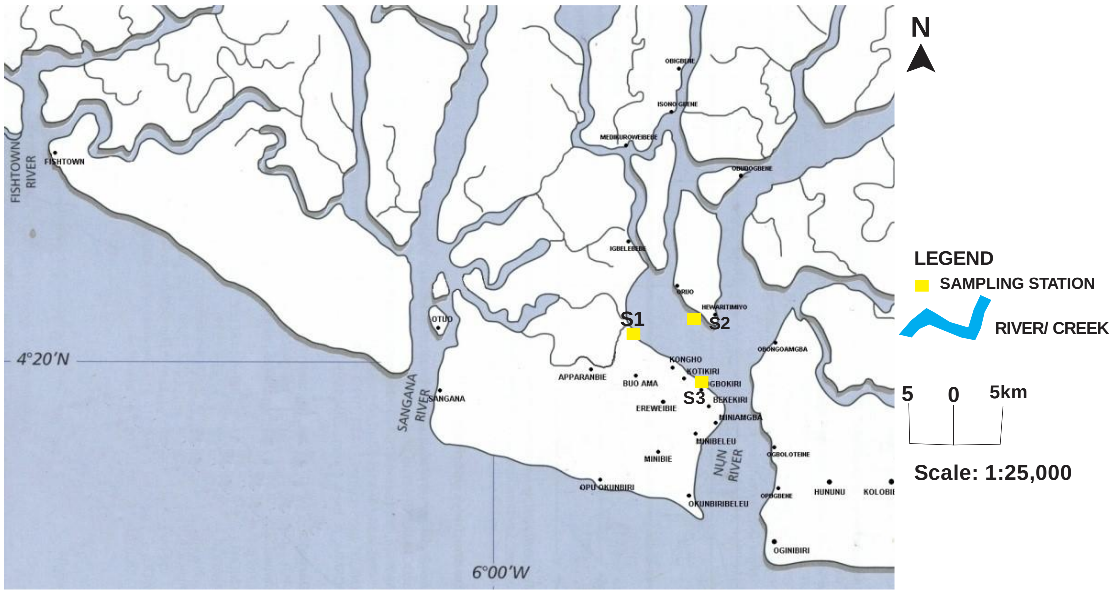

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Figure 1: Map showing the river Nun estuary in Bayelsa State and its tributaries

Sampling Stations

T. fuscatus samples were collected from three sampling stations. Station 1 was established in a mudflat near Bouama creek (located in Latitude: 4°20’3988 North, Longitude: 6°30’7.8048 East); station 2 was established in a mudflat in Tebekubu (located in Latitude: 4°19’490908 North, Longitude: 6°3’468072 East); while station 3 was established in a mudflat in Ogbokiri (located in Latitude 4°19’490908 North, Longitude: 6°3’468072 East)- see figure 1.

Sample Collection and Preparation

The samples were collected in September 2019 at the ebb of the spring tide from the intertidal mudflat of mangrove swamps. Samples were kept in ice-packed coolers and taken to the laboratory until required for analysis.

Samples of *T. fuscatus* were washed and the clean samples were placed on aluminum pan according to their stations and are placed on the hot plate and the heat turned on. The heats drove out the periwinkles from their shells and they were picked into beakers.

Sample Digestion (wet digestion)

Exactly 1g each of *T. fuscatus* was weighed in kjeldahl digestion flasks and placed on the block. Exactly 20ml aliquots of digestion acid (Conc. HNO_3, Conc. H_2SO_4 and Conc. $HClO_4$ in the ratio of 1:3:1), were added into the flasks and heated to obtain a clear solution. After cooling the mixture of acids was diluted with 20ml of distilled water.

Digested samples were filtered into 100ml volumetric flasks and the digestion flasks were rinsed and the volumetric flasks were made up to the marks. Samples are ready for analysis.

Atomic Absorption Analysis

The Analyst 700 AAS was switched on and the individual lamps are calibrated and the samples were aspirated on the AAS machine (Atomic Absorbtion Spectrophotometer) to obtain the various elements.

