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Bioaccumulation of Heavy Metals in Oily Drill Cuttings by Mangrove Littoral Periwinkle (*Tympanotonus fuscatus*) of the Lagos Lagoon

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Abstract: The bioaccumulation of Cu, Fe, Ni, Zn, V and Pb from the oily drill cuttings by the mangrove littoral periwinkles *T. fuscatus* of the Lagos Lagoon was evaluated in the laboratory. 450 specimens of *T. fuscatus* were collected from the edge of the Lagos lagoon and adjacent mangrove swamp at low tide, put in different holding tanks (113cm x 54cm × 80cm), half filled with lagoon water and aerated with a 220v air pump. Drill cuttings used were collected in two 20 litres plastic bucket from the main discharge point at the Shell Development Petroleum Corporation. Atomic absorption spectrometer technique was used for the heavy metal analysis. The exposure of these animals to sublethal concentration ($1/100^{th}$ and $1/10^{th}$ of $96EC_{50}$) of drill cuttings showed that the animals bioaccumulated varying degrees of metals. Post treatment analysis of whole body tissues of these animals revealed that the organisms accumulated higher amount of metals than the residual levels in the untreated control media. The level of heavy metal, accumulation is positively correlated with the concentration of drill cuttings in the test media and the duration of exposure. *T. fuscatus* exposed to 1.024ml/L drill cuttings for 32 days have 0.056mg/g, 2.91mg/kg, 0.15mg/kg, 1.27mg/kg and 0.004mg/kg overall net gain of Cu, Fe, Ni, Zn, V and Pb respectively. Organisms exposed to 10.024ml/L of drill cuttings have 0.046mg/kg, 2.98mg/kg, 0.025mg/kg, 1.5mg/g, 0.007mg/kg and 0.008mg/kg overall net gain of Cu, Fe, Ni, Zn, V and Pb respectively. Comparisons between the concentration of metals in the body tissues of the animals and sediment showed that the concentration of metals accumulated by these animals were lower than that in the sediment. The significance of this result is the need to include bioaccumulators of heavy metals such as *T. fuscatus* in monitoring programmes aimed at establishing the environmental levels of such pollutant as drill cuttings in aquatic ecosystems.

Keywords: Bioaccumulation, Mangrove Littoral Periwinkles, Oily Drill Cuttings, Lagos Lagoon

1. Introduction

In Nigeria, cases of indiscriminate dumping and discharge of drill cuttings on terrestrial and aquatic environment by the oil industries has been observed. The Soku fields in Niger Delta shows variation in pH values of soil samples ranging from acidic (5.9) around the discharge pit of drill cuttings to alkalinity (7.6) 100m away from Soku [8]. Metal leaching also occurred from discharge pit which resulted in elevated metal concentration in the surrounding soil. Drill cuttings are produced during exploitation of crude oil and may be accidentally discharged in inland waters and swampy areas and may affect the natural biota within the area of exploitation. Heavy metal constituent of oil based drill cuttings include barium, copper, cadmium, iron, lead, manganese, nickel, vanadium and zinc [11]. Acute toxicity of heavy metal and other pollutants is not the only environmental problem that can arise from pollution of aquatic environment by drill cuttings. This is so because when non degradable metal pollutants persist even at low concentration in aquatic ecosystems they are liable to being bioacumulated by living organisms over time. Bioacumulation is the process whereby an organism concentrates metals in it's body from the surrounding medium or food either by absorption, or ingestion [13, 12]. In

Nigeria, most studies on heavy metal pollution have concentrated on levels of occurrence and distribution of these pollutants in sediment and water column of aquatic resources [7, 3, 14] without relating the observed level of occurrence to biological actions such as acute toxicity and sublethal chronic action including biaoccumulation. However, shrimp (*Macrobrachium vollenhoevenii*) following three 85hrs intermittent exposures to metal-laden WEMA BOD effluent at 14 days intervals accumulated 15.42, 32.10, 13.26, and 12.32 -ug g-i of Cd, Zn, Ni and Cr respectively [5]. Hermit crab accumulated 1.6-6.3mg/Kg of Pb at exposure periods ranging from 4-20 days [9]. *Tympanotonus fuscatus* accumulated 0.71-23.89 ugg-1 of Cu at exposure periods ranging from 7-28 days while *Clibanarius africanus* accumulated 1.26-2.96 ugg-1 of Cu at the same exposure period [16]. Trace elements such as copper, iron and zinc are essential to maintain human metabolism.

Heavy metals at sublethal concentration can adversely affect metabolic process and cause gross morphological malformation of important organs in some sensitive animals and plants. High concentration of cadmium causesitai- itai disease. Lead severely damages the brain and kidney. Mercury permanently damages the brain, kidney and developing foetus [1].

Pollution arising from heavy metal constituent of oily drill cuttings are considered very hazardous because these substances are toxic at relatively low concentration and highly persistent in the environment [6].

