Total Hydrocarbon Concentration in the Tissues of *Clarias gariepinus* of Taylor Creek, Niger Delta.

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ABSTRACT

Total Hydrocarbon Concentration in the tissues (gills, muscle and liver) of *Clarias gariepinus* was determined along the stretch of Taylor creek in Bayelsa State Niger Delta. Seven (7) sample points were selected along the stretch of the Creek and selected spilled sites. Samples were collected in monthly basis from November 2015 to October 2016 and analysed following standard procedures using Spectronic 21D Spectrophotometer. THC were in the order; liver > gills > muscle. Their concentrations ranged from 14.53mg/kg to 21.53mg/kg in the liver, 12.20 mg/kg - 19.19mg/ kg in the gills and8.85 mg/kg – 10.60 mg/ kg in the muscle tissues of *Clarias gariepinus*. Statistically the values were not significant ($P<0.05$). The results showed that Total Hydrocarbon Concentrations in the studied fauna exceeded the WHO recommended limits of 0.001µg/g for seafood. Hence, consumption of *Clarias gariepinus* from the Creek should be reduced to prevent adverse health effects on consumers and also anthropogenic activities along the creek and shorelines should be regulated and monitored to prevent further contamination of other aquatic species.

Keywords; Hydrocarbons, *Clarias gariepinus* (Liver, Gills Muscle tissue), Taylor Creek.

1.1 Introduction

Petroleum is composed of a complex mixture of hydrocarbons that readily undergo chemical and biological conversions on entering aquatic environments. These conversions lead to the formation of a host of oxygenated products, some of which are potentially toxic to aquatic lives and to the consumer of fishery products. Aquatic ecosystem polluted with a wide range of pollutants in recent times has become a matter of great concern over the last decades (Al-weher, 2008). The extraction and usage of petroleum products as energy sources in the world has led to a widespread pollution of the biosphere and about 6-10 million barrels of crude oil are spilled into the aquatic environment yearly (Nwillo and Badejo, 2005). Niger Delta plays host to majority of the oil industries in the oil sector, to which Nigerian economy depends has led to pollution by oil spillage and petroleum products, which is a regular occurrence in the

Niger Delta region and thus has led to contamination of the aquatic environment. The ultimate discharge of effluents by industries and other anthropogenic activities in and around creeks and rivers constitute a major environmental challenge particularly in developing areas such as the Niger Delta (Moslen and Daka., 2016). Appreciable quantities of crude oil when mixed with sea water have been shown to affect the feeding habit / behavior of fish, shellfish, and are also stored in sediments which are frequently released to the water thereby leading to the contamination of the aquatic ecosystem (Al-Shwafi, 2008). Crude oil may also reduce growth, tissues and organ damage in fish (Atuanya and Nwogu). Fish from the natural aquatic environment are consumed every day for nutritional requirements and this could expose such consumers of fish from presumed polluted areas to health risk (Calderon *et al.*, 2003). Dietary intake of toxic pollutants is the main route of exposure for most people (Powers *et al.*, 2003). According to FAO Statistics, fish accounted for about 16% of the global population intake of animal protein and 6% of all protein consumed. Despite the numerous benefits of fish as diet, the potential health risk arising from frequent consumption of fish is of great concern. All fish ingest petroleum hydrocarbons directly or indirectly from contaminated water as food and sediments leading to their contamination and also may result to massive destruction of the entire aquatic ecosystem (Asuquo and Ewa-Oboho, 2004). Polycyclic aromatic and Aliphatic Hydrocarbon fractions of dissolved petroleum are readily absorbed by most finfish and shellfish because of their high lipid solubility and are bioconcentrated in them (Olaji *et al.*, 2014). Humans exposed to these pollutants may suffer health effects like cancer, mutations and birth defects (White 1986). Adverse effects of PAHs have also been observed in marine organisms and fish which include growth reduction, endocrine alteration (Meador *et al.*, 2006), malformation of embryo and larvae (Carls *et al.*, 2008), and DNA damage (Caliani *et al.*, 2009). Ingestion of contaminated food (Meador *et al.*, 1996) and diffusion from water across their gills and skin are the major routes of PAHs exposure to fish.

