

Evaluation of Total Hydrocarbon in Marine Organisms and Sediment of Mgboshimili Creek, Niger Delta, Port-Harcourt, Nigeria

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Abstract

The total hydrocarbon (THC) levels in the sediment, oyster and crab in Mgboshimili Creek in Niger Delta area of Port Harcourt Nigeria were studied between October 2020 to April 2021. Result revealed high concentration of THC in all the sampling stations (SSA, SSB, SSC) except station D (SSD, control station) which recorded least value. The variation in the pattern of THC within study station implies that most of THC in the sample studied were as a result of human activities within the Creek. It was also observed that sediment had the highest overall mean concentration (495.49 ± 98.34 mg/kg) followed by oyster (10.59 ± 2.73 mg/kg) and crab (6.14 ± 1.93 mg/kg) recorded the least value. This is an indication that sediment is an important sink and repository for metals and polycyclic aromatic hydrocarbons (PAHs) emitted from natural and anthropogenic sources. Conclusively, the levels of THC in biota and sediment in this study indicated that the activities of oil bunkering and boat transportation have considerably alter their quality. This therefore, emphasizes the need for compliance of environmental laws to prevent the Creek from further contamination.

Keywords: Hydrocarbon, sediment, oyster, crab, creek, environment.

Introduction

The exploration and exploitation of available natural resources by man for his own benefit has resulted to the pollution of the environment (Babagana *et al.*, 2012). However, various activities of man which have contributed negatively to our ecosystem include but not limited to; untreated wastes from processing and manufacturing industries, agricultural activities, landfills to mention but few. In addition, oil spills through oil pipe vandalization and bunkering activities by youth in the Niger Delta region is one of the major consequences for the declining predominant population of fishes in the seas and rivers aside plants on land and water (Osuagwu and Olaifa, 2018).

Opulari and Ibaba (2008) and Kori-Siakpere (2000) reported that exploration and exploitation activities may lead to aquatic toxicological effects which are deleterious to aquatic life. Previously, Kafada (2012) stated that, the Nigeria National Petroleum

Cooperation (NNPC) warned that the act of illegal oil bunkering in the Niger Delta could expose the region to the worst environmental disasters ever faced in the country. Furthermore, the cooperation also disclosed that the country currently loses over 180,000 barrels of crude oil per day to "oil thieves" warning that if unchecked, such criminal activities could cripple the nation's oil and gas production.

Similarly, it was gathered that the Nigeria Extractive Industries Transparency Initiative (NEITI) has also raised an alarm over increasing rate of oil theft in parts of the Niger Delta, and urged government to declare a national emergency to tackle the menace of illegal bunkering in the sector (Safety4sea, 2011).

Oil bunkering which results to frequent oil spills on both surface water and land has change the chemical constituent and concentration on the soil surface, making benthic animal in contact with such oil vulnerable to contamination of hydrocarbon from oil spill, thereby threatening their health. Oil spills occurring as a result of bunkering activities have many adverse effects on the environment (Jacqueline and Merv, 2016) including air, land and water pollution thereby degrading the natural landscape, creates more ecological hazards, which endanger man, plants and other animals' convenience.

Previous reports have shown that the level of petroleum hydrocarbons in water and sediments of some creeks such as Ikoli Creek in Bayelsa (Ighariemu *et al.*, 2019), Kua/Kinabere Creek in Ogoni land (Wokoma, 2015), Qua-Iboe River, Ibeno, Akwa-Ibom (Inyang *et al.*, 2018), all in Niger Delta area of Nigeria were neither conformed to acceptable international guideline nor found below established permissible levels. This observation has been presumed to pose severe threat to aquatic organisms' survival as well as human over period of time. Ighariemu *et al.* (2019) reported Total Hydrocarbon Content and Total Petroleum Hydrocarbon in a range of 0.010 – 0.254 mg/L and 0.001 - 0.437 mg/L in water respectively while in sediments, the Total Hydrocarbon Content and Total Petroleum Hydrocarbon were in ranges of 0.01 – 1.43 mg/kg and 0.001 – 0.44 mg/kg respectively. In their report, it was found out that, the Total Hydrocarbon Content and Total Petroleum Hydrocarbon value in sediments increases across each of the sampling station in the study area and these hydrocarbons are reported to be repository in nature.

Similarly, Edori *et al.* (2021) reported variations in the concentration of hydrocarbons in both sediment and water within the month of January to June in water and sediment samples collected from effluent discharge points into the new Calabar River in River State. It was reported that hydrocarbons prefer the sediment phase to the water phase following the portioning of the hydrocarbons in both sediment and water matrices. Their work revealed the sediment to be the natural sink for aquatic pollutants while the high values of the THC in the aquatic media examined has been linked to anthropogenic influence in the study area.

Samuel *et al.* (2022) found out in his assessment on total hydrocarbon content in fresh surface water and sediments of Oyigbo communities in Rivers State that, the sediment had more total hydrocarbon content than the surface water, a usual expectation due to the fact

that sediment serves as a reservoir for the water. The sediment and water THC were found to be lower than the WHO permissible standard which is an indication of low risk level.