Many aquatic organisms for example periwinkles have the ability to accumulate and biomagnify contaminants like heavy metals, polycyclic aromatic hydrocarbon and PCB in the environment [10, 2]. *Tympanotonus fuscatus* commonly called periwinkle is found in mangrove swamps and mud flat in low salinity areas of the Lagos lagoon. *T. fuscatus* is a dominant benthic specie in West Africa coast line and also a high source of animal protein. Therefore, this present study is aimed at determining the bioaccumulation of selected heavy metals by *T. fuscatus* exposed to sublethal dosages of oily drill cuttings under laboratory conditions.

2. Materials and Method

2.1. Test Animals

The test animals used for this bioassay were periwinkles, *Tympanotonus fuscatus* (Mollusca, Gastropoda, Mesogastropoda, Potamidae). *Tympanotonu*s *fuscatus* were collected from the mangrove flats of Lagos lagoon. Each of this animals was handpicked into a separate 10 litres plastic bucket containing water from the habitat. The animals were of unknown age but approximately the same range (Length of shell 3.0 ±0.5, diameter of aperture 0.8 – 1.0mm). In the laboratory, sand from the site of collection was placed at the bottom of the holding tanks serving as substrate. 450 test animals were put in different holding tanks (113cm x 54cm × 80cm) and half filled with lagoon water. These holding tanks were aerated with a 220v air pump and then changed every 48 hours to acclimatize to laboratory conditions (28 + 2, 72.2%R.H) for 7 days before used for experiment.

2.2. Test Compound.

40 litres of oily drill cuttings used for this study were collected in two 20 litres plastic bucket from the main discharge point at the Shell Development Petroleum Corporation Warri. Chemical characterization of the cutting samples showed a pH value.

2.3. Sub-lethal Test (Bioaccumulation Studies)

Bioaccumulation of Heavy metals (Cu, Fe, Zn, Ni, V and P) by *T. fuscatus*exposed to sublethal concentrations of drill cuttings. *T. fuscatus*was exposed to only sublethal concentrations (fractions of 96hLC 50 values drived from expriment carried out during acute toxicity test).

A total of 120 test animals were exposed per sublethal concentration or control in 3replicates (40 per animals per replicate). Each experiment chamber held a thin layer of standardized sediment substrateand test media.

In these series of bioassays that went on for thirty two days (32) in order to investigate the rate at which the metals (Cu, Fe, Zn, Ni, V and Pb) can be accumulated from drill cuttings by *T. fuscatus* and the static renewal bioassay procedure was adopted. To avoid drastic changes in concentration, test media was renewed once every forty-eight hours (48 hours) by transfering the same exposed animals into freshly prepared test media over a 32 days period of experimentation. At predetermined time intervals (days 0, 4, 8, 16 and 32), five live *T. fuscatus*per replicate making fifteen (15) per treatment including control were randomly selected, and cleaned with distilled water, placed in labeled plastic container and frozen. The whole animal tissues of frozen samples were digested and analysis for metals accumulated carried out by Atomic absorption Spectrophotometry. Sublethal concentration under which bioaccumulation of metals (Cu, Fe, Zn, Ni, V and Pb) by *T. fuscatus* and from oily drill cuttings investigated were as follows: Drill cuttings was tested against *T. fuscatus*:

1.02ml/L (0.01 of the 96hEC50)

10.25ml/L (0.1 of the 96hEC50) and treated control

2.4. Analysis of Metals in Tissues Samples

5g of the sample was weighed into a porcelain crucible and heated over a hot plate ignite as well as carefully burn the sample. The residue was then heated in a muffle-furnace at 55°C untill the carbon was oxidized (about 1 hr) completely. The residue left was dissolved in few drops of aqua-regia (3 part conc. HCL + 1 part of conc. HNO_3) and then diluted with distilled water.

The resulting mixture was then filtered, rinsed very well and the filtrate made up to $100cm^3$ marks in a standard flask. The resulting solution was then aspirated into flame of Atomic Absorption Spectrophotometer (AAS) 960 model series using air-acetylene flame for the metal analysis against standard metals solution.

2.5. Regression Analysis

Regression analysis was carried out to determine correlation coefficient (r^2) between concentrations of test metals accumulated in the test animals or sediment with period of exposure.

Bioaccumulation Factor (BAF) was estimated as the ratio of the concentration of the metal in animal tissue after 32 days in the test media [15].

3. Results

Bioaccumulation of heavy metals (Cu, Fe, Ni, Zn and Pb) by *T. fuscatus* exposed to sublethal concentration of oily drill cuttingsBioaccumulation of copper by *T. fuscatus*.

Post treatment analysis of whole body tissue of *T. fuscatus* showed that the animal exposed to (1.024ml/L and 10.24ml/L) sublethal concentrations of drill cuttings accumulated higher quantities of Cu (1.08 and 1.03 times respectively higher) than the residual levels in animals in the untreated control media over 32 day period of observations (Table 1).

Furthermore, at the end of the 32 day exposure period, there was an overall gain of 0.56mg/kg and 0.46mg/kg of Cu over the respective initial amount of Cu in the animal tissue exposed to the sublethal concentration of 1.024ml/L and 12.04ml/L respectively (Table 1).

