PETROLEUM HYDROCARBONS AND HEAVY METAL CONCENTRATIONS IN TISSUES OF PERIWINKLES *(Tympanotonus fuscatus)* FROM WARRI RIVER IN NIGERIA

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ABSTRACT

The concentrations of hydrocarbons and heavy metals in the tissues of periwinkle Tympanotomus fuscatus from Warri River in Edo State were investigated. The study adopted the experimental design. Six hundred samples of periwinkles collected fortnightly for a period of six months from three stations (Jala, Ubeji and Suoroagbene-control) along Warri River were analysed using Soxhlet Extractor Gravimetric(SEG) method for the determination of hydrocarbons and Atomic Absorption Spectrophotometry (AAS) for the determination of heavy metals. The mean concentrations of total hydrocarbon varied as mean Lead (Pb) concentrations also varied. Mercury (Hg) and Cadmium (Cd) were found to be below the instrument detection limit in all the three stations. The concentrations of total hydrocarbon and Lead were significantly higher at Jala and Ubeji than Suoroagbene, the control station. Constant monitoring of water bodies receiving effluents among others was recommended in order to forestall cumulative effects of pollutants which may lead to sub-lethal consequences in the aquatic fauna and clinical poisoning to man.

Keywords: *Hydrocarbon, heavy metals, pollution, periwinkle, Warri River*

INTRODUCTION

Oil pollution, one of the environmental consequences of crude oil exploration and exploitation activities, produces aqua-toxicological effects, which are deleterious to aquatic life (Kori-Siakpere, 2000; Agbogidi, Okonta and Dolor, 2005). Aquatic organisms can acquire trace elements from food, suspended particles or directly from the water (Carvalho and Fowler, 1993). Many of these pollutants are non- biodegradable compounds and dangerous due to their innate ability to constantly remain within the ecosystem (Hernandez-Hernandez , Medina , Ansuategui and Conesa 1990). According to Van Vuuren, Du Prez, Wepener , Adendorff and Barnhoorn (1999), metal pollutants are currently considered to be some of the most toxic contaminants present world-wide.

The adverse effects of heavy metals in aquatic environment have been documented (Jack, Fekarurhoho , lgwe and Okorosaye-Orubite 2005, Ideriah, Braide and Briggs 2005, Zeinab, 2006). Many aquatic organisms have been used as sensitive indicators of heavy metal pollution (Osibanjo and Ajayi, 1980, Foulkes. 1990). Bioaccumulations in aquatic organisms such as crustaceans, mollusk and fish have been reported to depend on exposure time and concentrations of metals in the water (Jackson , Baird and Els 2005). Periwinkles are mollusk and have been reported to be one of the preferred pollution biomonitors because of their sedentary and bottom feeding habits which make them good accumulators of heavy metals and polycyclic aromatic hydrocarbons (Wilson , Powell , Wader, Taylor , Presley and Brooks., 1992; Jack, Fekarurhoho, lgwe and Okorosaye-Orubite, 2005).

Periwinkles are mass-consumer products constituting re1atively cheap animal protein in Delta State (Ekanem and Otti, 1997) and are one of many delicacies in the Nigeria cuisines. *Tympanotomus fuscatus* is a common species of periwinkle found in the Warri River. Warri River stretches within latitude 5021' - 60.00'N and Longitude 5024' - 60.21'E and has outlets to the Atlantic Ocean. The river which supports major commercial activities such as shipping of crude oil, fishery, and recreational fishing and prawning has been implicated in heavy metal contamination in the past (Egborge, 1991, Edema, Ezenmoye and Egborge, 1992; Ayenimo, Adeyinwo, Amoo and Odukudu , 2005).

With an extensive utilization of crude oil and its refined products in Nigeria, the Niger Delta region especially the Warri River, would continue to receive run-offs or industrial effluents which will contaminate and bioaccumulate in aquatic organisms. There is therefore, a need for periodic assessment of levels of these pollutants to ensure that they are within permissible limit for human consumption. This research determines the concentrations of petroleum hydrocarbons and heavy metals in the tissues of Tympanatonus fuscatus from Warri River.

