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Full Length Research Paper

A study of the levels and seasonal variation of heavy metal contamination of *E. radiata* from creeks in Burutu area of Delta state, Nigeria

James Azuka, Adaku Ijeoma and Ijeagha Ifeatu

Department of Fishery and Aquaculture, Faculty of Agriculture & Natural Resource Management, Ebonyi State University, Abakaliki, Ebonyi State, Nigeria.

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Levels of heavy metal concentrations in tissues of *Egeria radiata* from Obotebe and Gbekobor Creeks in Burutu Local Government Area were investigated. *E. radiata* samples were collected fortnightly for 12 months in 2008. The soft tissues of *E. radiata* were extracted, weighed and dried in oven for three days at 60^0C. Ten grams of the dried samples were homogenized and digested before analysis using the atomic absorption spectrophotometer (AAS) to determine levels of heavy metals such as (copper, lead, manganese, cadmium, mercury, chromium and nickel). The results obtained showed that tissues of *E. radiata* from the creeks were contaminated with heavy metals. The mean concentrations of heavy metals in tissues of *E. radiata* followed an increasing sequence of Hg < Cd < Cr < Mn < Pb < Cu < Ni. Heavy metal concentrations in tissues of *E. radiata* were higher but were not significant in the dry season than in the rainy season. Levels of heavy metals in tissues of *E. radiata* were found to be below the FAO/WHO acceptable limits of heavy metal pollution in fishes and shell fish. Mean levels of lead (Pb), manganese (Mn) and Cadmium (Cd) were found to be higher than world standard but not significant. Nickel were significantly lower than world standard. There is a need for constant monitoring of levels of heavy metals in the area of study in order to forestall any significant rise in their levels.

Key words: Heavy metals, *E. radiata*, creeks, Burutu, Nigeria.

INTRODUCTION

E. radiata is a fresh water clam inhabiting the lower reaches of some large West African rivers (Udoidiong and Akpan, 1991). Most clams occur in shallow waters, in which they are generally protected from wave action by the surrounding bottom. Clams lie buried just beneath the surface to depth of about 2 feet. The possessions of inhalant and exhalent siphons enable the clams to obtain food by filter feeding from incurrent water and expel wastes from the exhalent current. Whetstone, Sturmer and Oestering (2005) reported that clams prefer a combination of mud and sand as substrates among other suitable substrates. Lorio and Malone (1995) noted that the distribution of clams is determined by hydrodynamic factors that affect various pre and post settlement processes which may be related to geographic locations such as sediment types and depths.

Shell fishes in general including clams are good indicators of the levels of contamination of water bodies due to their filter feeding habits and contact with bottom sediment. Clams are particularly biomonitors by virtue of their distribution, large body size and high population density (Phillips, 1976, Ahn, 2005, De Astudillo, Yen and Berkele, 2005, Kanakaraju, Ibrahim and Berseli, 2008). Heavy metals can therefore bioaccumulate in tissues of benthic organisms such as *E. radiata*. Heavy metal contamination has been known to impact negatively on aquatic organisms. Jackson, Baird and Els (2005) reported that lead (Pb) and zinc (Zn) contamination caused impairment of brood and larval development of *Callisiassa kraussi* (burrowing crustacean). Chin and

*Corresponding Email: james_azuka@yahoo.com

Chen (1993a) reported contamination above FAO acceptable limit in *Oreochromis niloticus* and *Synodontis* species and in the hard clam, *Meretrix lusona.* Studies on the aspects of the biology and temporal trends in heavy metal concentrations in *E. radiata* have shown that every metal displayed a perculiar temporal fluctuational pattern and that variation in the concentration of some of the heavy metals appeared to be strongly related to the tissue weight of the clam (Moses, 1990; Etim et al., 1991).

Saxena and D'Suoza (2005) reported that heavy metal contamination are of special concern because they are non-degradable and therefore persist in the ecosystem. Most of the creeks in Burutu are contaminated with heavy metals due to crude oil exploration and exploitation activities in the area and environs especially Warri, which is an industrialized town with lots of petrochemical industries (Adekoya, 1997; Ipingbemi, 2009). Rainbow (1995) stated that the use of biomonitors offer time integrated measures of portions of the ambient metal load that are of direct ecotoxicological relevance.

E. radiata happens to be one of the fishery resources in the area and is consumed by people in the area of study. In view of the toxicological importance of this edible clam, this study is undertaken to assess the levels and seasonal variation of heavy metal contamination of *E. radiata* from creeks in the study location in order to ascertain their suitability and safety as shell fish for the local people.