Similarly, there was a significant and positive correlations (r^2 = 0.8873 and 0.8256) between the amounts of Cu accumulated by *T. fuscatus* with time of exposure for the (1.024ml/L and 10.24ml/L test media respectively) (Figure 1). On the basis of the computed bioaccumulation factor (BAF), with reference to sediment concentration, the levels of Cu accumulated by the test animals exposed to sublthal concentrations (1.024ml/L and 10.24ml/L) and control were found to be lower than the concentration detected in the sediment substrate of the test media. (BAF = 0.16, 0.12 and 0.15 for 1.024ml/L, 10.24ml/L and control test media respectively) (Table 2).

Table 1. *The accumulation of heavy metals (Cu, Fe, Ni, Zn, V and Pb) by T. fuscatus exposed to sublethal concentrations of drill cuttings over a 32-day period.*

Treatments (ml/L)	Mean Concentrations of Heavy Metals in Whole Animal Tissues (mg/kh weight basis					Overall net Gain*
	Day 0	Day 4	Day 8	Day 16	Day 32	
Copper (Cu)						
Control	0.141	0.166	0.166	0.167	0.192	
1.024m/L (1/100th EC_{50})	0.141	0.166	0.171	0.174	0.197	
Net gain**		0.026	0.004	0.003	0.023	0.056
Iron (Fe)						
Control	13.22	13.52	13.55	15.10	15.97	
10.24ml/L (1/10th EC_{50})	13.22	14.00	15.09	15.61	16.13	
Net gain**		0.78	1.09	0.52	0.52	
Control	13.33	13.52	13.55	15.10	15.97	
10.24m/L (1/10th EC_{50})	13.22	14.21	15.16	15.66	16.20	
Net gain**		0.99	0.95	0.50	0.54	2.98
Nickel (Ni)						
Control	ND	0.002	0.003	0.008	0.008	
1.024m/L (1/10th EC_{50})	0.00	0.006	0.007	0.014	0.015	
Net gain**		0.006	0.001	0.007	0.001	0.015
Control	ND	0.002	0.003	0.008	0.008	
10.24m/L (1/10th EC_{50})	0.00	0.008	0.010	0.023	0.025	
Net gain**		0.008	0.002	0.013	0.002	
Zinc (Zn)						
Control	14.98	15.75	15.99	16.00	16.08	
1.024m/l (1/100th EC_{50})	14.98	15.99	16.03	16.25	16.25	
Net gain**		1.01	0.04	0.17	0.05	1.27
Control	14.98	15.75	15.99	16.00	16.08	
10.24m/l (1/10th EC_{50})	14.98	16.06	16.09	16.35	16.48	
Net gain**		1.01	0.04	0.17	0.05	1.27
Vanadium (V)						
Control	ND	ND	ND	0.001	0.002	
1.024M/L (1/100TH ec_{50})	0.00	0.00	0.00	0.003	0.004	
Net gain**	0.00	0.00	0.00	0.003	0.001	0.004
Control E	ND	ND	ND	0.001	0.002	
10.24m/L (1/10th EC_{50})	0.00	0.001	0.003	0.006	0.007	
Net gain**		0.001	0.002	0.003	0.001	0.007
Lead (Pb)						
Control	ND	ND	0.001	0.003	0.004	
1.024m/L (1/100th EC50)	0.00	0.00	0.001	0.004	0.006	
Net gain**		0.00	0.001	0.003	0.002	0.006
Control	ND	ND	0.001	0.003	0.004	
10.24m/L (1/10th EC50)	0.00	0.003	0.004	0.005	0.008	
Net gain**		0.003	0.001	0.001	0.003	0.008

*Overall net gain = concentration in animal after 32days – concentration in animal at zero day

**Net gain – difference in concentration between the immediate preceding days of harvesting e.g. 4-0 day, 8-4day etc.

*1/100th 96-h EC_{50} values of the drill cuttings in the test compounds

**1/10th 96-h EC_{50} values of the drill cuttings in the test compounds

***Table 2.** Bioacculation factors of heavy metals (Cu, Fe, Ni, Zn, V and Pb) by T. fuscatus exposed to sub-lethal concentrations of drill cuttings over a 32 days period.*

Treatment/Metals Control	Mean Concentration of Metals in Sediment mg/kg	Mean Concentration of Metals in Animal Tissues After 32 days mg/kg	BAF
CU	1.22	0.182	0.15
Fe	54.18	15.97	0.29
Ni	0.08	0.08	0.10
Zn	24.94	16.08	0.64
V	0.00	0.002	0.00
Pb	0.12	0.004	0.03
1/100th of 96hLC50 (1.024ml/L)			
Cu	1.25	0.197	0.16
Fe	54.23	16.13	0.30
Ni	80.02	0.015	0.0002
Zn	25.01	16.25	0.65
V	0.005	0.004	0.80
Pb	0.139	0.006	0.004
1/10th of 96hLC50 (10.24m/L)			
CU	1.52	0.187	0.12
Fe	54.71	16.20	0.30
Ni	0.23	0.025	0.11
Zn	25.42	16.48	0.65
V	0.05	0.007	1.40
Pb	1.38	0.008	0.006