2.0 Materials and Methods

2.1 Description of the study area

Okordia clan is located along the interior of the Taylor Creek in the North Eastern part of Yenagoa Local Government Area of Bayelsa State. It is bounded in the north by Biseni, in the East and south by the Engenis, and on the west, it is bounded by the Gbarain clan situated at about 20km away from the capital city. Okordia Clan comprises of different villages namely, Ikarama, Calabar, Akumani.

The inhabitants are predominantly farmers and fishermen which is their basic source of livelihood.The region is characterized by tropical rain forest and freshwater swamps which is usually flooded in the rainy season. The creek is a non-tidal freshwater that empties into river Nun. The area is host to Shell and Agip Oil Companies and surrounded by oil locations and oil fieldswhich undoubtedly may lead to effluent discharge and oil spillage into the creeklets.

2.2 Sample Stations

Seven (7) main sample collection stations were selected in the study area as shown in fig. 1. These include;

1. Freetown creek as station 1 (S. 1) N 05^0 16081E$006^0$46655
2. Ikarama creek as station 2 (S.2) N 05^0 15240 E006^0 45502
3. Kalaba creek as station 3 (S.3) N 05^0 14846 E$006^0$45076
4. Spill site 1 as station 4 (S.4)N05^0 15127 E006^0 44839
5. Spill site 2 as station 5(S.5)N05^0 15260 E006^0 45245
6. Spill site 3 as station 6 (S.6)N05^0 15534 E 006^0 45681
7. Spill site 4 as station 7 (S.7) N05^0 14978E 006^0 45708

2.2 Sample Collection and Method

2.2.1 Fish Sample Collection

Samples of *Clarias gariepinus* were obtained with the help of professional fisherman using a boat to assess the sample stations with local fishing tools such as nets, hooks and baskets which were properly inspected. The samples were caught, washed in distilled water, labeled in an air tight plastic container and transferred into an ice chest before transported to the laboratoryand for analysis. The samples were frozen in a freezer (-21^o) until analysis in order to prevent post mortem changes which may be either putrefactive or autolytic in nature.

2.2.2 Treatment of Fish Samples

Fish samples ranging from 10-20m where thawed at room temperature, cleaned scaled and eviscerated. Fish were filleted with a clean plastic knife to obtain the tissues (gills, muscle and liver). The extracted tissues(gills, muscle and liver) were immediately transferred into an oven at 110^oC. The dried samples were then transferred to a plastic high-speed blender. Blending continued for several minutes with frequent stopping of blender to scrape down sides of cup. Recombined portions were blended until sample became homogenous.

Determination of Total Hydrocarbon in Fish Tissue

Ten grams (10g) of the air-dried and ground tissues (gills, muscle and liver samples were shaken for three minutes with 10ml of toluene to extract the hydrocarbon. The extract was measured using spectronic 21D spectrophotometer *(Odu, et al., 1988).*

Statistical Analysis

Data were subjected to statistical analysis using SSPS software. Means and standard deviations were calculated for sampled variables. Analysis of variance was employed to compare means at 95% confidence limit.

