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Original Research Article

Total petroleum hydrocarbon accumulation in gills and muscle tissue of Tilapia spp in Kolo Creek, Imiringi, Bayelsa State

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Abstract

Petroleum spill into aquatic environment is a regular occurrence in the Niger Delta. Total petroleum hydrocarbon accumulation in Gills and muscle tissue of Tilapia *spp* from Kolo Creek has been analysed. The Tilapia fish samples were collected from the Kolo creek water, prepared and spectroscopically analysed at 420nm with spectronic 21D spectrophotometer. The measurement values were based on dry weight of the fish samples. The mean values of total petroleum hydrocarbon concentration recorded from tilapia gills analysis ranged between 6,140.38±7812.05 and 16,517±18209.90mg/kg. The values recorded for muscle tissue analysis ranged between 3170.81± 2076.31 and 5708.51±8351.49mg. Seasonal variation indicated higher values in dry season than wet season. For gills the values are as follows. Gills (wet: 5364.09 ± 6401.91mg/kg, dry: 15747.60 ± 11003.31mg/kg). Muscle tissue (wet: 2254.86±1580.13. Dry: 5781.51±4703.15mg/kg). Total petroleum hydrocarbon concentration in gills was higher than that recorded in the muscle tissue. The obtained values of total petroleum hydrocarbon were relatively higher when compared with reported levels in similar ecosystems. The concentration of total petroleum hydrocarbon in the Tilapia fish samples from Kolo Creek analysed is significantly high and constitutes a health risk to people of the area.

Keyword: Fish, gills, tissue, petroleum hydrocarbon and Kolo Creek.

INTRODUCTION

Oil spillage is a worldwide problem which nations have been experiencing since the discovery of crude oil (Kadafa, 2012). In Nigeria, oil was first discovered in a place called Itokopiri in Oloibiri clan in Ogbia Local Government Area of Bayelsa State within the core Niger Delta, in the year 1956 by Shell British Petroleum (Anifowosel, 2000 and Onuah, 2008). The Niger Delta is situated within the Atlantic coast of Southern Nigeria and is considered to be the second largest delta in the world ((Kadafa, 2012). Since 1958, Oil exploration and production has been ongoing in the Niger Delta. The region has experience series of oil spills which have had serious negative impacts on the environment of the region and has adversely affected people's health and means of livelihood including fishing in the region.

The Kolo Creek Shell Development Company flow station derives its name from the Kolo Creek which served as a landmark when the (SPDC) establish the flow station in the 50s. The Kolo Creek serve as a navigation root to people of the area, The Engene, Ekpeye and the Nembe people. Apart from being a navigational root, the creek was a means of livelihood to the people of the area as majority of them were majorly fishermen and farmers. The Kolo Creek like many other

aquatic environments in the Niger Delta has witness several oil spills from pipeline rupture and accidental discharge from oil production activities.

Studies carried out in most cities in Nigeria had shown that industrial effluent is one of the main sources of surface water pollution in Nigeria. (Ekiye and Zeijao, 2010; Adeleke and Adegunde, 2011) reported that large quantities of pollutants have continuously been introduced into ecosystems as a consequence of urbanization and industrial processes. (Kadafa, 2012) reported that an estimated 9 million- 13 million (1.5 million tons) of oil has been spilled in to the Niger Delta ecosystem over the past 50 years. Destruction of plants and animals lives by oil spillage is therefore a common feature in the Niger Delta region of Nigeria. Olaji et al. (2014) reported that Oil spillage has led to contamination of aquatic and terrestrial environment. Besides, oil contamination of coastal amenities has adverse effects on tourism, recreation and aesthetics of the impacted area. This effect can be substantial on a community whose economy depends on tourism.

Crude oil can reduce growth, cause tissues and organ damage in fish. (Olaji et al., 2014). The concentration of petroleum hydrocarbon release into the aquatic environment can be small but in the long run may cause significant negative health effects to humans through consumption of fish and other sea foods which have bioaccumulated and biomagnified hydrocarbon in their body tissues.

Fish is a veritable source of protein and has low fat content. It constitutes a bulk of the protein intake of adults in rural areas. Hence the frequent release of crude oil into the water bodies is a risk to human health as people depend heavily on fish as a source of protein and fat. Human beings are usually exposed to total petroleum hydrocarbon through the air, soil, water and food but dietary intake of petroleum hydrocarbon has been shown by studies to be the major route of entrance of polyaromatic hydrocarbon to human body system (Dhananjayan and Muralidharan, 2012). Available literature indicates that several studies have shown that petroleum hydrocarbon have some negative effects to human health (Asuquo and Ewa-Oboho, 2004; Nkpai et al., 2013 and Rose et al., 2012).