BAF = Bioaccumulation factor (steady state 32 days)
= Concentration in Animal Tissue
Concentration in Water

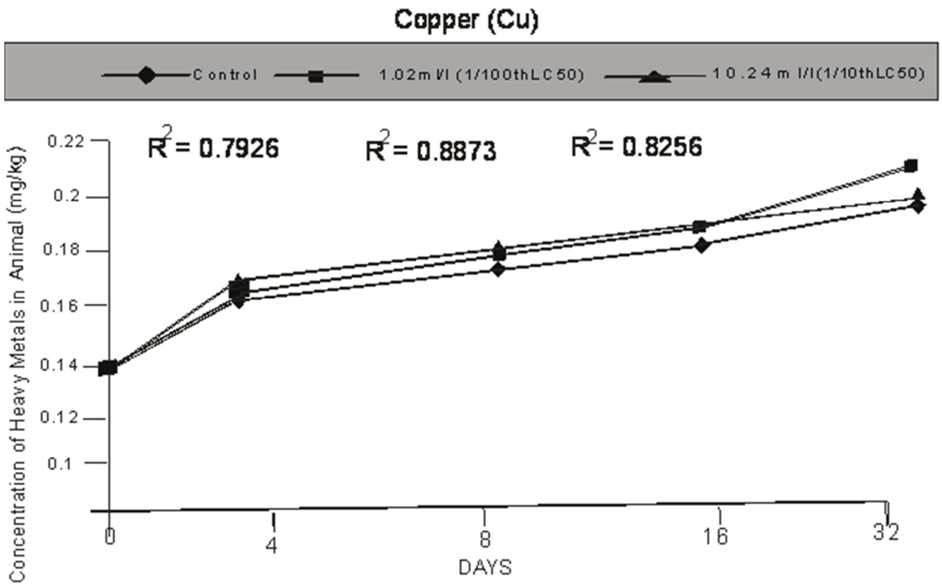

***Figure 1.** Profile of Accumulation of Copper (Cu) by T. fuscatus Exposed to Varying Sublethal Concentrations of Drill Cuttings over a 32-day period.*

3.1. Bioaccumulation of Iron by *T. fuscatus*

Post treatment analysis of whole body of *T. fascatus* showed that the animals exposed to (1.024ml/L and 10.24ml/L) sublethal concentration of drill cuttings accumulated higher quantities of Fe (1.01 times respectively higher) than the residual levels in animals in untreated control media over 32 day period of observations.

Furthermore, at the end of the 32 day exposure period there was an overall gain of 2.91ml/kg and 2.98mg/kg of Fe over the respective initial amount of Fe in the animal tissue exposed to sublethal concentration of 1.024ml/L and 10.24ml/L respectively (Table 1).

Similarly, there was a significant positive correlation (r^2 = 0.9779 and 0.9747) between the amounts of Fe accumulated by *T. fuscatus* with time of exposure (1.024ml/L and 10.24ml/L test media respectively) (Figure 2).

On the basis of the computed bioaccumulation factor (BAF) with reference to the sediment concentration, the amount of Fe accumulated by the animals exposed to sublethal concentration (1.024ml/L, 10.24ml/L and control media) were found to be lower than the concentration detected in the sediment substrate. (BAF = 0.30, 0.30 and 0.29 for 1.024ml/L, 10.24ml/L and control test medium respectively) (Table 2).

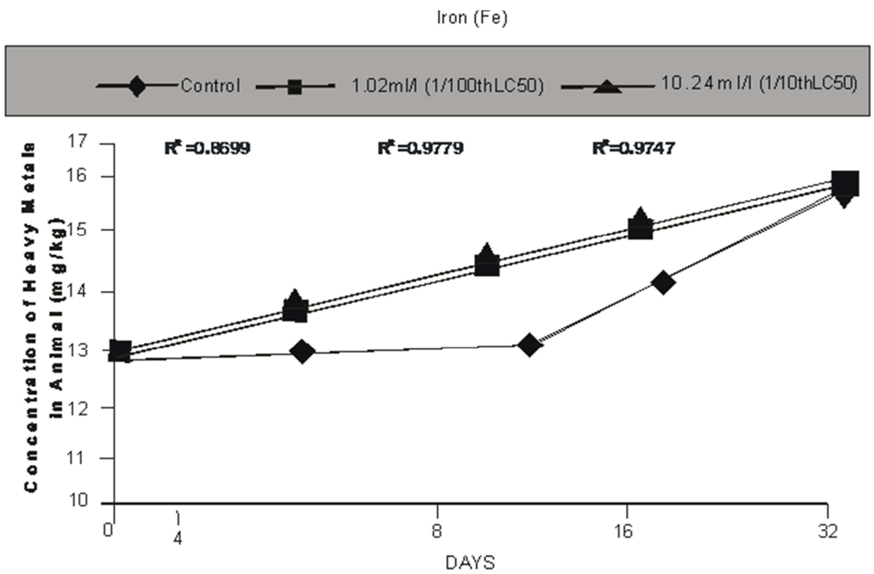

Figure 2. *Profile Accumulation of Iron (Fe) by T. fuscatus Exposed to VaryingSub-lethal Concentrations of Drill Cuttings over a 32-day period.*

3.2. Bioaccumulation of Nickel by *T. fuscatus*

Post treated analysis of whole body tissue of *T. fuscatus* showed that the animals exposed to sublethal concentrations (1.024ml/L and 10.24ml/L) of the drill cuttings steadily accumulated higher quantities of

the Ni (1.88 and 3.125 times higher) than the residual levels in animals exposed to the untreated control media over 32 day period of observations (Table 1).