MATERIALS AND METHODS

This study adopted the experimental research design. Six hundred samples of *Tympanotonus fuscatus* periwinkles were randomly collected fortnightly from three stations namely: Jala and Ubeji, representing areas more susceptible to pollution as a result of high industrial activities and Suoroagbene, a residential area along the Warri River for a period of six months. Periwinkles were washed and frozen at 5°C until they were ready for analysis. Later, periwinkles were deshelled and the soft tissues air-dried at room temperature for three weeks and analysed at the Petroleum Training Institute Efferent Laboratory, Warri. Tissues of periwinkles were ground to powder form, sieved, weighed and ashed at 77°C for two hours in a furnace.

Ten grams ashed periwinkle tissues were digested with 20 ml of concentrated Hydrogen trioxonitrate (v) (HNO_3) and heavy metal determined using solar model-unicam 969 Atomic Absorption Spectrophotometer. The Soxhlet Extraction Gravimetric method was used for determination of hydrocarbon. Fifty grams of air-dried and ground periwinkle tissues were extracted in Soxhlet Extractor for 8 hours using hexane acetone (60:40) cocktail solvent. Soluble metallic soaps were hydrolyzed by acidification. Oils and solids or viscous grease present were separated from liquid samples by filtration. After extraction, the residue after solvent evaporation was weighed to determine the oil and grease content. Compounds volatilized at or below 103°C were lost when filter was dried up. Data obtained were subjected to one way analysis of variance using Statistical Package for Social Sciences (SPSS) at 95% confidence interval and means separated using Duncan's - Multiple range Test (DMRT).

RESULTS AND DISCUSSION

The concentration of Total Hydrocarbons (THC) and heavy metals in the tissues of periwinkles analysed are presented on Table 1. The mean THC concentrations varied from 0.0045mg/g to 0.093mg/g in all three stations sampled. The concentrations of THC at Jala and Ubeji were significantly higher ($P < 0.05$) than at Suoroagbene, the control station. A slight variation in concentration of THC was however, observed in Jala and Ubeji. The higher mean concentrations of THC observed in Jala and Ubeji stations were probably due to more industrial activities in these stations than in Suoroagbene, the control station, which is more of a residential area. Though the control station is residential, some level of pollution was observed. Variations in levels of pollution could be due to the varying levels of activities at each station and the extent of discharge of wastes into the water body.

According to Ideriah, Braide and Briggs (2005), levels of pollution observed suggest that in addition to tidal actions, domestic wastes containing discharges of metal and THC may have contributed to the level of pollution in aquatic organisms. Petroleum and allied industries located close to Jala and Ubeji stations are likely sources of the higher level of THC observed in these stations. The concentrations of THC in tissues of periwinkles in all three stations were generally low compared with levels of previous reports from the same river (Edema, Ezenmoye and Egborge, 1992) and similar polluted river (Ideriah, Braide and Briggs, 2005). Jack, Fekarurhoho, lgwe and Okorosaye-Orubite. (2005), noted that hydrocarbons take longer time to sink to the riverbed and that marine organisms accumulate hydrocarbons due to their sedentary and bottom feeding habit. Figure 1, shows levels of hydrocarbons in tissues of periwinkles from Warri River.

The presence of heavy metals in the tissues of periwinkles supports the report of Ayenimo, Adeyinwo, Amoo, and Odukudu (2005), which showed the presence of heavy metals in tissues of periwinkles from Warri River. Mean Lead (Pb) concentrations varied from 0.0027ppm to 0.046ppm. Mercury (Hg) and cadmium (Cd) were below the Instrument Detection Limit (IDL) of <0.001ppm in all three stations. The concentration of Lead (Pb) at Suorogbene was significantly lower ($P < 0.05$) than at Jala and Ubeji. The concentration of lead was also higher in Jala and Ubeji stations than in Suoroagbene, the control station. The further location and longer distance of Suoroagbene from the major road could be responsible for the lower mean concentration of Lead (Pb) observed in this station. This implies that emissions from automobile activities on the major roads close to Jala and Ubeji could have also contributed to the higher level of pollution observed in the stations. Similar observations on bioaccumulation of heavy metal pollution had earlier been reported in tissues of oysters and periwinkles (Cummingham and Tripp, 1975; Davies, Allison and Uyi (2006). Figure 2, shows levels of heavy metals in tissues of periwinkles from Warri River as compared with WHO (2004) provisional weekly tolerance intake of Lead, Mercury and Cadmium.