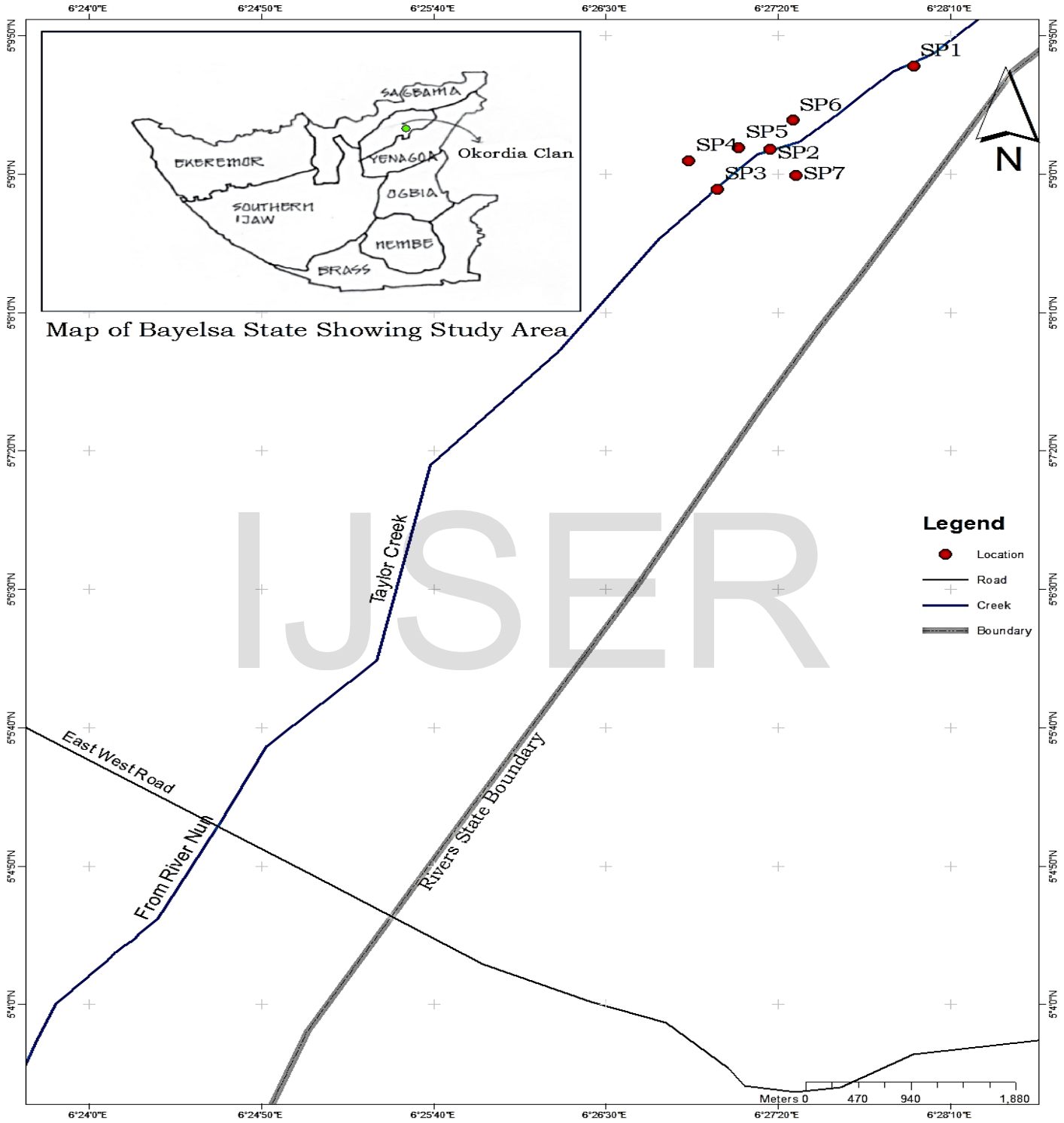

Fig. 1: Map of Bayelsa State showing Taylor creek the Study Area

3.0 Results

The mean THC on the gills of *C. gariepinus* ranged from 12.20±6.87 mg / kg to 19.19±9.88 mg / kg (Table 1). Station 2 recorded the highest concentration 19.19±9.88 mg / kg followed by station 3, 1, 4, 6, 7 and 5 with mean concentration of 18.47±9.76 mg / kg,17.52±8.24mg/kg, 16.20±8.79 mg/kg, 15.35±8.23 mg/kg, 15.35±9.96 mg / kg, and 12.20±6.87 mg / kg (Table 1).These values however were not significantly different using Turkey's multiple comparison at P>0.05.

The mean THC in the muscle tissue of *C. gariepinus* ranged from 9.12±4.98 mg / kg to10.60±3.66 mg / kg (Table 1). Station 3 recorded the highest concentration 10.60±3.66 mg / kg followed by station 4, 2, 7, 1, 6 and 5 with mean values of were 10.46±2.85 mg/kg, 10.30±4.05 mg / kg, 10.18±3.97 mg / kg, 9.53±3.70 mg / kg, 9.12±4.98 mg / kg and 8.85±4.98 mg / kg respectively (Table 1). Statistically the values were not significantly different (P<0.05).