Furthermore, at the end of the 32 days exposure period, there was an overall gain of 0.0.15mg/kg and 0.025mg/kg of Ni over the respective initial amount of the Ni in the animal tissues exposed to the sublethal concentration of (1.02ml/L and 10.24ml/L respectively) (Table 1).

There were positive correlations between the amounts of Ni accumulated by *T. fuscatus* with time of exposure (r^2 = 0.9426 and 0.9456 for the 1.024ml/L and 10.24ml/L test medial respectively) (Figure 3).

On the basis of the computed bioaccumulation factor (BAF), with reference to sediment concentration, the amount of Ni accumulated by the animals exposed to sublethal concentration (1.024ml/L, 10.24ml/L and control medium) were found to be lower than the concentration detected in the sediment substrate. (BAF = 0.0002, 0.11 and 0.8 for the 1.024ml/L and 10.24ml/L control media respectively) (Table 2).

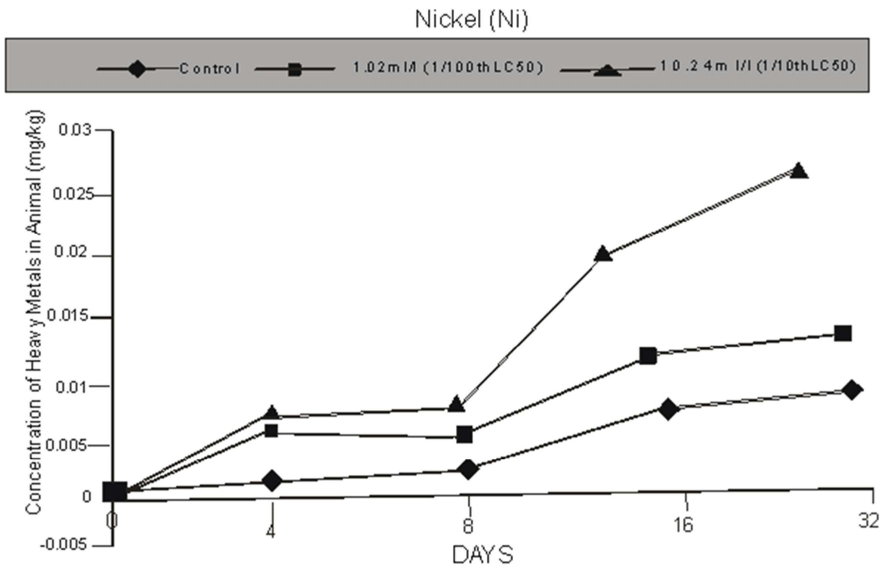

Figure 3. *Profile Accumulation of Nickel (Ni) by T. fuscatus Exposed to Varying Sub-lethal Concentrations of Drill Cuttings over a 32-day period.*

3.3. Bioaccumulation of Zinc by *T. fuscatus*

Post treatment analysis of whole body tissue of *T. fuscatus* showed that the animals exposed to sublethal concentration (1.024ml/L and 10.24ml/L) of drill cuttings accumulated higher quantities of Zn (1.01 and 1.02 times respectively higher) than the residual levels in the animals in untreated control over a 32 days period of observations (Table 1).

Furthermore, at the end of the 32 day exposure period there was an overall gain of 1.27mg/kg and 1.5mg/kg of the Zn over the respective initial amount of Zn in the animal tissue exposed to the sublethal concentrations of 1.024ml/L and 10.24ml/L respectively (Table 2).

There were positive correlations between the amounts of Zn accumulated by *T. fuscatus* with time of exposure (r^2 = 0.698 and 0.7706 for the 1.024ml/L and 10.24ml/L respectively) (Figure 4).

