International Journal of Technical Research and Applications e-ISSN: 2320-8163,
www.ijtra.com Volume 4, Issue 4 (July-Aug, 2016), PP. 58-62

COMPARATIVE STUDY OF HEAVY METAL CONCERNTRATIONS IN TISSUES AND SHELLS OF TYMPANOTONUS FUSCATUS FROM OKORO ETE RIVER, EASTERN OBOLO LOCAL GOVERNMENT AREA OF AKWA IBOM STATE, NIGERIA

Ekanim, M.P. [1], Etim, I.N[1], Udofia, I.I.[l] George, U.U[2]
[1]Department of Marine Biology, Akwa Ibom State University, P.M.B 1167 Uyo, Nigeria
[2]Department of Fisheries and Aquaculture, Institute of Oceanography, University of Calabar
maryekanim@yahoo.com
Phone No; +2348023245525

Abstract— **Water pollution by heavy metals is an emerging problem in both developed and undeveloped countries. This research was carried out to determine the concentration of Ni, As, Cu, Fe, Pb and Cd in periwinkle (T. fuscatus) tissues and shell from Okoro Ete River, Eastern Obolo, Akwa Ibom State, using UNICAM 629 Atomic Absorption Spectrometer. The mean concentrations of each heavy metals: Ni (0.72 ± 0.20 mg/kg); Cu (9.23 ± 5.60 mg/kg); Fe (56.98 ± 32.03 mg/kg); Pb (17.64 ± 4.00mg/kg); Cd (22.46 ± 5.50 mg/kg) in Tympanotonus fuscatus tissues were higher than the concentration of metals: Ni (BDL); Cu (0.41 ± 0.23 mg/kg); Fe (33.17 ± 12.80 mg/kg); Pb (1.49 ± 0.20 mg/kg); and Cd (2.21 ± 1.00 mg/kg) in shell samples and also higher than the WHO and FAO permissible standards of 0.5 mg/kg (Ni); 0.2 mg/kg (Cu); 5.0 mg/kg (Fe); 5.0 mg/kg (Pb); and 2.0 mg/kg (Cd) indicating higher levels of accumulation of these metallic contaminants by the test organisms implying that these organism may pose high risk upon human consumption due to high pollution of the study area by heavy metals contaminating from both point source and non point source. The result of this study revealed a very high concentration of Lead both in the tissues and shell of T. fuscatus. This indicates that T, fuscatus from Okoro Ete River, Eastern Obolo, Akwa Ibom State is unfit for human consumption.**

Index terms- **Heavy Metal, Tympanotonus fuscatus, Okoro Ete River, Lead, Tissues, Shells.**

I. INTRODUCTION

Heavy metal is a group of metals and metalloids with an atomic density greater than 4g/cm^3 that pose environmental concern because of their harmful effects on plants, animals and man even at low concentration (Duffus, 2002). Examples of heavy metals common in the environment are Cd, Hg, Pb, As, Cu, Zn, Cr, B and the platinum group metal, which comprises the Platinum, Palladium, Rhodium, Ruthenium, Osmium and Iridium (Hillard, 1999). The contamination of natural waters associated with these heavy metals has adverse effects on aquatic biota and poses considerable environmental risks and concerns (Cajaraville,et al., 2000; Ravera, 2001).

Periwinkle (Tympanotonus fuscatus) is one of the available biota affected by these heavy metal contaminants because it has the ability to accumulate and bio-magnify heavy metals in the tissue. Tympanotonus fuscatus are mass-consumer products (Ekanem and Otti, 1997) and one of the many delicacies in Nigeria cuisines, thus monitoring programmes and research on heavy metals in aquatic environment samples have become widely important due to concerns over accumulation and toxic effects in aquatic organisms and to humans through the food chain (Otchere, 2003).