Apart from petroleum hydrocarbon, fish intake of heavy metals from petroleum spilled into the aquatic environment is another cause for concern. For instance, exposure to lead (Pb) through consumption of lead accumulated fish can cause seizures, mental retardation, and behavioral disorders in human beings (Soboleu and Begonia, 2008; Olaji et al., 2014). Chronic cadmium exposures can result to kidney damage, bone deformities, and cardiovascular problems (Goyer and Clarkson, 2011). Studies have also shown relation between long term exposure to copper and decline of intelligence in young adolescents (Lenntech, 2009). In this study, the concentration of total petroleum hydrocarbon in tilapia fish spp obtained from Kolo Creek has been analysed with the aim of evaluating the health risk of the dietary intake of fish from the Kolo Creek.

MATERIALS AND METHOD

Study area

Kolo Creek which is in Imiringi Town is situated 10km away from Yenagoa the capital city on the NNW of the capital city of Bayelsa State. It lies within latitude $4^{o}50'$-$4^{o}55$N and long $6^{o}26^{o}$-$6^{o}25'$E on the south south in the Niger Delta Region of Nigeria. Figure 1 is a map of Bayelsa State showing location of Ogbia Local Government where the Kolo Creek is situated.

The Niger Delta of Nigeria is characterized by tropical rainforest and freshwater swamps which are usually flooded in the rainy season. Kolo Creek which is the major river of the area of study is a non-tidal freshwater that empties into River Nun. The major industrial activity in the area is exploration and exploitation of crude petroleum oil. Oil fields from different locations are connected to the Kolo Creek flow station which powers the Bayelsa State gas turbine to generate electricity.

Sample collection, treatment and analysis

Tilapia fish samples were collected from five sampling points for the two seasons, which are September October for rainy season and January-February for Dry season. Fish (Tilapia mosambica and Tilapia nigra) samples were collected using local fishing tools such as nets, hook and baskets. Samples were washed in distilled water, collected in well labeled air tight plastic containers and transferred to the laboratory for pre-treatment and analysis. Fish samples ranging from 10-20cm were filiated with clean sterile knife to obtain all flesh and gills. The whole body tissue and gills were immediately transferred according to stations and months, oven dried at 110^{o}C and blended.10g.of the air-dried samples were shaken for 3 minutes in 10ml of toluene to extract the hydrocarbon. The extract was analysed, with 21D spectrophotometer.

Data analysis

A two way analysis of variance using MINITAB with level of significance maintained at 95% was employed to analyse the data for level of significance

RESULTS AND DISCUSSION

Hydrocarbon concentration in gills and muscle tissue are

Figure 1. Map of Bayelsa State showing position of Ogbia where Kolo creek is situated.

Table 1. Spatial variation (mean and standard deviation) of THC in gills and muscle tissue.

Parameters	Stations									
	1		2		3		4		5	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
THC in Gills (mg/kg)	6140.38	7812.05	16517.23	18209.90	15063.23	10016.65	6775.74	5294.64	8282.61	4295.40
THC in muscles Tissue (mg/kg)	5708.51	8351.49	3408.72	1883.74	4012.87	2947.11	3790.05	1718.71	3170.81	2076.31

Table 2. Seasonal Variation (mean and standard deviation of Gills and muscle tissue.

Parameters	Season			
	Wet		Dry	
	Mean	SD	Mean	SD
THC in M.T (mg/kg)	2254.86	1580.13	5781.51	4703.15
(Muscle Tissue) THC in Gills (mg/kg)	5364.09	6401.91	15747.60	11003.31

summarized in Table 1. This shows the mean values for the five stations sampled. Total petroleum hydrocarbon in gills indicate high values with mean levels of 5706.51, 39.048.86, 401287, 3790.05 and 3770.81mg/kg at stations 1, 2, 3, 4 and 5 respectively. Table 2 shows the seasonal variation where the dry season values are higher than the wet season. The mean concentrations of total petroleum hydrocarbon in the fish tissue from the various stations sampled are 5708.5, 3408.72, 4012.87, 2790.05 and 3170.80mg/kg. Muscle tissue however had lower values than gills in all the stations. The comparison of the TPH concentration in the tilapia gills with concentration in muscles tissues is presented in Figure 2. It indicates the significant difference between TPH concentration in gills and muscles tissues of the same fish sample.

The result of the analysis of variance (ANOVA) shows that p-values for total petroleum hydrocarbon in gills and fish tissue during the dry season were significantly higher than the p value during the wet season (0.484: 0.02 and