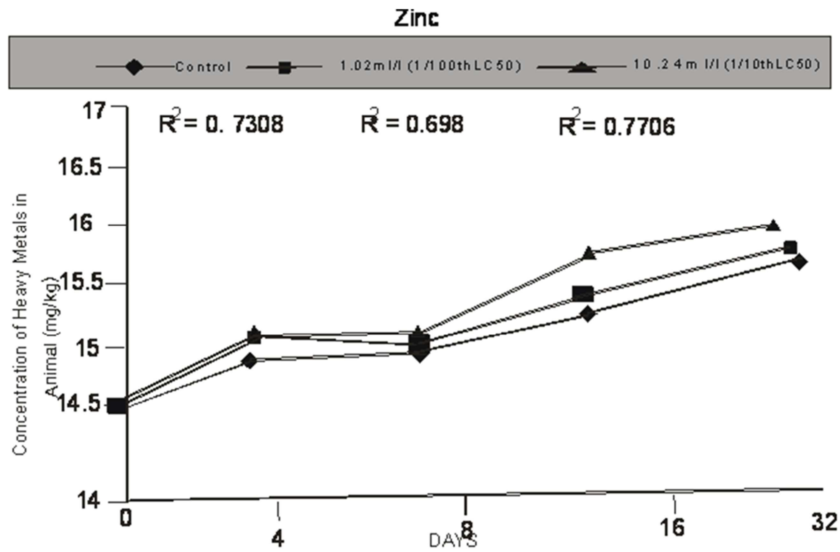

Figure 4. *Profile Accumulation of Zinc (Zn) by T. fuscatus Exposed to Varying Sub-lethal Concentrations of Drill Cuttings over a 32-day period.*

3.4. Bioaccumulation of Vanadium by *T. fuscatus*

Post treatment analysis of whole body tissue of *T. fuscatus* showed that the animals exposed to sublethal concentration (1.024ml/L and 10.24ml/L) of drill cuttings steadily accumulated measurably higher quantities of V that were (2 and 4 times) higher than the residual levels in the animals in untreated control media over 32 days period of observation (Table 1). Furthermore, at the end of the 32 day exposure period there was an overall gain of 0.04mg/kg and 0.007mg/kg of V over the respective initial amount of the metal in the animal tissues exposed to the sublethal concentration of 1.02ml/L and 10.24ml/L respectively (Table 1).

There was positive correlations between the amounts of V accumulated by *T. fuscatus* with time of exposure (r^2 = 0.7961 and 0.9704 for 1.024ml/L and 10.24ml/L test media respectively) (Figure 1).

On the basis of the computed bioaccumulation factor, with reference to sediment concentration, the amount of V accumulated by the test animal exposed ton sublethal concentrations (1.024ml/L, 10.24ml/L and control) were found to be lower than the concentration in the sediment substrate. (BAF = 0.8, 0.4 and 0.00 for 1.024ml/L, 10.24ml/L and control media respectively) (Table 2).

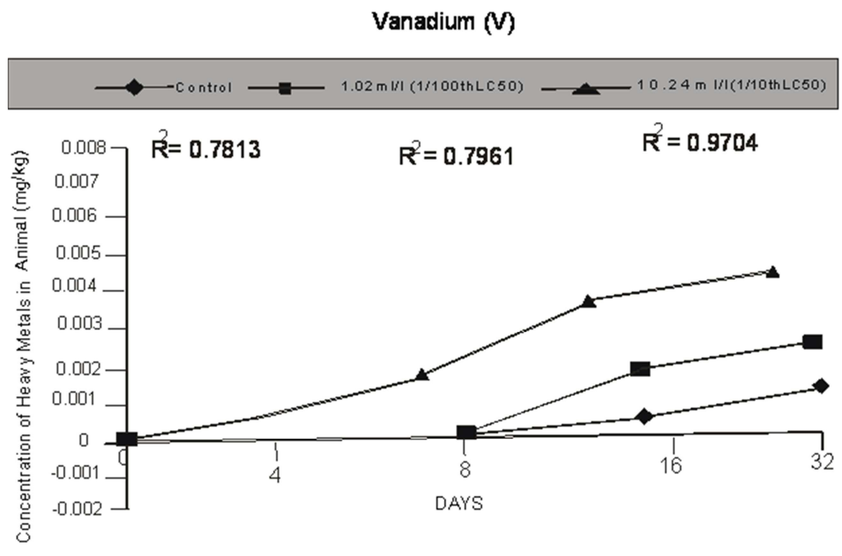

Figure 5. *Profile Accumulation of Vanadium (V) by T. fuscatus Exposed to VaryingSub-lethal Concentrations of Drill Cuttings over a 32-day period.*

3.5. Bioaccumulation of Lead by *T. fuscatus*

Post treatment analysis of whole body tissue of *T. fuscatus* showed that the animals exposed to sublethal concentration (1.024ml/L and 10.24ml/L) of drill cuttings accumulated measurably higher quantities of Pb that were 1.5 and 2 times respectively higher than the residual levels in animals in the untreated control media over 32 days period of exposure (Table 1). Furthermore, at the end of the 32 days exposure period there was an overall gain of 0.006mg/kg and 0.008mg/kg over the respective initial amount of the Pb in the animal tissues exposed to the sublethal concentration of 1.024ml/L and 10.24ml/L respectively (Table 2).

There was positive correlations between the amounts of Pb accumulated by *T. fuscatus* with time of exposure (r^2 = 0.8889 and r^2 = 0.9529 for the 1.024ml/L and 10.24ml/L test media respectively) (Figure 6).

