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Impact of Discharge Fertilizer Effluents on The Toxicological Profile of Fish Harvested from A Receiving Creek in Okirika, Rivers State

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Abstract- *The impact of fertilizer effluent discharge on toxicological profile of fish was studied by harvesting fish from Okrika creek which receives treated fertilizer effluent and analysing same for heavy metal (Lead Pb, Nickel Ni, Zinc Z and Copper Cu); Polycyclic Aromatic Hydrocarbon (PAH) and Total Petroleum Hydrocarbon (TPH) concentrations. Similar fish was harvested from Otamiri River which is far from any industrial activity and used as control. Heavy metals were analysed using Atomic Absorption Spectrophotometer while the PAH and TPH were analysed using Gas Chromatography. Result indicated unacceptable high values in most of the studied parameters with significantly higher (P<0.05) values; Pb (8.10±0.02 mg/kg), Ni (1.24±0.12 mg/kg), Zn (22.82±0.13 mg/kg), Cu (2.79±0.16 mg/kg), TPH (1.24±0.01 mg/kg). PAH indicated no significant difference (P>0.05) with value 0.003±0.01 mg/kg. Result indicates an unacceptable high level of these metals in the fish tissue which is of great concern to consumers and could reflect the level of pollutant in the effluent. The company is thus advised to treat their effluents properly and government ensures compliance.*

Keywords *– Effluent, heavy metals, Polycyclic Aromatic Hydrocarbon, Total Petroleum Hydrocarbon.*

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1. Introduction

The environmental consequences of marine pollution include creating a toxic marine environment which adversely affects activities of marine micro- flora as well as fish and other marine lives [1, 2, 3, 4]. Fish play important roles not only in human food diets but also in animal and poultry rations. It is palatable and easily digested food which is rich in vitamins, calcium, phosphorous and iodine. All over the world, fish is considered as a cheap food article if compared with other foods of animal origin [5]. The flesh of healthy fish is considered as a pollution marker for the natural aquatic environment [6].

NOTORE (formerly known as NAFCON) is a fertilizer plant at Onne near Port Harcourt, Rivers state. It is the largest nitrogenous fertilizer company in Nigeria and it is sited along the banks of Okirika creeks. It started production in 1987 and has the capacity to produce over 700, 000t of combined (NH2) CO, N, P, K (NPK) and bulk blended fertilizers per annum. The fertilizer plant being so sited along the Okirika creek, eventually uses the creek as its effluent disposal site and little attention has been given to the damage done to the Okirika creek by the effluent discharge [7]. Fertilizer plant effluents may include domestic and sanitary sewage, ammonia and urea plant condensate, steam condensate, contaminated run- off, storm water and utility waste waters (boiler blow down, cooling tower blow down and demineralised regenerate waste). These effluents contain essentially toxic components such as free ammonia, numerous ammonium compounds, phosphate compounds, urea, heavy metals from chemicals used in stabilising production process, oil, grease and fuel from machinery [8, 9]. NOTORE is estimated to generate approximately 50% of the total nitrogen and virtually the total phosphorous from industrial sources of pollution in Port Harcourt [10].

Sludge discharged from fertilizer plant may raise the carbon- nitrogen ratio of the environment and causes loss of carbon dioxide and affects the physico- chemical parameters of the marine milieu [11]. Contamination of aquatic environment due to fertilizer wastes is becoming of great concern. This is because fertilizer wastes discharged into natural bodies of water constitute a major cause of

eutrophication and threaten the ecological health of the environment. Human induced eutrophication is a rapidly growing environmental crisis in freshwater and marine water systems nationwide. Nutrients that cause eutrophication include nitrogen and phosphorous. They are critical to biological processes in aquatic ecosystems; increased run off of these nutrients to aquatic ecosystem from land- based sources result in increased biomass production, upsetting the natural balance of these ecosystems [12].

Owing to the frequent clashes between industries, visitors, strangers and their host communities in Niger delta, scientific samplings of aquatic and terrestrial environment in these areas are sometimes approximately impossible and some samplings, if eventually carried out are usually done haphazardly with suspense and fear of being attacked. Consequently, there is little or no reliable data available on the ecological impact of the NOTORE effluent on the Okirika creek [7]. Thus, this work set to determine the toxicological profile of fish harvested in the Okirika creek to ascertain the impact of the fertilizer effluents on heavy metal concentration of the fish.

2. Materials and Methods

2.1 The Experimental Design

Heavy metals (Lead, Nickel, Zinc and Copper) Total Petroleum Hydrocarbon (TPH) and Polycyclic Aromatic Hydrocarbon (PAH) concentrations were determined in fish samples harvested from Okrika creek in Okrika Local Government Area of Rivers state. This was compared to fish harvested from Otamiri River in Imo state which was chosen due to its distance from activities of any chemical industry which may lead to contamination of the River.

2.2 Sample Collection and Preparation

The fish were harvested few distances from the effluent disposal point. Twelve fish samples were harvested within the sample area. The samples were appropriately labeled after the collection, stored in a portable cool container and transported to the laboratory for storage/analysis. The fish samples were air dried ground and used for analysis

2.3 The Determination of Heavy Metals Parameters

Heavy metals were determined by Atomic absorption Chromatography while TPH and PAH were determined by Gas Chromatography.