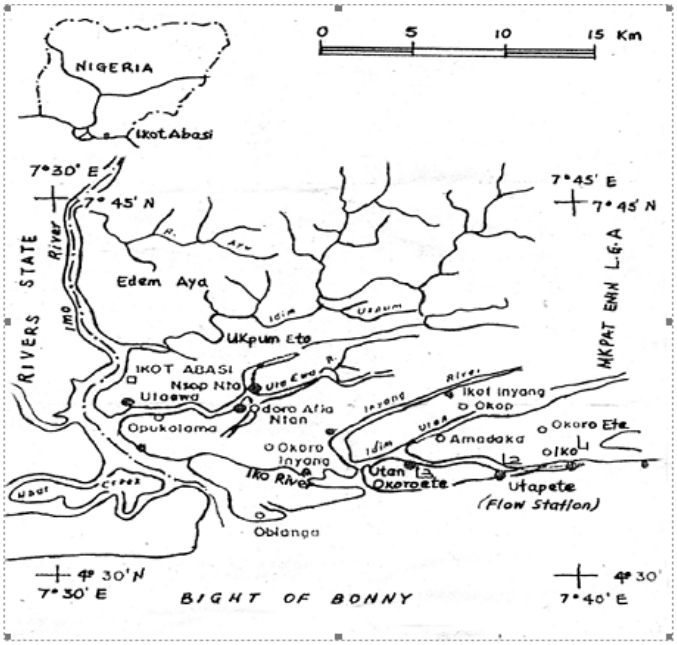
The present research shows a comparative study of heavy metal concentration in tissues and shells of Tympanotonus fuscatus. The main objective of this research was to ascertain the suitability of Tympanotonus fuscatus for human consumption and aquaculture, and also to compare the heavy metal concentrations with WHO and FAO standard.

II. MATERIALS AND METHODS

A. Study Area

The Study area is Okoro Ete River located in Eastern Obolo Local Government Area of Akwa Ibom State, Nigeria, which lies between longitude 7^o 35'E and 7^o 40'E and latitude 4 ^{o}30'N and 4^{o}45^{o}N as shown in Fig.1. It has several adjoining tributaries and creeks, part of it drains into Imo River estuary which opens into the Atlantic Ocean

and the Bight of Bonny. Okoro Ete River takes its rise from the Qua Iboe River catchment and empties directly into the Atlantic Ocean at the Bight of Bonny (Ekpe et al., 1995).



.

Fig. 1: Map of South-South Nigeria Showing Okoro Ete River

B. Sampling

The periwinkles (Tympanotonus fuscatus) known to be harmless were handpicked (Hugget et al., 1973) along the river channel during ebb tide at five different stations. The samples collected were washed with distilled water and placed in decontaminated and labeled cellophane bags packed with ice, further transported to the laboratory for onward chemical analysis.

C. Sample Preparation

The sample preparation was done using a modified Edet and Ntekim (1996) procedures. The samples were allowed to thaw gradually at room temperature. The muscles were removed from the shells using a decontaminated utensil. The tissue part was separated from the shells. Both parts were rinsed properly with distilled water. They were placed in clean, sterilized and labeled petri dishes and dried in an oven at 105 ^{o}C until brittle enough for grinding. The samples were grinded using a mortar and pestle. After grinding to fine powder, the samples were sieved and the obtained fine powder further dried to constant weight at 105 ^{o}C, then put in labeled cellophane bags and preserved in a dessicator for further analysis. 5 g of each of the samples were accurately weighed into digestion flasks. The digestion was carried out using a mixture of concentrated HNO_3 and HCl at a ratio of 3:1. After digestion, 5g of each of the samples was accurately weighed into clean platinum crucibles, ashed at 450-500 ^{o}C for 12 hrs and then cooled to room temperature. The ash was dissolved in 5cm^3 20% HCl, and the solution carefully transferred into a 100 cm^3 volumetric flask. The crucible was well rinsed with distilled water and was then made up to mark with distilled water. The flask was well shaken to mix well to obtain an homogenous component. Analysis was carried out using Atomic Absorption Spectrophotometer (AAS: UNICAM 969 model).

D. Statistical Analysis

Data were analyzed using ANOVA at ($P<0.05$) to test the significant difference in both the tissues and shells of Tympanotonus fuscatus. Statistical analysis was computed using statistical software (Minitab 17).

E. Results and Discussion

Table 1 shows the summary of heavy metals concentrations with the descriptive statistics in periwinkle (T. fuscatus) tissues and shells along five stations in Okoro Ete creek. Figure 2 - 5 shows the variations of Ni, Cu, Fe, Pb and Cd in T. fuscatus tissues and shell in five sampling stations respectively.