On the basis of the computed bioaccumulation factor (BAF), with reference to sediment concentration, the amount of Pb accumulated by test animals exposed to sublethal concentration (1.024ml/L, 10.24ml/L and control) were found to be lower than the level of concentration detected in sediment substrate. (BAF = 0.04, 0.006 and 0.03 for 1.024ml/L, 10.24ml/L and control test media respectively) (Table 2).

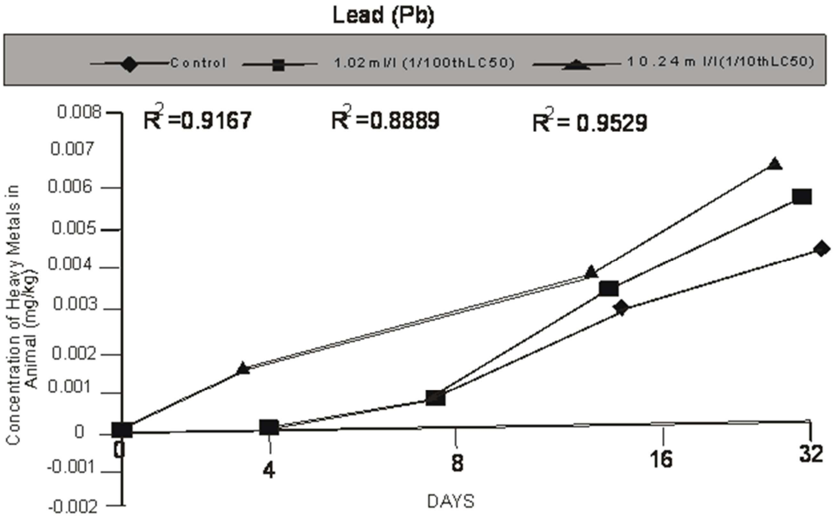

Figure 6. *Profile Accumulation of Lead (Pb) by T. fuscatus Exposed to VaryingSub-lethal Concentrations of Drill Cuttings over a 32-day period.*

4. Discussion

In this study, the exposure of *T. fuscatus* to sublethal concentrations of oily drill cuttings resulted in the accumulation of ranging degree of metals (Cu, Fe, Ni, V and Pb) by the exposed organisms. The level of heavy metal, accumulation is positively correlated with the concentration of drill cuttings in the test media and the duration of exposure. *T. fuscatus* exposed to 1.024ml/L drill cuttings for 32 days have 0.056mg/g, 2.91mg/kg, 0.15mg/kg, 1.27mg/kg and 0.004mg/kg overall net gain of Cu, Fe, Ni, Zn, V and Pb respectively. Organisms exposed to 10.024ml/L of drill cuttings have 0.046mg/kg, 2.98mg/kg, 0.025mg/kg, 1.5mg/g, 0.007mg/kg and 0.008mg/kg overall net gain of Cu, Fe, Ni, Zn, V and Pb respectively.

The exposure of *T. fuscatus* to sublethal concentration (10.24ml/L) of Cu revealed that the amount of Cu accumulated in the tissues of these animals fluctuated slightly at the end of the 32 days periods, also indicating the capability of the test animals to regulate its tissue concentration of copper. This observed ability of *T. fuscatus* to regulate its body concentration of Cu is rather expected because copper is a component of haemocyanin, which is a respiratory pigment in the body tissue of *T. fuscatus*. Polychaete worms, *Melinna Palmata* and *Tharynxmarioni* which naturally have high concentration of copper in their tissues have been observed to possess the ability to regulate their tissues concentration of copper [4].

The significance of this observation and those of other researches is that in biomonitoring programmes, the concentration of copper in tissues of aquatic animals such as *T. fuscatus* and *T. marioni* may not serve as good estimate of environmental levels of the metal (Cu) in the sediment and water column.

With regard to Iron (Fe) and Zinc (Zn) accumulation in *T. fuscatus*, the exposure of the test animals to sublethal concentrations of oily drill cuttings, were found to result in a slight increase in the body tissue concentration of the exposed animals over a 32 day experimental period. This result of heavy metal accumulation is in agreement with some findings that Cu, Cd, Fe, and Zn are sometimes slightly bioaccumulated by benthic organisms [18].

The exposure of *T. fuscatus* to sublethal concentrations of drill cuttings showed that the amounts of Ni accumulated by the test organisms were positively correlated with the duration of exposure and it also increased with increase in the sublethal concentration.

With regard, to Vanadium accumulation, the exposure of the test animal to sublethal concentration of drill cuttings was found to result in an increase in the body tissues concentrations of vanadium in the exposed animals over the 32 days experimental period. The concentration of V accumulated by *T. fuscatus* was found to increase with period of exposure and concentration of these metals in the sediment of the test medium.

Furthermore, exposure of *T. fuscatus* to sublethal concentration of oily drill cuttings showed that the amount of lead (Pb) accumulated in the tissues of the test animals was found to increase steadily with period of exposure and concentration of Pb in the bioassay sediments.

Concentrations of these metals in exposed animals such as *Palaemonestes africanus, Tympanotonus fuscatus*, *Tilapia guneensis* and *Clibanarius africanus* increased with time of expoure and test medium concentration [5, 16].