3. Results and discussion

Table 1: Heavy metals, TPH and PAH Concentration of Fish (mg/kg)

Samples	Parameters					
	Pb	Ni	Zn	Cu	TPH	PAH
Okrika Creek	8.10 ± 0.02[a]	1.24 ± 0.12[a]	22.82 ± 0.13[a]	2.79 ± 0.16[a]	1.24 ± 0.01[a]	0.003 ± 0.01[a]
Otamiri River	7.48 ± 0.13[b]	0.68 ± 0.15[b]	16.50 ± 0.78[b]	1.79 ± 0.51[b]	0.90 ± 0.03[b]	0.003 ± 0.001[b]

Values are Means ± standard deviation of triplicate determinations.
Values in each column with different superscript letters differ significantly at 5%.

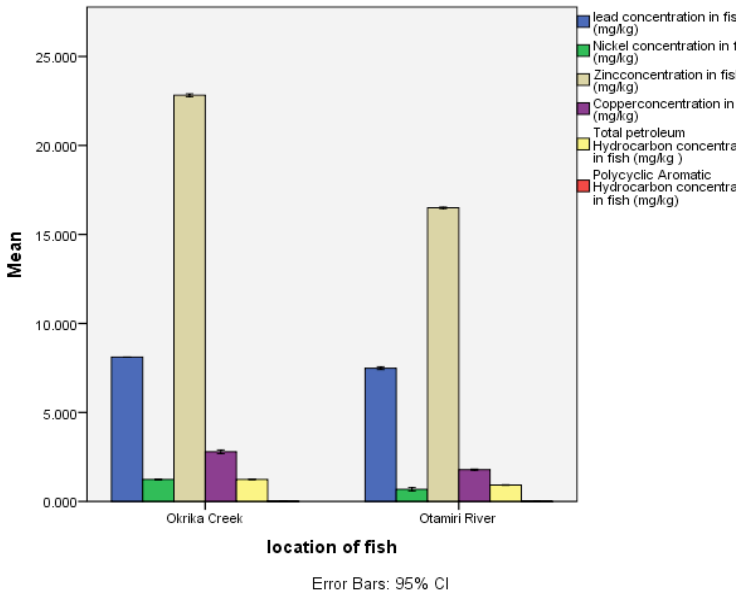

Figure 1. Mean Heavy metals, TPH and PAH Concentration of Fish (mg/kg)

The result of heavy metals, TPH and PAH concentration of the fish harvested from the study and control areas is presented in Table 1. The result obtained from the study area show that Lead, Nickel, Zinc Copper and TPH were significantly higher ($p < 0.05$; [b]) in Okrika Creek which received treated fertilizer effluent.

PAH was however not significantly higher in the study area (a).

From the result as presented above, it is seen that the levels of Ni, Pb, Zn and Cu are highly elevated. There was a statistically higher ($p < 0.05$) value for lead, Nickel, Zinc Copper and TPH in fish harvested from Okrika creek than fish from the control area. The concentration of PAH was not significantly higher in fish harvested from the study area. The Food and Agricultural Organization has set the maximal value of Pb in fish to be 0.5 mg/ kg [13]. Lead has been classified as one of the most toxic heavy metals, causing renal failure and liver damage in humans [14]. The result of this analysis for lead was higher than the stated allowable value. This goes to show that the consumption of fish from Okirika creek is a high risk due to the high Pb content of the fish.

The US Food and Drug Administration allowable limit for Ni in fish is 70- 80mg/ kg [15]. The major source of Ni in humans has been shown to be from food uptake as well as from natural sources. There has been a reported increase of cancer of the lung and nasal cavity caused by Ni inhalation among Ni smelters [16]. Although the result of Ni is not higher than the stated allowable limit, chronic consumption of fish from Okirika creek may result in cancer of the lung and nasal cavity as is the case of the Ni smelters owing to prolonged exposure of it.

The Food and Agricultural Organisation has set the maximal value of Cu in fish to be 0.5mg/ kg [13]. Cu is a co-factor of many essential enzymes and is necessary for synthesis of haemoglobin. The result obtained was higher than the allowable limit. This implies that the high level of Cu may bring about Cu toxicity to persons consuming fish from the creek.

The Food and Agricultural Organisation has set the maximal value of Zn in fish to be 30mg/ kg [13]. Zn is an essential trace metal for both animals and humans. Its deficiency is marked by retarded growth and decreased fertility [17]. Zn toxicity is rare but at concentration of up 40mg/ kg, it may induce toxicity characterised by irritability, muscular stiffness, loss of appetite and nausea [16]. The result was lower than the maximum allowable limit. Prolonged consumption of fish from this creek may lead to Zinc accumulation.

4. Conclusions

This study shows possibility of migration of heavy metals and other constituents from the fertilizer effluents discharged into fish harvested from the creek. The company can do more by way of treating their effluents properly before discharge. These findings call for the regulatory agencies to regularly monitor the quality of treated effluents discharged into the receiving waters so as to circumvent the discharge of pollutants into surrounding ecosystems that may pose health risks and hazards. The values obtained are already on the high side; if left unattended to, it will keep on bioaccumulating in the tissues of the fish consumers thereby exposing them to the dangers of consuming fish with contaminants in them.

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