Results

The mean±SD of tissue concentration of heavy metals in *T. fuscatus* from Bouama, Tebekubu, and Ogbokiri are presented in Table 1. Heavy metal concentration in *T. fuscatus* that were collected from the mangrove swamps of the Nun River estuary in the Niger Delta were analyzed in September, 2019. The concentrations ranged from 0.83mgkg^{-1} to 1.12mgkg^{-1}, 0.12mgkg^{-1} to 0.22mgkg^{-}1, 1.57mgkg^{-1} to 3.27mgkg^{-1}, and 0.27mgkg^{-1} to 0.59mgkg^{-1} for Zn, Cu, Pb and Cd, respectively. The hierarchy in the heavy metal concentration in *T. fuscatus* from all the three sampling stations indicate that Pb>Zn>Cu but Hg was not detected.

The mean and standard deviation of the respective heavy metals ranged from Cd (0.48± 0.18 mgkg^{-1}) Pb (2.66 ±.95mgkg^{-1}), Cu (0.15± 0.06mgkg^{-1} and Zn (0.95± 0.1 5mgkg^{-1} respectively (figure 2).

Table 1: Mean Value of Heavy Metal Concentration in *T. fuscatus* from Bouama (station 1), Tebekubu (station 2) and Ogbokiri (station 3) creeks respectively.

Sampling Stations	Heavy Metals				
	Cd (mgkg^{-})	**Pb (mgkg^{-1})**	**Cu (mgkg^{-1})**	**Zn (mgkg^{-1})**	**Hg (mgkg^{-1})**
1	0.59±012	3.14±002	0.22±013	0.90±011	ND
2	0.27±011	1.57±003	0.12±021	0.83±013	ND
3	0.58±015	3.27±011	0.12±002	1.12±022	ND

Values are reported as mean±standard deviation. ND (not detected).

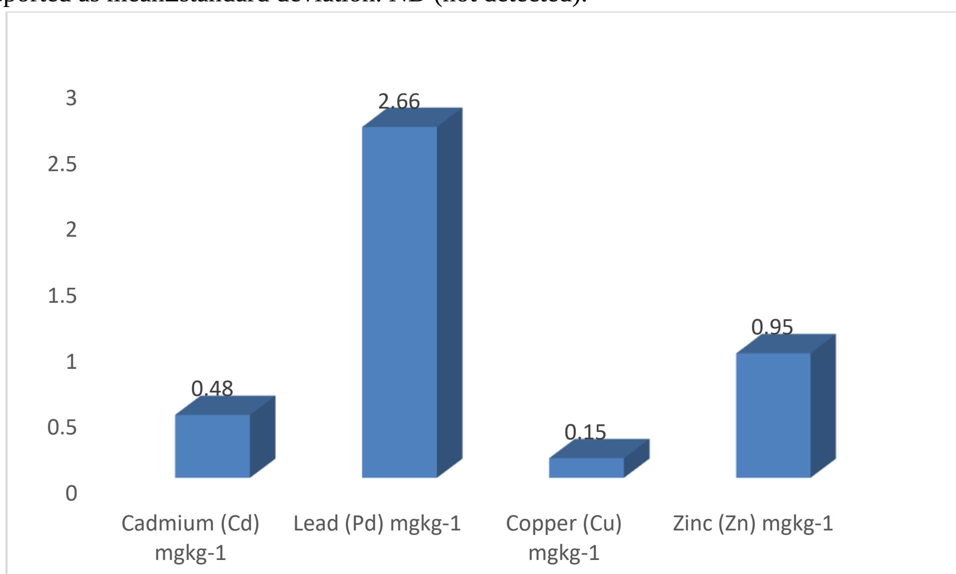

Figure 2: Mean values of heavy metals concentration of in T. fuscatus across all three stations

