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*Full Length Research Paper*

# Heavy metal concentrations in water, sediment and periwinkle (*Tympanotonus fuscastus)* samples harvested from the Niger Delta region of Nigeria

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**Heavy metal pollution of terrestrial and aquatic environments in Niger-delta region of Nigeria is on the increase due to increased urbanization and crude oil exploration. *Tympanotonus fuscastus* are mud dwellers and could bioaccumulate heavy metals; therefore consumption of heavy metal contaminated sea foods like periwinkle may breed lots of health problems. Heavy metal concentration in water, sediment and Periwinkle samples from three locations (Itu-River, Abuloma River and Oron River) in the Niger Delta Region of Nigeria were evaluated using atomic absorption flame photometry. Result showed that cadmium (Cd) concentration was highest in water samples from Abuloma River (0.106 mg/l) while lead (Pb) concentration was highest (0.01mg/l) in the water samples from Itu River. Cd and Pb concentrations (0.127 and 0.08 mg/kg, respectively) in sediment samples were highest in Abuloma River. The concentration of Cd in *T. fuscastus* samples was 0.11 mg/kg in Abuloma River, while concentration was 0.27 mg/kg in Oron River. Copper (Cu) was generally low in the water samples; the highest concentration (0.011 mg/kg) was obtained in water samples from Oron River. Sediment concentration of Cu was high (0.088 mg/kg) in Itu River, while its concentration in the periwinkle samples was 0.54 mg/kg in Abuloma River. The results also showed that Cr, As and Hg were below detectable concentration in tissues, soil and water samples from Itu and Abuloma Rivers, while Hg concentration in Oron River sediment was 64.2 mg/kg.**

**Key words:** Sea foods, heavy metals, pollution, environment, nutrition, bioaccumulation

## INTRODUCTION

The Niger Delta region with its creeks and tributaries harbors rich collection of biotopes dominated by vast areas of mangrove swamp forest. However, this region, with its complex ecological form is being subjected to considerable environmental pollutants from industrial activities and crude oil exploration. This has resulted in the release of pollutants (hydrocarbons and heavy metals) capable of contaminating soil and water bodies (Otitoju et al., 2011; Ewa-Oboho, 1994). Heavy metals have been reported to exert negative effect on biological processes in general and may influence the nutritional and biological status of sea foods (Udosen et al., 2001).

Sea-food is a rich source of nutrients; however, its nutritional values may be affected based on the environment in which these organisms live (Nsikak et al., 2007). These important food sources constitute a major part of the diet in the Niger Delta region of Nigeria, where they are traditionally cooked without removing the shells before consumption and these organisms could be contaminated with heavy metals which may be detrimental to the

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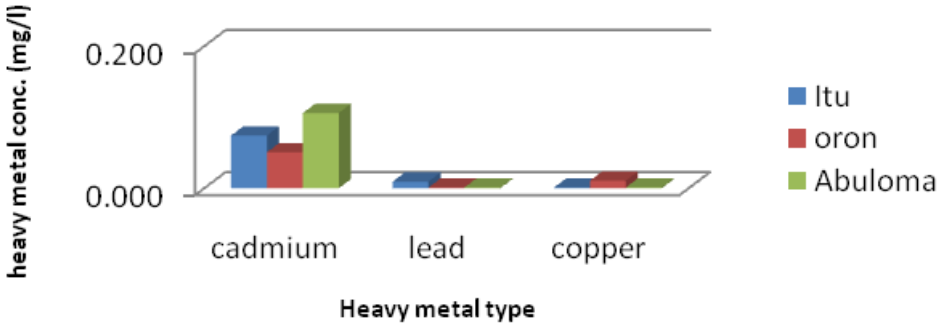


**Figure 1.** Heavy metal concentration in water samples from Oron, Itu and Abuloma Rivers, Nigeria.

health of children, pregnant women and even the general public.

Large number of people living in the Niger Delta region of Nigeria consumes sea foods harvested from different water bodies laden with history of crude oil spillage and other industrial activities. Heavy metals are high priority pollutants because of their relatively high toxic and persistent nature in the environment. These metals in the form of inorganic compounds from natural and anthropogenic sources continuously enter the aquatic ecosystem where they could pose serious threat to the food chain.

The aim and objectives of this research were to determine the levels of trace metals {lead (Pb), mercury (Hg), chromium (Cr), arsenic (As), cadmium (Cd) and copper (Cu)} in water, sediment and periwinkles harvested from the Niger Delta region of Nigeria.

