Bioaccumulation of Heavy Metals in the Tissue of Periwinkle (*Tympanotonus fuscatus*) from Creek Road and Bodo Water Bodies in Rivers State.

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Abstract
Periwinkles forms part of the daily staple food. This study evaluates periwinkle samples (Tympanotonus fuscatus) collected from two distinct water bodies, namely Bodo and Creek Road water-sides, in River State to examine and assess the level of contamination. After analyzing the data from the field study. The total levels of cadmium (Cd), chromium (Cr), lead (Pb), nickel (Ni), copper (Cu) and Polyaromatic hydrocarbon (PAH) were determined using the Atomic Absorption Spectrophotometer. The result from the bioaccumulation factor shows that Pb, Cd and Cu were hyperaccumulated, Ni was tolerant in Tympanotonus fuscatus from Bodo water front while Cr and Ni were hyperaccumulated, Cd, Pb and Cu were tolerant in Tympanotonus fuscatus from Creek Road water body respectively. The BAF of trace elements in the periwinkle (Tympanotonus fuscatus) was in the order: Pb>Cd>Cu>PAH>Ni>Cr at Bodo water body, and Cr>Ni>Cd>Pb>Cu>PAH at Creek Road water body. The analysis report suggests that activities in the area have contributed to high levels of these contaminants and consumption of periwinkle with heavy metal concentration above the permissible limits may be considered unsafe and will cause harm to human life.

Keywords: *Bioaccumulation, Impact, Periwinkle Contamination, Pollution*

INTRODUCTION

The experimental water bodies of Bodo and Creek Road water-side are areas of high human activities and sites for commercial fisheries. Bodo water bodies is located in Ogoni land, an area designated for the Nigeria's largest ever oil spill clean-up initiative implemented by the Hydrocarbon Pollution Remediation Project (HYPREP) - a project of the Nigerian Federal Ministry of Environment, and funded by the Shell Petroleum Development Company joint venture. This study would therefore validate the effectiveness of the environmental remediation done. Creek Road Water-Side is a metropolitan area, with an historic boat jetty, used to ferry humans and cargo to hinterland communities that can only be assessed through water. This study would validate its contamination status and continuous use as a site for commercial fishery.
Periwinkle (*Tympanotonus fuscatus*) was used as the sentinel bioindicator organism to ascertain the contamination status of the water bodies. Periwinkle is a deposit feeder, feeding on mud and digesting the detritus and other organic matter in highly productive and in most cases extremely

polluted estuarine ecosystems (Udiba *et al*., 2020). It forms part of the daily staple food in the Niger Delta region of Nigeria, human exposure to trace metal contaminants through the consumption of periwinkle may result in adverse health effects (Etuk *et al*.,2020). Heavy metals generally enter the aquatic environment through atmospheric deposit, erosion of the geological matrix or anthropogenic activities caused by industrial effluent, domestic sewage, mining and agricultural. Heavy metals such as cadmium, lead, chromium, nickel and metalloid of arsenic have been implicated with the high toxicity and in carcinogenicity (Allison and Paul, 2014). Thus, these heavy metals are of severe environmental and public health significance (Allison and Paul, 2014; Mahurpawar, 2015; Mitra *et al*.,2022; Rehman *et al*.,2018). Anthropogenic activities either in the sea and or on land have directly and indirectly predisposed sea foods to environmental contaminants/pollutants such as urban runoff, petroleum, heavy metals etc, which can be ingested or absorbed through the food chain (Bob-Manuel *et al*., 2022; Ojha and Tiwary, 2021). Metal contamination of sea food in particular is fast becoming a global crisis given the fact that sea water is vulnerable to increasing discharges from coastal activities (Ahmed *et al*., 2015). These health effects with varying symptoms depend on the nature and quantity of the metal ingested (Jaishankar *et al*., 2014; Rehman, *et al*., 2018; Hu, 2002). Many aquatic organisms for instance periwinkle have the ability to accumulate and bio-magnify contaminants like heavy metals, polycyclic aromatic hydrocarbons and PCB in the environment (Oriakpono and Jaja, 2022; Moslen *et al*., 2017). Periwinkles (*T. fuscatus*) have been recognized as good accumulators of organic and inorganic contaminant and these species are abundant, cheap and accessible source of protein and as such its accumulation can easily affect humans which are the ultimate consumers" (Davies *et. al*., 2006). Creeks and aquatic environment of Rivers State in the Niger Delta have been consistently exposed to Crude oil spills and other pollutants (Oriakpono *et al*., 2022). Bioaccumulation factors (BAF) are calculated by considering contaminant tissue concentrations with respect to environmental concentrations. BAF values > 1 indicate that the accumulation in the organism is greater than that of the medium (e.g., sediment, soil or water) from which the contaminant was taken from.