Table 1: Levels of heavy metals in periwinkle (T. fuscatus) tissues and shell from the study location (mg/kg).

Stations/ Sample type	Ni		As		Cu		Fe		Pb		Cd	
	Tissue	shell	Tissue	Shell	Tissue	shell	Tissue	Shell	Tissue	shell	Tissue	Shell
1	0.00	0.00	0.00	0.00	0.00	0.00	25.34 ±15.82	25.34 ±3.96	18.43 ±0.40	0.64 ±0.03	22.15 ±0.16	0.00
2	0.00	0.00	0.00	0.00	8.52 ±0.57	0.00	65.24 ±4.13	22.52 ±5.33	18.44 ±0.40	0.66 ±0.02	22.15 ±0.16	2.15 ±0.03
3	0.52 ±0.04	0.00	0.00	0.00	3.46 ±1.97	0.34 ±0.09	67.14 ±5.08	54.62 ±11.73	20.50 ±1.43	0.69 ±0.01	26.10 ±1.82	2.14 ±0.04
4	0.68 ±0.12	0.00	0.00	0.00	11.32 ±1.97	0.00	65.70 ±4.36	29.24 ±0.97	20.02 ±1.19	0.71 ±0.01	28.12 ±2.83	2.25 ±0.02
5	0.96 ±0.26	0.00	0.00	0.00	13.64 ±3.13	0.48 ±0.16	61.50 ±2.26	34.12 ±1.48	10.83 ±3.41	0.82 ±0.06	13.77 ±4.35	2.31 ±0.05
Mean	**0.43**	**0.00**	**0.00**	**0.00**	**7.39**	**0.16**	**56.98**	**33.17**	**17.64**	**0.70**	**22.46**	**1.77**
SEM	**0.77**	**0.00**	**0.00**	**0.00**	**13.21**	**0.66**	**101.94**	**59.33**	**31.56**	**1.26**	**40.12**	**3.17**

Nickel (Ni)

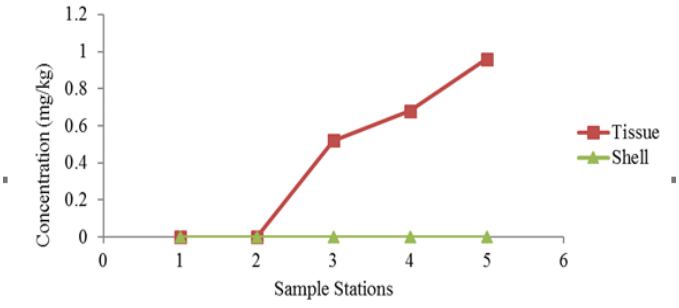


Figure 2: Variation of Ni in T. fuscatus tissue and shell in five sample stations

The levels of Ni in tissues samples ranged from below detection limit to 0.96 mg/kg. From the results Ni concentration was not detected in the five stations analyzed. However, the mean concentration and SEM (0.43 ± 0.77 mg/kg) of Ni in tissues recorded was within the limit of WHO standard of 0.5 mg/kg for aquatic food. The descriptive statistics (Table 1) shows the coefficient of variation of 2.8 % indicating that the levels of Ni varied evenly in all the study locations. Higher value (0.96 mg/kg) in tissues samples was recorded in station 5. The levels of Ni in tissue samples were undetected in stations 1 and 2.

Copper (Cu)

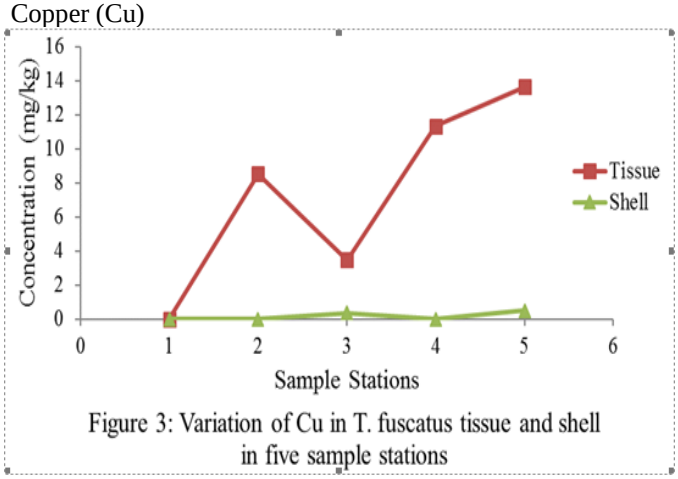


Figure 3: Variation of Cu in T. fuscatus tissue and shell in five sample stations