## MATERIALS AND METHODS

### Description of the study areas and sampling locations

Smooth specie of periwinkle (*Tympanotonus fuscastus)* commonly found in the Niger Delta region of Nigeria were collected from three different Rivers. This research covered three different locations situated across the Niger Delta region of Nigeria. The studied areas include; Oron River in Idia-oro, Oron Local Government area located in the South-eastern part of Akwa-Ibom state. The second studied area was Itu River in Ikot-Udobia; which is located in the North-western part of Akwa-Ibom state while the third studied area was Abuloma River in Abuloma, Port-Harcourt located in the South axis of Rivers state. The sea food samples were transported in clean polyethylene bags to the Biochemistry Laboratory, University of Uyo were they were washed with deionized water to remove all dirt particles; they were also shelled and kept in an oven at 65°C for 2 days after which they were grounded to powdered form.

### Heavy metal analysis

#### *Digestion methods*

**Nitric acid:** Hydrochloric acid digestion- 1.0 g of the powdered sea food sample was digested in 6 ml of HCl and made up to 30 ml with distilled water. Filtration was carried out using an acid wash filter paper (Whatman) and stored in sample bottles. The filtrate was taken to the UNICAM 939 Atomic Absorption Spectrophotometer (AAS) for Hg, As, Cd, Cr, Pb and Cu determination in triplicate.

### Statistical analysis

Mean values (±SD) of duplicate experiment were taken for each analysis. Significantly different results were established by one-way ANOVA. The accepted level of significance is $p<0.05$.

## RESULTS

Result showed that Cd concentration was highest in water samples from Abuloma River (0.106 mg/kg) while Pb concentration was highest (0.01 mg/kg) in the water samples from Itu River (Figure 1). Cd and Pb concentrations in sediment samples (0.127 and 0.08 mg/kg) were higher in Abuloma River, respectively (Figure 2). The concentration of Cd in *T. fuscastus* samples was 0.11 mg/kg in Abuloma River while concentration was 0.27 mg/kg in Oron River (Figure 3). Cu was generally low in the water samples, the highest concentration (0.011 mg/kg) was obtained in water samples from Oron River. Sediment concentration of Cu was high (0.088 mg/kg) in Itu River while its concentration in the periwinkle samples was 0.54 mg/kg in Abuloma River. The results also showed that Cr, As and Hg were below detectable concentration in Itu and Abuloma Rivers, while Hg concentration in Oron River was 6.42 mg/kg.

## DISCUSSION

The aquatic systems are being polluted anthropogenically with chemical pollutants from industrial, domestic and agricultural wastes, which are ultimately absorbed by aquatic animals and plants. Pollution of aquatic ecosystems by heavy metals is an important environmental problem, as heavy metals constitute some of the most dangerous toxicants that can be bioaccumulated in living tissues (Guo et al., 1997; Omoregie et al., 2002). Consumption of periwinkle in the Niger Delta region of Nigeria