The mean THC on the Liver of *C. gariepinus* ranged from 14.50±5.98 to 21.53±8.59 mg/kg (Table 1). Station 2 recorded the highest concentration of 21.53±8.59 mg/kg followed by Station 6, 1, 7, 3,5 and 4 with mean values of 20.01±11.57 mg / kg, 17.49±8.94 mg / kg, 16.64±9.88 mg / kg, 16.04±7.94 mg / kg, 14.52±7.61 mg / kg and 14.50±5.98 mg / kg respectively (Table 1), statistically the values were not significantly different (P<0.05).

Table 1: Mean levels of THC in the tissues (gills, muscle and liver) of *Clarias gariepinus* caught during the Study Period (Nov. 2015 - Oct. 2016)

Stations	Gills (mg / kg)	Muscle (mg / kg)	Liver (mg / kg)
1	17.52±8.24[a]	9.53±3.70	17.48±8.94[a]
2	19.19±9.88[a]	10.30±4.05	21.53±8.59[a]
3	18.47±9.76[a]	10.60±3.66	16.04±7.94[a]
4	16.20±8.79[a]	10.46±2.85	14.50±5.98[a]
5	12.20±6.87[a]	8.85±4.98	14.52±7.61[a]
6	15.35±8.23[a]	9.12±4.98	20.01±11.57[a]
7	15.35±9.96[a]	10.18±3.97	16.64±9.88[a]

3.1 Discussion

The high concentration of hydrocarbon in the gills could be due to the constant interaction of the gills which are highly vascularized with the source of pollution. These results may be attributed to flaring, persistent oil spillages/ leakages from pipelines in the study area.

Gill tissues are the main site of material exchange in water, including the exchange of pollutants, and their concentrations reflect that of the external environment (Dhaneesh *et al.*, 2012), as they are the main organs in direct contact with water, Respiration in particular keeps the gills constantly exposed to contaminants in the water.The result obtained were lower than those obtained by Enuneku *et al.*(2015) fortotal petroleum hydrocarbon (TPH) in gills with Isibor *et al.* (2016) who recorded lower values. Therefore

high levels of hydrocarbons will lead to direct destruction of organism through coating of the gill lamellae and asphyxiation of the cells (Asuquo and Ewa-Oboho 2004).

Higher levels were recorded in the Liver of the studied fish (*Clarias gariepinus*) across the sampled stations (Table 1). The liver is responsible for the transformation, detoxification and storage of toxic materials and consequently can manifest pathological effects in relation to the degree of pollutants which could be related to their roles in metabolism (Omar et al., 2013). Sonali *et al.* (2017) recorded higher values in marine fishes around offshore (oil and gas fields) in west coast of India, Enuneku *et al.* (2015) and Seiichi *et al.* (2003)also recorded higher levels in the liver, however, THC in the liver of fish may lead to Increased cellular vacuolization, RER proliferation and glycogen depletion in the fish, (Haque *et al.*, 2017).

THC was lower in muscle than in the gill and liver of fish. It is well known that muscles are not an active site for bio-accumulation, but in polluted aquatic habitats, fish muscles could exceed the permissible limits for human consumption and may imply severe health threats.

3.2 Conclusion and Recommendation

The elevated values of Total Hydrocarbons concentration in the studied *C. gariepinus* (Liver > Gills > Muscle) recorded in the studywere above WHO permissible level of 0.001µg/g in seafood (WHO, 1998) which can be attributed to prolonged crude oil pollution due to flaring, leakages from pipelines and spillages (Chindah *et al.*, 2004). The observed high concentrations of total hydrocarbon in liver, gills and muscle were indication of bioaccumulation which may pose serious health hazards to the inhabitants in the area over time if the discharge of untreated/partially treated effluents into the surface water is allowed to continue unabated. It is known that the African catfish (*Clarias gariepinus*) is of great commercial importance because it is the most widely consumed as it constitutes an important source of dietary protein to people residing at the shoreline of Taylor creek and its environment. Therefore consumption of *Clarias gariepinus* from the Creek should be reduced to prevent adverse health effects on consumers and also anthropogenic activities along the creek and shorelines should be regulated and monitored to prevent further contamination of other aquatic species.

Authors' contributions

This work was carried out in collaboration between all authors. Authors IKE designed the study and wrote the protocol, author EYP performed the statistical analyses and wrote the first draft of the manuscript. Authors EYP, AWG and IKE managed the literature searches and analyses of the study. Author AWG did the final draft of the manuscript. All authors read and approved the final manuscript.

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