The levels of Cu in tissues samples ranged from undetected to 13.64 mg/kg and from undetected to 0.48 in shell samples. The mean value (7.39 ± 13.21mg/kg) in tissues samples was higher than the mean value (0.16 ± 0.66mg/kg) in shell samples and also higher than the FAO standard of 0.2 mg/kg in fishery resources as shown in table 2. However, descriptive statistics showed that the levels of Cu varied spatially (60.7 %, 56.1%) in tissues and shell samples with the highest levels (13.64 mg/kg and 0.48 mg/kg) recorded in station five respectively. Lower values were found in stations 1 and 2 (Figure 3). Higher values in tissues indicates higher accumulation from the study area.

Iron (Fe)

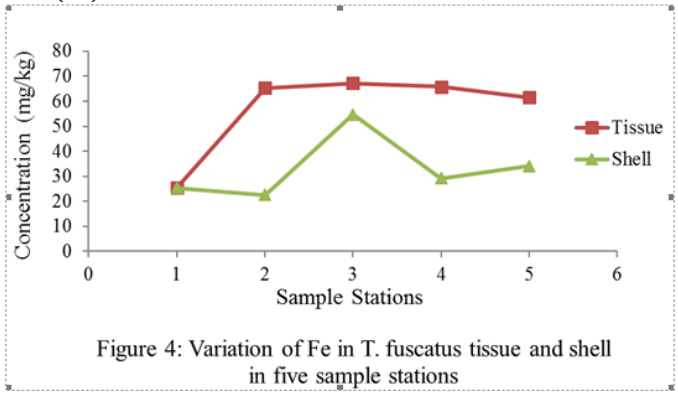


Figure 4: Variation of Fe in T. fuscatus tissue and shell in five sample stations

. The concentrations of Fe in T. fuscatus tissues and shell analyzed in five stations presented in Table 1 shows that the mean concentration and SEM (56.98 ± 101.94 mg/kg) in tissues samples were higher than the mean value (33.17 ± 59.33 mg/kg) in shell samples. These values were in turn higher than the WHO permissible limit of 5.0 mg/kg for fishery resources. Higher Fe values in T. fuscatus tissues from the study area may indicates higher accumulation into the body system of the aquatic organism through feeding and also as a result of low metabolisation rate of the test organism. On the other hand, the highest value (67.24 mg/kg and 54.62 mg/kg) were recorded in tissues and shell respectively in station 3, while the minimum value (25.34mg/kg) in tissues was recorded in station 1 and that of shell was recorded in station 2. The coefficient of variation in concentration levels (Table 1 and Figure 4) indicated spatial variation (56 %) among tissues samples and even distribution (CV = 38.6 %) among shell samples.

Lead (Pb)

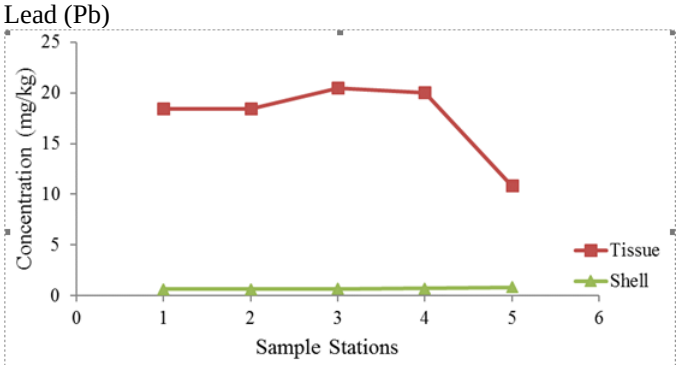


Figure 5: Variation of Pb in T. fuscatus tissue and shell in five sample stations