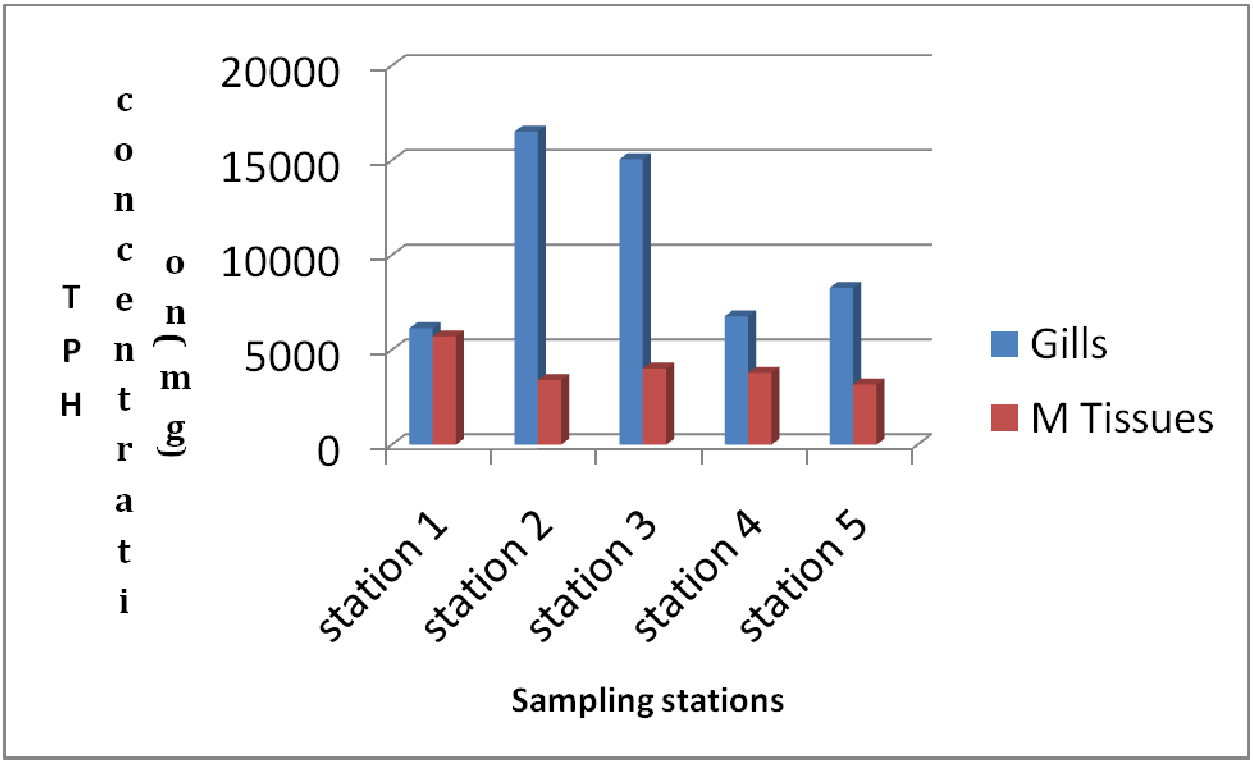

Figure 2. Comparison of TPH concentration fish gills with concentration in Muscle tissue.

and 0.991: 0.097.

The high levels of total petroleum hydrocarbon in gills indicated that Kolo Creek aquatic system is heavily polluted with hydrocarbon. These results may be attributed to oily discharge from the flow station and oil pipe lines. Significant necrosis and degeneration of gill epithelial cells in fish species exposed to spent lubricant oil has been documented by (Annune, 1992). (Ekweozor, 1989) reported that high levels of hydrocarbons will lead to direct destruction of organisms through coating of the gill lamellae and asphyxiation of the cells. The observed higher concentration of hydrocarbons in gills than tissue of tilapia spp suggests that the contamination is probably more of ingestion than contact (Chinda and Braide, 2000). The results obtained in this study agree with earlier findings of (Badsha and Goldspink, 1982)

The nature and structure of the gills (large surface area and high permeability makes the gills a major site for entry and subsequent accumulation of large amounts of many toxicants. In the natural environment, lack of proper oxygen supply to tissues may damage the gills also and possibly death observed in fish exposed to different petroleum hydrocarbons

Major fisheries of the world are concentrated in areas of high biological productivity such as areas of upwelling and continental shelf waters, mangrove, estuarine and lagoon waters. In some parts of the world, incidentally, these areas are characterized with the onshore offshore petroleum industry activities. This development has resulted to constant pollution of the aquatic environment. This is the situation in the Kolo Creek. Where the SPDC pipeline is buried across the creek.

CONCLUSION

Concentration of total petroleum hydrocarbon in both gills and body tissue of tilapia fish obtained from the Kolo creek is significantly high and this indicates that the creek is severely polluted. Consumption of tilapia spp and other species of fishes from the creek is a significant health risk as a result of the accumulation of petroleum in fish because of the level of pollution.

RECOMMENDATIONS

I. Effort should be made by Shell and the Federal Government to clean the creek of oil and other oil spill sites in the area.
II. Genuine effort should be made by the various security agencies to stop oil bunker and illegal refining going on in the area.
III. Old and rusted oil pipeline in the area should be changed without further delay.
IV. Pipeline surveillance in the area should be taken

seriously.

V. There should be frequent and sustained public enlightenment campaign on the effect of oil pollution on human health and the environment.

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