The Influence of Oil-based Mud Exposure on the Uptake of Heavy Metals and Total Hydrocarbon in *P. barbarus* Soft Muscle Tissue

C. Nwakanma and A.I. Hart  
Department of Animal and Environmental Biology, University of Port-Harcourt, Nigeria

**Abstract:** The influence of oil-based mud exposure on the uptake of heavy metals (Zn, Fe, Cd, Cr, Mn, Pb) and Total Hydrocarbon uptake in the soft muscle tissues of *Periophthalmus barbarus* from the mangrove shores of the Rumuche river in Emohua Local Government area, Port-Harcourt, Niger Delta, Nigeria was analyzed using Atomic absorption Spectrophotometer. The mean metal levels (µg/g dry weight) ranged from Zn (10.52 - 62.33), Fe (89.33 - 301.00), Cd (0.18 - 0.75), Cr (1.33 - 4.99), Mn (7.00 - 53.00), Pb (2.96 - 10.27) and THC (24.53 - 79.30). Of all the metals, Fe accumulated more in the media. Statistical analysis showed no significant difference (p>0.05). The differential uptake (p>0.05) accumulation of the metals in the soft muscle tissue was Fe>Zn>Mn>THC>Pb>Cr>Cd. However, the highest concentration of OBM (10%) had the higher values of metal uptake in the soft muscle tissues of *P. barbarus*. The levels of metals in the tissue were higher than the control tank which means that uptake of metals via the soft muscle tissue of *P. barbarus* indicated that consumption of exposed fish or fauna can be very risky and bioaccumulation of toxicant can be dangerous to our health and the environment.

**Keywords:** Bio-accumulation, mangrove, mudskippers, Niger delta, spectrophotometer

**INTRODUCTION**

Studies on the bioaccumulation of pollutants by fish are important. Several studies have been carried out to investigate the presence of heavy metal pollutants in aquatic ecosystems in water bodies (Calamari and Naeve, 1994; Obasohan and Oronsaye, 2000; Oguzie, 2000). A concern about oil-based mud bioaccumulating in the tissues of marine organisms particularly in North Sea countries has been reported (Rushing et al., 1991; Vik et al., 1996). According to Payne et al. (1989) and Stagg and McIntosh (1996), demersal fish are able to bio-accumulate petroleum hydrocarbon from oil-based fluid cuttings.

Bio-accumulation typically refers to the uptake and retention of a contaminant by an organism. In a few test conducted by Cordah (1998) and Hart et al. (2007), bivalve molluscs and crustaceans appeared to bio-accumulate small amounts in their tissue. This is because many aquatic organisms are capable of accumulating or bio concentrating contaminant for example, heavy metals and Polycyclic Aromatic Hydrocarbon (PAHs) in their tissues. Bio magnification of heavy metals in soft muscle tissues of aquatic fauna, for example, *P. barbarus* could pose health hazards to consumers. The Niger Delta is a region that has been exposed to decades of pollution from oil activities and dumping of operational material called drilling mud. Laboratory studies of the influence on aquatic species have revealed heavy loads of heavy metals and total hydrocarbon (Neff et al., 2002; EPA, 1999; Hart and Ulonnam, 2008). Hence, this study was undertaken to assess the uptake levels of heavy metal and total hydrocarbon in the soft muscle tissues of *Periophthalmus barbarus* an indigenous species from the mangrove swamps of the Rumuche River in Emohua LGA, Niger Delta, Port Harcourt, Nigeria.

**MATERIALS AND METHODS**

The study was carried out in the Hydrobiology/Fisheries laboratory of University of Port Harcourt, Choba, Nigeria. The test organisms were collected by trap nets at low tide and were transported in the late hours of the day in air buckets. In the laboratory, they were sorted out into different sizes and initial length and weight measurements were taken. After conditioned for one week, the experimental fish were exposed to prepared OBM in which 1% OBM = 100 mL/L. Ten organisms were distributed into the appropriate tanks and exposed within 4 days using a static bioassay technique (Sprague, 1970; Hart et al., 2007; EPA, 2000). The test Materials (OBM) was tested for the following prior to its usage, pH, total hydrocarbon, TOC, TDS, K, Na, Ca, Mg, NO3-N, PO4, Cl, Zn, Fe, Cd, Pb, THC, Cr and Mn using spectrophotometer.

At the end of the 4 days exposure to different concentrations of OBM (10, 8, 4, 2, 0%, respectively (control)), the soft muscle tissue was extracted from each fish using a stainless steel knife. The tissue was then dissected and homogenized in a mortar which was
digested with a 3: 1 vol/vol H₂SO₄ and HNO₃ mixture for 4 h. All reagents used in the preparation were standards and the stock solutions were prepared for each metal and analyzed using Buck scientific atomic absorption spectrophotometer 200A according to Porte and Albaiges (1993).

RESULTS

The bioaccumulation of the metals indicated that as concentration increased, the metals uptake also increased progressively (Table 1). The levels of Fe in the soft muscle tissue were higher than the levels of Zn, Pb, Cd, Cu, Ni and THC. The bioaccumulation trend of the metals in the soft muscle tissue was not significantly different as \( p>0.05 \) with a variation ranged from Fe>THC>Zn>Mn>Pb>Cd>Cr.

DISCUSSION

The increase in concentration of metals leads to a progressive increase in the uptake of heavy metal and total hydrocarbon. Fish may be directly affected by the uptake of oil via water contaminated sediments and food materials. Bioaccumulation of metals in the test fauna are generally related to oil concentration in the treatment tanks. All test fauna showed accumulations of hydrocarbons in tissues above the concentration found in tissues of fish in controls. This observations is similar to that made by Davies and Pirie (1980) and Dambo and Ekweozor (2000) in oyster (Crassostrea gasar), Hart et al. (2007) in Crab (Callinectes amnicola), Hart and Ulonnam (2008) in Periwinkle (Tympanotonus fuscatus) and Rushing et al. (1991) in gills and gut of F. grandis treated with drilling fluid. All the metals studied are known to be toxic to man at certain levels of intake and hence consumers of P. barbarus, of which is a major source of protein in the Niger Delta could stand the risk of heavy metal poisoning if these levels increases beyond that recommended for consumptions.

REFERENCES