This study demonstrated evidence of bioaccumulation of total hydrocarbons (THC) and Lead (Pb) in the tissues of periwinkles from Warri River. Levels were however, observed to be below the recommended tolerance levels of 0.01mg/g for hydrocarbon and 10mg/kg for lead (WHO, 2004; Davies, Allison and Uyi, 2006). The values obtained in this study were also lower than those reported in previous study which was suggestive of sub-lethal toxicity in humans (USEPA, 1986; Sharp, Becker and Smith, 1987), Ayenimo, Adeyinwo, Amoo, and Odukudu, 2005). The results of this study show imminent problems of contamination in Warri River if control measures are not put in place. This emphasizes the importance of constant monitoring of rivers and other water bodies receiving effluents in order to forestall cumulative effects of pollution in the river which may lead to sub lethal consequences in the aquatic fauna and clinical poisoning to man.

CONCLUDING REMARK

The concentrations of hydrocarbons and heavy metals in the tissues of periwinkle *Tympanotomus fuscatus* from Warri River in Edo State were investigated. The concentrations of total hydrocarbon and Lead (Pb) were observed to be significantly higher at Jala and Ubeji than Suoroagbene, the control station. The higher concentrations of total hydrocarbon and Lead (Pb) in tissues of periwinkles from Jala and Ubeji were attributed to more industrial activities and close proximity of the stations to the major road where emission from automobiles abound more than Suoroagbene, which is purely a residential area. This study demonstrated the evidence of bioaccumulations of total hydrocarbons and lead but levels were below the recommended tolerable levels and also lower than levels reported previously in periwinkles tissues by some authors in same river. Therefore, constant monitoring of water bodies receiving effluents is recommended in order to forestall cumulative effects of pollutants which may lead to sub-lethal consequences in the aquatic fauna and clinical poisoning to man.

Table 1: Mean Concentrations of Total Hydrocarbon (THC) and Heavy Metals in Tissues of Tympanotonus fuscatus from Warri River

Sampling Stations	THC (mg/g)	Pb (ppm)	Hg (ppm)	Cd (ppm)
I - Jala	0.093	0.0043	<0.001	<0.001
II - Ubeji	0.098	0.0046	<0.001	<0.001
III - Suoroagbene (Control Station)	0.0045	0.0023	<0.001	<0.001

<0.001 - less than Instrument Detection Limit (IDL)

Source: Fieldwork, 2009

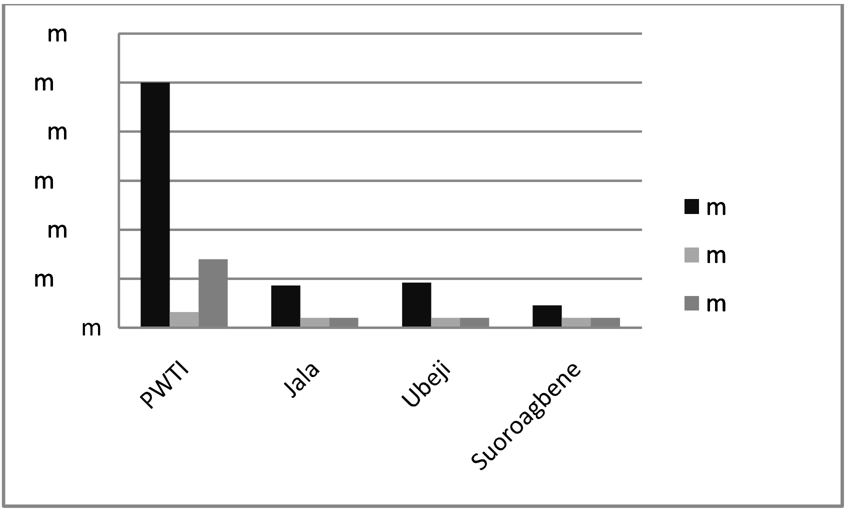

Figure 1: Levels of heavy metals in tissues of periwinkles from Warri River compared with Provisional Tolerance Weekly Intake (PWTI).

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