MATERIALS AND METHODS

Egeria radiata samples for the study were collected fortnightly from Obotebe and Gbekebor creeks in Burutu Local Government Area of Delta State (Figure 1).The study lasted 12 months from January to December, 2008. Twenty samples of *E. radiata* ranging from 6.9cm to 10.7cm in length were purchased monthly from Obotobe and Gbekebor creeks each for the study. The soft tissues of *E. radiata* were extracted, weighed and dried in the laboratory oven for three days at a constant temperature of 60^{o}C. The dried samples were weighed and homogenized in a porcelain mortar and stored in an air tight container. Ten grams of the dried and homogenized samples were weighed into a 250 ml conical flask. Twenty ml of perchloric acid ($HClO_4$) and 20 ml of nitric acid (HNO_3) in a ratio of 1:1 was added to the sample in the conical flask. The content of the flask was heated at a temperature of 160^{o}C using a burner (digester) to reduce the volume of the content of the flask to 5 ml. The residue was then energized with 5 ml 20% hydrochloric acid (HCl) and filtered into 100 ml volumetric flask made up to the 100 ml mark with deionized water. The digest was transferred to plastic bottles and later analyzed using Atomic Absorption Spectrophotometer (model- unicam 969)

Heavy metals analyzed were copper, lead, manganese, cadmium, mercury, chromium and nickel. Data obtained were subjected to analysis of variance test at 95% confidence limit. Duncan Multiple Range Test (DMRT) was also used to separate the means.

RESULTS

Analysis of heavy metal contamination in tissues of *E. radiata* shows that it was contaminated with heavy metals. The mean concentrations of heavy metals in the tissues of *E. radiata* from the creeks followed an increasing sequence of Hg < Cd < Cr < Mn < Pb < Cu < Ni. The mean concentrations of heavy metals in tissues of *E. radiata* observed in 2008 were copper 5.43 mg/kg, lead 3.30 mg/kg, manganese 2.71 mg/kg, cadmium 1.04 mg/kg, mercury 0.42 mg/kg, chromium 2.68 mg/kg and nickel 7.10 mg/kg (Table 1).

Heavy metal concentrations in *E. radiata* were observed to be higher during the dry season than in the rainy season though not significantly higher ($P > 0.05$). The concentration of copper throughout the study period remained below the WHO permissible limit of 20mg/kg. The highest concentrations of copper in the tissues of *E. radiata* tissue 10.32mg/kg was obtained in July followed by June. Higher mean concentration of 5.38mg/kg lead was observed in the tissues of *E. radiata* in the month of February compared with WHO limit of 1.5mg/kg and least in the month of December. Manganese was highest in concentration in the month of August with 4.15mg/kg in tissues of *E. radiata* which was higher than WHO limits of 1.0mg/kg and least in February with 0.56mg/kg. Cadmium was also higher than WHO permissible limits with highest values of 1.35 and1.34mg/kg in the months of April and May respectively and lowest in the month of December and January with 0.92mg/kg. Mercury, chromium and nickel were highest in mean concentrations in the months of January for mercury and February for chromium and nickel with values of 1.50, 3.78 and 34.31mg/kg and lowest mean concentrations of 0.15, 0.86 and 0.24mg/kg in June, April and March in tissues of *E. radiata* respectively. Copper, manganese, cadmium, mercury and nickel were higher in tissues of *E. radiata* from Obotebe while lead and chromium were higher in concentration in tissues of *E. radiata* from Gbekebor creek (Table 2). Mean levels of lead (Pb), manganese (Mn) and cadmium (Cd) were found to be higher than the world standard but not significantly higher. Mean heavy metal concentration in tissues of *E. radiata* compared with world standard is shown in table 3. Nickel was however, significantly ($P < 0.05$) lower than world standard.