5. Conclusion

The observation of the ability of periwinkle *T. fuscatus*to accumulate heavy metals to the levels that are several folds higher than the amount in its environment demonstrate how biological systems can render unsafe an otherwise seemingly low and apparent safe prevalent level of persistent pollutants in ecosystem.

Therefore reliance on chemical analysis of individual waste waters to identify potential toxic components may be misleading, and so integrated strategies involving the inclusion of such bioaccumulators as *T. fuscatus*in monitoring programmes aimed at deriving realistic water quality procedures and standard for the protection of our aquatic ecosystem in Nigeria should be adopted.

References

[1] Abiaobo N. O., Akpan I. I., and Umana S. I. (2017). Assessment of Heavy Metals concentration in Shell andFin fish from Ikot River Estuary, South East Nigeria. JAERI 12 (4); 1-8.

[2] Aigberua O. A and Izah S. C. (2018). Evalation of heavy metals in tissue of *Tympanotous fuscatus* sold in market in port Harcourt metropolis, Nigeria. MOJ. Toxicol. 4 (5): 334-338.

[3] Bhalerao, B. N. and Adeeko, A. B. (1981). Pollution Survey of Some Textile Mills in Lagos State. In: Proceedings, Federal Ministry.

[4] Bryan, G. W. and Gibbs, P. E. (1987). Polychaetes as indicators of heavy metal availability in marine deposits. Oceanic processes in Marine pollution, Biological processes and wastes in the ocean, vol. 1 (ed. J. M. Capuzzo and D. R. Kester). Melbourne, FI, USA. Krieger Publishing Co. 37-49 pp.

[5] Chukwu, L. O. (1991). Studies on heavy metal contamination of water, sediment and decapod crustaceans (Family *palaemonidae*) from River Sasa. Ph.D Thesis. University of Lagos. 164 pp.

[6] Clark, R. B. (1992). Marine Pollution. 3 rd Edition, Oxford University Press. 161 pp.

[7] Fodeke, V. A. (1979). Studies on heavy metals and microbial contamination of Tilapia sp. in Lagos lagoon (M.Sc. Thesis). University of Lagos, Nigeria.

[8] Kinigoma, B. S. (2001). Effects of drill fluid additives on the Niger Delta Environment: A case study of the Soku Oil Fielda. J. Appl. Sci. Environn. Mgt. 5 (1): 57-61.

[9] Momoh, A. E. (1995). Bioaccumulation of lead by *Clibanariusafricanus* (Aurivillus) exposed to sublethal concentration of spent engine oil. M.Sc. Thesis. University of Lagos. 22 pp.

[10] Moslen, M., Ekweozor, I. K. and Nwoka, N. D. (2017). Assesment of Heavy Metals and Bioaccumulation in Periwinkles (*Tympanotonusfuscatus Var. radula*) (L) obtained from the Upper Bonny Estuary, Nigeria. J. Heavy Met. Toxicity Dis. Vol 2 No. 2: 3.

[11] Neff, J. M (1987). Biological effects of drilling fluids, drill cuttings and produced waters. In: Boesch, D. F. and Rabalaise, N. N (Eds). Long term effects of offshore oil and gas development Elsevie Applied Sciences Publishers, London, 469-538 pp.

[12] Nwakanma, C. and Hart, A. I. (2013). The influence of oil based mud exposure on the uptake of heavy metals and total hydrocarbon in *P. barbarus*of soft muscle tissues. Int. J. Fish. andAquat. Sci. 2 (3): 43-45.

[13] Obasohan, E. E. and Orosanye, J. A. O. (2000). Heavy metals in water, sediments and some important fish species from Ikpoba River, Benin City, Nigeria. J. Appl. Sci. Environ. Mgt, 4 (2): 63-68.

[14] Okoye, B. C. O. (1989). A study of some heavy metals in Lagos lagoon (Ph.D Thesis). Obafemi Awolowo University, Ile-Ife. 142 pp.

[15] Otitoloju, A. A and Don-Pedro, K. N. (2002). Establishment of the toxicity ranking of order of heavy metals and sensitivity scale of benthic animals inhibiting the Lagos lagoon. West African Journal of Applied Ecology. 3: 31-41.

[16] Oyewo, E. O. (1998). Industrial sources and distribution of heavy metals in Lagos lagoon and their biological effects on estuarine animals. Ph.D Thesis. University of Lagos. 274 p.

[17] Ozoh, P. T. E. (1980). Effects of reversible incubations of zebra fish eggs in Copper and Mercury ions with or without shell membrances. Bull. Enviro. Contam. Toxicol. 21: 782-786. Production and Exploitation Association Limited (APPEA) (1998). Framework for the environmental management of drillfluids on cuttings. APPEA Issue Paper, March, 1998.

[18] Weis, P., Weis, J. S. and Couch, J. (1993). Histopathology and bioacummulation in oysters, *Grassostreavirginica* living in wood preserved with chlorinated copper assernate. Diseases of Aquatic Organisms. 17: 41-46.