Discussion

The results from the study show the presence of various heavy metals in the tissues of *T. fuscatus* which indicates high levels of lead (Pb) 2.66± 0.95mgkg' across all stations, followed by Zinc (Zn) 0.95±0.15 mgkg^{-1}' which is greater than cadmium (Cd) 0. 48± 0. l8mgkg^{-1}, and Copper (Cu) 0.15± 0.06mgkg^{-1}. The concentration of Copper (Cu) 0.15± 0.06mgkg^{-1} was the least among the heavy metals. Ijeomah *et al.*, [4] had reported that heavy metals in the tissues of crabs, water snails, periwinkles and oysters ranged from 0.020 to 0. 40 mg/kg for Cadmium; 0.038 to 0.087 mg/kg for Chromium; 1.213 to 2.403 mg/kg for copper; 60.293-145.39 mg/kg for Iron; and 0.057 to 0.813 for

Lead. Cadmium (Cd) concentration in *T. fuscatus* reported in the present work however, contrast with that reported by Emmanuel [5] in *Callinectes amnicola* and *Tympanotonus fuscatus*.

Salinity of the water *and T. fuscatus* size are factors that affect its accumulation of heavy metals [6]. Accumulation of cadmium, chromium and lead were reported by Davies *et al.,* [7] in the shell and soft tissues *of T. fuscatus* collected from Elechi creek, Niger Delta. Nigeria. Moslen and Miebaka, [8] studied the heavy metals in tissues of *S. melanotheron* obtained from Azuabie creek and reported that heavy metals in the tissue of the fish were in the order Cd < Ag < Ni < Cr < Pb < Cu with mean concentrations of 0.38 ± 0.08mgkg^{-}1, 1.02 ± 0.34mgkg^{-1} 1.94 ± 0.34mgkg^{-1}, 2.69 ± 1.44mgkg^{-1}, 5.12 ± 1.23mgkg^{-1} and 5.59 ±l.06mgkg^{-1}, respectively.

In another investigation reported by Moslen, [8] on Azuabie creek, mean metal concentrations in tissue of *Mugilcephalus* were as follows: Cr (1.96 ±0.81 mgkh^{-1}), Ni (1.82 ±0.4 mgkg^{-1}) Cu (4.12 ±l.07mgkg^{-1}), Pb (2.96 ± 0.67mgkg^{-1}), Ag (1.20 ±0.33mgkg^{-1}) and Cd (0.33±0.09mgkg^{-1}). This finding supports the results of the current study confirming that heavy metals are present in the area under study. The mean values of lead (Pb), Copper (Cu), Cadmium (Cd) and Zinc (Zn) in the tissue of *T. fuscatus* in the present work however, were below the limits recommended USFDA (1993), FAQ/WHO (1989) and FAO (2003) in seafood [9-14]. In another study of mudskipper (*periophthalmus* sp) tissues, collected from the Azuabie creek, Moslen and Miebaka [15] found that values of nickel, argon, lead and chromium were present above the limits recommended by WHO (1985) and FAQ (1983) [10, 14] in sea food and concluded that mudskippers has the ability to bio-accumulate and bio-magnify these heavy metal pollutants and not display any sign of distress. This is also the case with *T. fuscatus* in the present work.

Conclusion

The levels of heavy metals concentration in *T. fuscatus* indicate increase from anthropogenic activities around the river and has remained a major source of concern. Heavy metals in the creeks has increased significantly because of unregulated activities, mainly from oil & gas companies and other human activities. This has placed the abundant and highly consumed periwinkle in the region at high risk. However, lead (Pd), copper (Cu), Zinc (Zn) and cadmium (Cd) were detected in the tissue of *T. fuscatus* but Mercury (Hg) was not detected.

Recommendations

- Reduce these pollutants by regularly monitoring of the river and the biotic factors therein and encourage government/institutional funding of in-depth research.
- To also advocate environmental surveillance of the creeks in order to achieve good sediment quality and contamination-free *T. fuscatus* for safe human health.

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