DISCUSSION

Tissues of *E***.** *radiata* from Obotebe and Gbekebor creeks were found to be contaminated with heavy metals. This shows that aquatic organisms from most creeks in oil polluted environments are likely to be contaminated with heavy metals (Kori-Siakpere, 2000, Agbodidi, Okonta and Dolor, 2005). Duruibe, Ogwuegbu and Egwurugwu

Table 1. Monthly variation of heavy metals in fresh water clam, *E. radiata*

Months	Heavy Metal Concentration						(mg/kg)	Means
	Cu	Pb	Mn	Cd	Hg	Cr	Ni	
January	4.21	1.46	*2.43	*0.92	1.50	3.05	10.09	3.35
February	4.21	*5.38	0.56	*1.05	0.20	3.78	34.31	7.07
March	3.25	*4.17	*2.04	*0.91	0.17	0.87	0.24	1.66
April	3.25	*4.07	*2.10	*1.35	0.17	0.86	0.78	1.80
May	4.91	*3.90	*3.34	*1.34	0.16	2.03	0.87	2.36
June	9.73	*3.71	*3.52	*0.93	0.15	2.47	2.08	3.23
July	10.32	*2.19	*3.94	*0.92	0.16	2.91	2.09	3.22
August	5.43	*3.83	*4.15	*1.15	0.16	3.68	4.05	3.21
September	7.14	*3.21	*3.78	*1.02	0.15	2.90	2.76	2.99
October	4.24	*4.11	*2.12	*1.01	0.37	3.21	9.73	3.54
November	4.22	*2.18	*2.21	*0.95	0.82	3.35	9.02	3.25
December	4.22	1.38	*2.32	*0.92	1.19	3.12	9.13	2.18
Mean ($\bar{x}$)	**5.43**	***3.30**	***2.71**	***1.04**	**0.42**	**2.68**	**7.10**	**3.24**

*Indicate means higher than world standard
(FAO/WHO,1984). Source: Field Survey (2008).

Table 2. Mean Concentrations of Heavy Metals in Tissues of *E. radiata* from creeks in Burutu South L.G.A.

Heavy Metal (mean – mg/kg)	Obotebe	Gbekebor
Cu	5.69	5.17
Pb	3.25	3.35
Mn	2.90	2.52
Cd	1.18	0.90
Hg	0.50	0.34
Cr	2.49	2.87
Ni	7.54	6.66

Source: Field Survey (2008).

Table 3. Mean Heavy Metal Concentrations of *E. radiata* from study area compared with world standard

Heavy Metal (mean – mg/kg)	Concentration in tissues of *E. radiata*	World Standard (FAO/WHO, 1984)
Cu	5.43	20.0
Pb	3.30	1.5
Mn	2.71	1.0
Cd	1.04	0.5
Hg	0.42	13.0
Cr	2.68	13.0
Ni	7.10	80.0

Source: Field Survey (2008).

(2007) reported that heavy metals are released into the environments by both natural and atmospheric sources especially mining, industrial activities and automobile exhaust. Ali and Fisher (2005) also reported that some