The concentration data presented in Table 1 shows that the mean concentration (17.64 ±31.56 mg/kg) in tissues samples was higher than the mean value (0.70 ± 1.26 mg/kg) in shell samples and much higher than the WHO standard of 5.0 mg/kg for aquatic food indicating high pollution of the study area with lead. This results indicate that the periwinkle obtained from Okoro Ete River in Eastern Obolo local government area is unsafe for human consumption. The minimum concentration (10.83 mg/kg) of Pb in tissues samples was recorded in station 5 while the maximum value (20.50 mg/kg) was recorded in station 3. In shell samples, the minimum value (0.64 mg/kg) was recorded in station 1 while the maximum value (0.82 mg/kg) was recorded in station 5 (Table 1 and Figure 5) indicating higher pollution by this contaminant. The coefficient of variation (22.7 %) in tissues samples indicates an even distribution while in shell samples the CV = 13.4 % also indicates an even distribution too.

Cadmium (Cd)

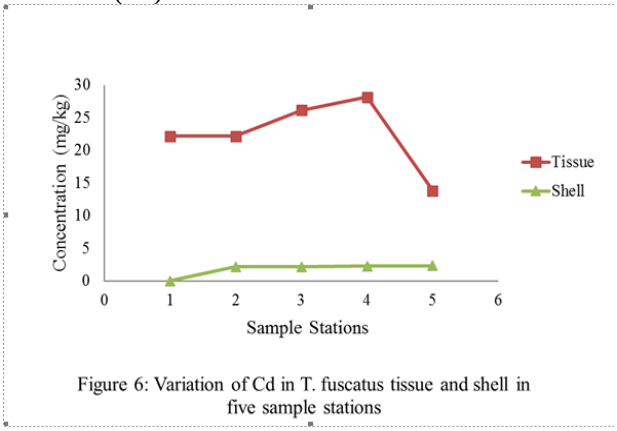


Figure 6: Variation of Cd in T. fuscatus tissue and shell in five sample stations

The levels of Cd showed that the mean value (22.46 ± 40.17mg/kg) in tissues samples was higher than the mean value (1.77 ± 3.17mg/kg) in shell samples. The minimum value in tissues samples (13.77 mg/kg) was recorded in station 5 while the maximum value (28.12 mg/kg) was recorded in station 4. The minimum value of Cd in shell samples was recorded in station 1 while the maximum concentration (2.31 mg/kg) was recorded in station 5. The coefficient of variation (CV = 24.5%) recorded in tissues samples shown in Table 1 and Figure 6 indicated an even distribution among stations while the coefficient of variation (CV = 45.2 %) in shell samples also indicated near even distribution. Comparing with the WHO standard (2.0 mg/kg), (see Table 2), the result of this study showed an elevated concentration indicating high accumulation of Cadmium in periwinkle from the study area.

Table 2; WHO standards of heavy metals in Fishery Resources (mg/kg)

Metal	Standards
Nickel (Ni)	0.5
Copper (Cd)	1.0
Iron (Fe)	5.0
Lead (Pb)	5.0
Cadmium (Cd)	2.0

Source: WHO/FAO (2011)

Discusion

The result of this research provides valuable information about heavy metal concentrations in tissues and shells of (T. fuscatus) from Okoro Ete River, Eastern Obolo, Akwa Ibom State. From the analysis, it was observed that the concentration of lead in the tissues and shells of (T. fuscatus) from Okoro Ete River, Eastern Obolo, Akwa Ibom State was higher than the permissible limits from WHO. Lead is a naturally occurring toxic heavy metal found in the Earth's crust. Its widespread use has resulted in extensive environmental contamination, causing significant public health problems in many parts of the world. Young children are particularly vulnerable to the toxic effects of lead and can suffer profound and permanent adverse health effects, particularly affecting the development of the brain and nervous system. Lead also causes long-term harm in adults, including increased risk of high blood pressure and kidney damage. Exposure of pregnant women to high levels of lead can cause miscarriage, stillbirth, premature birth and low birth weight, as well as minor malformations. For instance, lead poisonings in Zamfara State, Nigeria, led to the deaths of at least 163 people between March and June 2010, including 111 children (Wikipedia, 2015). Sources of this lead poisoning was gold mine which was bringing huge income to indigenes of this area who were engaged in this activity. Other sources include lead-base paint, cosmetics, pottery and jewelry