Bioaccumulation factor (BAF), was estimated as the ratio of the concentration of trace element in periwinkle to concentration in sediment.

In this study, bioaccumulation of heavy metals such as Chronium (Cr), Cadmium (Cd), Lead (Pb), Nickel (Ni) and Polyaromatic hydrocarbon (PAH) were evaluated in tissues of edible organism, periwinkles, which was used as a contamination indicator of the experimental water bodies. These target elements, through the consumption of periwinkles, can result in their bio-magnification in human populace, thereby causing public health issues.

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MATERIALS AND METHODS

Field methods

Subsurface sediments were collected across the various river front from three different point at low tide by using grasp sampler and a compost was make from each site, which were wrapped with aluminum foil, and transported to the laboratory for analysis.

The edible periwinkle is a mollusk widely distributed in coastal and estuarine areas in the Niger Delta. 10 samples of periwinkles were randomly collected at the water shore along the sampling stations and was washed and kept in well labelled plastic containers.

Periwinkle samples were collected by hand-picking during mid-tide level (MTL) and mean low tide level (MLTL) at the intertidal flats of mangrove swamps. All samples were stored at 40C inside an ice packed coolers while in transit and were conveyed to the lab the following day for identification and digestion.

Sample preparation/digestion

The shell of the fresh periwinkle sample for each station were cracked and removed to obtain their tissue (edible part). The tissue separated was rinsed with several changes of distilled water and was allowed to dry in the oven at 1200C for 10 hours. After which, it was burnt to ashes in a furnace at about 4500c. It was allowed to cool in a desiccator and was grinded to fine homogenous powder. The ash sample that weighed about 3.000g was transferred into a 100 ml beaker in a calibrated weighing balance.

30 ml of Aqua Regia was added to the sample in a fume hood. The samples were placed in a hot plate and was heated until digestion was completed (additional acid could also be added if necessary). The beaker was rinse with distilled water and the digest was filtered into the 50ml standard flask. It was increased to 50 ml mark with distilled water. 3-point calibration standards for each metal was prepared, which was used to calibrate the Atomic Absorption Spectrophotometer.

Sample Analysis

The resulting samples were analyzed for heavy metals commonly associated with crude oil and petroleum products such as chromium (Cr), Cadmium (Cd), Nickel(Ni), Lead(Pb), Copper (Cu) and Polyaromatic hydrocarbon (PAH) using Atomic Absorption Spectrophotometer. Sample preparation was by acid digestion, followed by filtration through a 0.45-micron membrane filter. Then aliquots of the filtrate were used to analyze for the various metals. The aliquots were analyzed in Triplicates for concentrations of Cd, Cr, Pb, Cu, Ni, and PAH, with the computerized scientific model 200a/20 atomic absorption spectrophotometers.