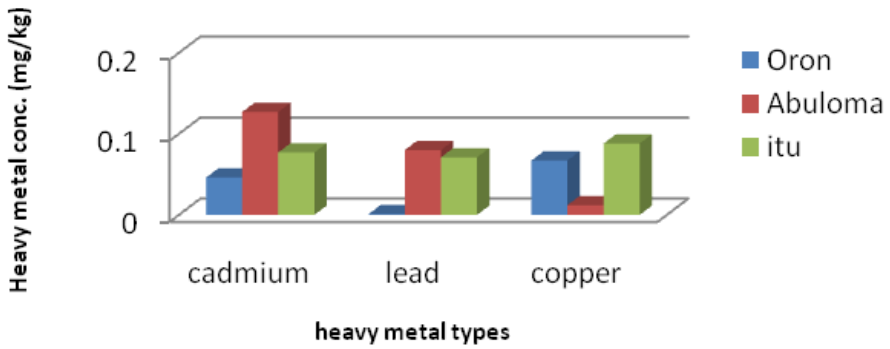


**Figure 2.** Heavy metal concentration in sediment samples from Oron, Itu and Abuloma Rivers, Nigeria.

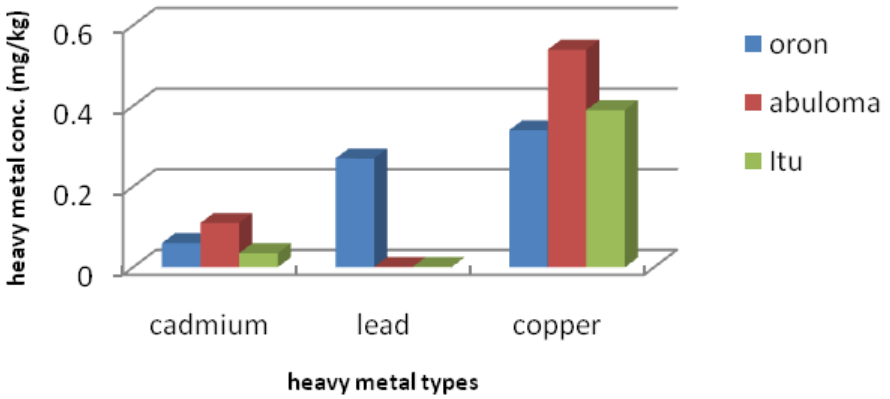


**Figure 3.** Heavy metal concentration in Sea-Food samples Oron, Itu and Abuloma Rivers, Nigeria.

is considered very common. However, the environments in which these organisms are harvested give reasons to worry.

The results obtained from this research showed that Hg was present in periwinkle samples from Oron River, this result was indeed unexpected, since Oron, is not an industrialized city. Nevertheless, Oron River transverses other locations within and outside Akwa Ibom State, resulting in the presence of Hg in this river and its bioaccumulation in the sea foods. Mercury is a dangerous heavy metal whose toxicity was dated back to the ancient time. The wide use of this liquid metal in medicine, industries and in electrical fittings made the environment especially the aquatic environment vulnerable to its pollution (Nsikak et al., 2007; Gress and Lord, 2002; Wiener, 2002). Similarly, a lot of farming activities where pesticides and other agrochemicals are utilized are ongoing along the shore of this River. The possibility of spillage or and leakage into the soil and consequently into the water bodies by run-off activities is inevitable.

The result also showed that copper (Cu) was present in all the water sediment and tissue samples. Abuloma River had the highest concentration of Cu which ranges between (0.288 and 0.556 mg/kg) and this range generally falls below the World Health Organization (1994) limits of 2.0 mg/kg for food and sea foods. Cadmium was also present in all the samples but the highest concentration of Cd was found in samples obtained from Abuloma River (0.118 mg/kg). This may be as a result of pollutants from industrial and agricultural processes as well as crude oil exploration. Bioaccumulation of this heavy metal most frequently results in kidney damage and can also cause Osteomalacia (Järup, 2003).

Itu River had undetectable concentrations of Pb 0.001 mg/kg, Oron River had low concentrations of Pb (0.027 mg/kg), while Abuloma River had the highest concentration of this metal (0.039 mg/kg). Pb has been reported to be associated with crude-oil exploration, pipe-line transportation, corrosion inhibition as well as many industrial processes (Oguzie and Igwegbe, 2007). High levels of Pb in foods can induce abdominal pains, drowsiness, vomiting, convulsion kidney and reproductive system malfunction (Goldsmith and Hildzard, 1985). The Food and Agriculture Organization and the World Health Organization stipulates the weekly intake of Cd and Pb for adults at 0.42 to 0.49 and 1.5 to 1.7 mg/kg, respectively

(Leski and Rudawska, 2005). From our results, the concentration of Cd and Pb in the samples was lower than the recommended range by FAO and WHO (1999) and Sabin and Wendy (2009). Therefore, these metals may not pose serious health consequence to consumers at short term of exposure but could be in the long run. Similarly, the concentrations of Cr and As were undetec-ted in the sea food samples from the three sampled rivers.

The traditional consumption of periwinkle using 'blowers method' where mouth is used to suck out the unshelled periwinkle may require a change because there could be more risk in consuming sediments from the intestinal tract of these organisms than the shelled periwinkle. Based on the result obtained from this study, it is observed that Cu, Pb, and Cd are present in sea foods but their concentration generally falls below the recommended range by World Health Organization and the Food and Agricultural Organization (FAO). We therefore conclude that heavy metal toxicity may not be an immediate problem in Niger-Delta region of Nigeria but may pose a lot of environmental problems if it is not properly checked. We also suggest that there is a need for regular public health checks on the levels of heavy metals among the communities that border the sampled rivers in order to avoid a possible future toxic exposure. Measures should also be put in place to control the treatment and discharge of effluent into the water bodies.

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