It was observed that arsenic (As) was below detectable limit both in the tissues and shell sample in all of the study locations. The mean concentration revealed the concentration trend in T. fuscatus tissues: Fe > Cd > Pb > Cu > Ni and in the shell the concentration trend was as follows: Fe > Cd > Pb > Cu > Ni. The concentration trend reveals that the dominant metal in both the samples tissues and shell was Fe while the least metal was Ni. On comparing the mean values of the analyzed heavy metals with the WHO/FAO, the result showed that the higher values of these metals were observed as when compared to the standards indicating that periwinkle obtained from the study area are unsafe for human consumption.

III. Conclusion

The result of the analysis, revealed that concentration of lead in T. fuscatus was above the threshold limt provided by WHO/FAO. Considering the effect of lead on man it is concluded that that T. fuscatus from Okoro Ete River, Eastern Obolo Local Government Area of Akwa Ibom State, Nigeria is considered unsafe for human consumption.

It is recommended that

1) Further studies be carried out on T. fuscatus harvested from other areas like Ibeno and Calabar.
2) Adequate measures be carried out to check dumping of toxic wastes into the bodies of water around us.

References

Cajaraville, M.P., Bebianno, M.J., Blasco,J., Porte, C., Saarasquette, C. and Viarengo, A. (2001). The use of biomarkers to access the impact of pollution in coastal environments of the Iberian Peninsula: a practical research. *Science of the Total Environment*, 247:295:311.

Duffus, J.H. (2002): "Heavy Metals" – A meaning term. Pure and Applied Chemistry 74, 793-807. Galloway J.N., Thornton, J.D., Norton, S.A., Volchok, H.L. and McClean, H.L. (1982): Trace metals in atmospheric deposition: A review assessment. Atmospheric environment, 16:1677-1700.

Edet, A.E. and Ntekim, E.U. (1996). Heavy metal distribution in ground waterform, Akwa Ibom State, Eastern Niger Delta, Nigeria: – A preliminary pollution assessment. *Global Journal of Pure and Applied Science* 2(1):67-77.

Ekanem, E.O. and Otti, B.N. (1997). Total plate count and coli form levels in Nigeria periwinkles from fresh brackish water. *Food Control*, 8:81-89.

Ekpe, U.J., Ekanem, U. and Akpan, E.R. (1995). Temporal changes in some water quality parameters in Iko and Uta Ewa River, South Eastern Nigeria. *Global Journal of Pure Applied Science*, 1:63-68.

Hillard, H. E. (1999): Platinum-Group Metals. in: Metal Prices in the United States through 1998, U. S. Geological Survey: pp. 99-104.

Hugget, R.J., Bencher, M.E and Slone, H.D. (1973). Utilizing metal concentration relationships in the eastern oyster (*Craostrae virginia*) to detect heavy metal pollution. *Water Research*, 7:151-540.

Otchere, F.A., Joiris, C., Holsbeek, L., Ali, I.B. and Vanderpuye, C.J. (2000). Heavy metals concentration and burden in bivalves Anadara (Senilia) senilis, Perna perna and Crassostrea tulipia from Ghana, In: 11th Annual International Conference on Heavy Metals in the Evironment (J. Nriagu, ed.), Contribution number 1061. University of Michigan, School of Public Health, Annbor, MI.

Ravera, O. (2001). Monitoring of the aquatic environment by species accumulator of pollutant: A review. *Journal of Limnology*, 60(1):63-78.

WHO/FAO (2011). Joint FAO/WHO Food Standards Programme Codex committee on contaminants in Foods Fifth session. The Hague, The Netherlands, 21-25 march 2011.

Wikipedia (2015). Zamfara State Lead Poisoning Epidemic

https://en.wikipedia.org/wiki/Zamfara_State_lead_poisoning_epidemic.Retrieved 30/09/2015.