RESULT

Table 1. Calculated bioaccumulation factors of trace elements for *Tympanotonus fuscatus*

Trace Elementa	**Bioaccumulation factor (BAF)**	
	BODO Water Body	**CREEK ROAD Water Body**
Lead (Pb)	44. 80	2.46
Cadmium (Cd)	18.00	3.47
Copper (Cu)	13.90	1.43
Nickel (Ni)	1.94	11.59
Chromium (Cr)	0.50	13.50
PAH	2.00	0.29

DISCUSSION

It is important to have a clear understanding of heavy metal concentrations in aquatic organisms as a result of Significant environmental damage due to oil spills caused by the extraction activities of multinational oil companies and waste disposal, have had detrimental effects on the environment in line with nature of management and human consumption of these species.

BAF of the trace elements in the periwinkle species (which are deposit feeder) are presented in Table 1. BAF<1 indicates no contamination of the periwinkle; 1>BAF≤10, the periwinkle is

tolerant and BAF>10, a hyperaccumulator (Ávila et al., 2017). Based on the classification, there was no contamination by Cr in *Tympanotonus fuscatus* at Bodo, and PAH in *Tympanotonus fuscatus* at Creekroad. *Tympanotonus fuscatus* was tolerant to PAH and Ni in Bodo while *Tympanotonus fuscatus* was tolerant to Pb, Cd and Cu in CreekRoad. *Tympanotonus fuscatus* hyperaccumulated Pb, Cd and Cu at Bodo, and hyperaccumulated Ni and Cr at Creekroak. The high BAFs could be explained on local environmental pollution of this species of periwinkles at the various loc. The BAF of trace elements in the periwinkle (Tympanotonus fuscatus) was in the order: Pb>Cd>Cu>PAH>Ni>Cr at Bodo water front and Cr>Ni>Cd>Pb>Cu>PAH at CreekRoad waterfront.
Bioaccumulation factor (BAF) describes the absorption and distribution of a substance in an organism after exposure in a given environmental matrix (Subotić et al., 2013)
The findings of this study agree with Davies, et al. (2006) reported the Bioaccumulation of heavy metals in water, sediment and periwinkle (Tympanotonus fuscatus var radula) from the Elechi Creek, Niger Delta. Jack et al. (2005) noted that hydrocarbons take longer time to sink to the riverbed and that marine organism accumulate hydrocarbons due to their sedentary and bottom feeding habit. Clinton, et al. (2009) reported total hydrocarbon in *T. fuscatus* from an oil polluted mangrove wetland located in the Niger Delta Nigeria, between November 2001 and October 2002 as 449.30 µg/g. Chindah, et al. (2009) reported concentration of total hydrocarbon content, chromium and cadmium in the tissue of T. fuscatus in three ecological zones of Bonny River System, Niger Delta, Nigeria in the range of 0.015 – 0.015 mg/kg, 0.0 – 1.0 mg/kg, 0.0 – 1.0 mg/kg respectively (dry season) and 8.405 – 23.207 mg/kg, 0.027 – 0.349 mg/kg and 0.333 – 0.454 mg/kg respectively (wet season). kejimba and Sakpa (2014) reported the concentration of cadmium in T. fuscatus var radula samples from Egbokodo River, Warri, Nigeria between September and February, to be in the range of 0.00 – 0.005mg/g. Ayenimo et al. (2005) reported a preliminary investigation of heavy metals in periwinkles from Warri River, Nigeria.

CONCLUSION

The findings of the descriptive analysis highlight the importance of implementing specific environmental management strategies in Creek Road and BODO Water bodies. Implementing these strategies is essential for reducing the potential environmental risks linked to high levels of heavy metals in periwinkle tissues. Continuously monitoring the situation is crucial for assessing the success of remediation efforts and maintaining the long-term well-being of aquatic ecosystems in these regions. The presence of trace metals in the environment is a significant issue in the Niger Delta region, raising concerns among scientists and researchers. The presence of metals such as Pb, Cd, Cu, Ni, Cr and PAH can be attributed to various factors, including oil spills, unregulated release of domestic and municipal waste, agricultural run-offs, and pipeline damage.

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