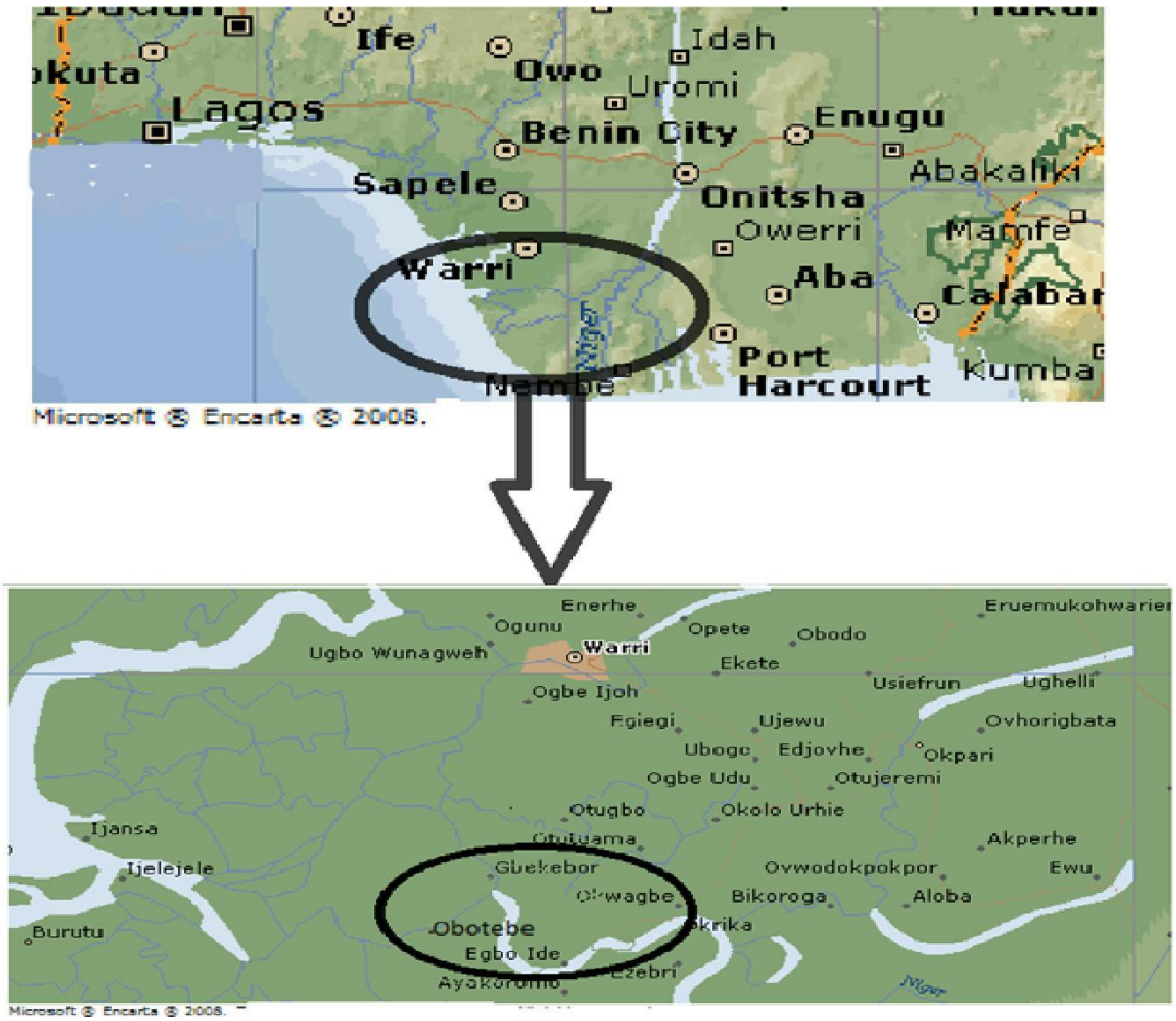

Figure 1. Map of Niger Delta Showing sampling locations at Gbekebor and Obotebe.

benthic invertebrates and fish accumulate heavy metals from water and sediments and that mollusks and crustaceans have higher concentrations than other invertebrates. There were variations in levels of heavy metals in *E. radiata* from Obotebe and Gbekebor creeks. This indicated that heavy metal concentration in the creeks studied varied but not significantly different ($P > 0.05$). Etim (1990) also reported heavy metal accumulation in *E. radiata* from Crosss River. Obotebe creek however, had higher concentration in most of the heavy metal (copper, manganese, cadmium, mercury and nickel) analyzed from tissues of *E. radiata.* Such variations are possible because of differences in sources of contaminations and individual differences in the bioaccumulations of heavy metal in the aquatic organisms (Ibok, Udosen, Doidionc, 1989, Kanakaraju, Ibrahim, Berseli, 2008). Monthly variation in heavy metal concentration was not significant. This shows that a rise in water level does not significantly cause any increase or decrease in heavy metal uptake by the clams. However, the monthly variations observed in this study indicated that levels of heavy metals were higher in the dry season than in the rainy season. The higher levels observed in the dry months could be due to concentration effect of low volume of water while the lower levels observed could be attributed to the influx of water from surface runoffs which is capable of washing away some of the heavy metals, thereby reducing their levels. Ideriah, Braide and Briggs (2006), reported that flushing of levels of heavy metal could occur during the rain. This report is however, contrary to the findings of Savari, Lockwood and Sheader (1991) who reported low levels of heavy metal concentrations in cockles from Southampton water during the dry season.

Levels of heavy metals (copper, mercury, chromium and nickel) in tissues of *E. radiata* were found to be below the acceptable limits of heavy metal pollution in fishes and shell fish (FAO/WHO, 1984). Mean levels of lead (Pb), manganese (Mn) and cadmium (Cd) were observed to be higher than the world standard but not significantly higher. This shows that the levels of lead and cadmium in the creeks are still tolerable. There is a need for constant monitoring of the levels of lead, manganese, cadmium and other heavy metals to forestall any significant rise in their levels. The insignificant low level nickel in the tissues of *E. radiata* in this study shows that manganese and nickel contamination of *E. radiata* may not be envisaged in the nearest future.

However, it should be noted that Lenntech (2004), reported that heavy metals have relatively high density and are toxic or poisonous even at low concentrations. In view of this, heavy metal pollution of water bodies (especially in the areas of study and environs) should be reduced to the barest minimum. This is to minimize shellfish and fish food contamination which will in turn reduce clinical poisoning in human who consume *E. radiata* and other fishery products from Obotebe and Gbekobor creeks.

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