Mgboshimili Creeks which is along Iwofe River in the Niger Delta region of Nigeria is known for fishing, periwinkle picking and crab capturing and in recent time, it has become the route for transportation of illegal refined petroleum products. Thus, this study seeks to assess the level of petroleum hydrocarbon in the tissue of some marine organism and sediment of Mgboshimili Creek.

Statement of Research Problem

Mgboshimili Creek which is along Iwofe River in the Niger Delta region of Nigeria is the route for transportation of illegal refined petroleum products leading to high concentration of petroleum hydrocarbon in the polluted environment.

Materials and Method

Description of the Study Area: Mgboshimili Creek in Rumuolumeni axis is a mangrove wetland with Creeks that links up to the lower reaches of Iwofe River. The study was carried out for a period of six months (October 2020 – April 2021). The Creek is tidal in nature while the vegetation found are notably white mangrove (*Rhizophora*) and the biota found include oyster, mangrove, mudskipper etc. The source of pollution in this creek is the discharge of crude oil spillage from oil bunker and domestic waste. A reconnaissance visit was paid to the study area during which four sampling stations were indicated as shown in (Fig. 1)

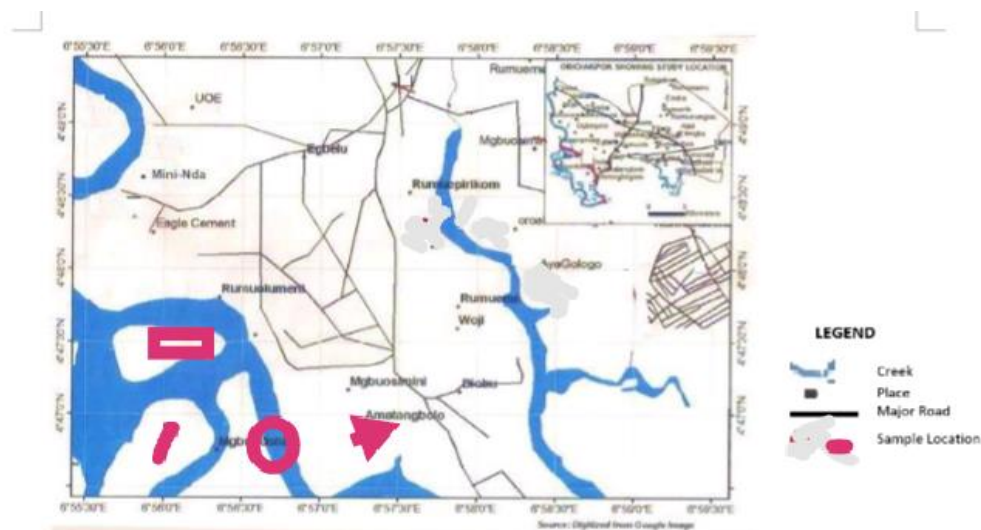


Fig. 1 Map of the study area showing the sampling stations

Station A (SSA): High disturbed area with recent oil spill during offloading of bunkers oil.

Station B (SSB): An extension of the main creek where loading of crude oil to commercial buyers took place.

Station C (SSC): Commercial boat terminals

Station D (SSD): Less activity area.

Sample Collection

Sample of fiddler's crab were captured alive by hand from the mudflats at low tide from each station while sample for oyster were cut out from the mangrove stem. These samples were stored in an ice chest prior to analysis in the laboratory.

Sediment samples were collected from the upper stations and were wrapped in aluminium foil. These samples were store in an ice chest before transporting to laboratory for analysis.

Preparation of Media Sample/Determination of Total Hydrocarbons (THC)

In the laboratory, after thorough washing with water, the samples were boiled to remove the edible tissues from the shell. The tissues were dried in the oven to constant weight. This was later crushed and 2 g of the crushed sample was weighed into a glass beaker followed by the addition of 20 ml of hexane, and with the aid of a glass rod, the mixture was stirred continuously, afterwards the sample was filtered in a glass furnace packed with cotton wool, silica gel and anhydrous sodium sulphate. Consequently, 10 ml of filtered organic extract was transferred into the calorimeter for detection. The detection limit for the THC was recorded to be 0.01 mg/kg.

Preparation of Sediment Sample/Determination of Total Hydrocarbons (THC)

The sediment sample were air-dried for four days after which it was macerated and then sieved through alum for total hydrocarbon determination. 5.0 g each of the sieved samples were shaken on a Stuart flask for 10 minutes. The extracts were later filled to 50.0 ml mark with toluene of which 10 ml of the filtered organic extract was transferred into the calorimeter for detection (detection limit of 0.01 mg/kg).

Statistical Analysis

Data were analyzed and presented as mean $\pm$ SEM using one way analysis of variance. While, Duncan Multiple Range Test (DMRT) was used to compare means between groups. The confidence level was set at $p < 0.05$.

Result and Discussion

The concentration of total hydrocarbon (THC) in the different sampling stations throughout the period of study show different trends of variation in sample media and sediment (Table 1 and Figure 2).

Table 1: Total Hydrocarbon Level across Sampling Stations

Stations	Oyster(mg/kg)	Crab(mg/kg)	Sediments(mg/kg)
A	15.64±6.61 ^a	10.53±5.87 ^b	1190.58±599.34 ^a
B	14.78±6.24 ^a	8.09±3.50 ^{a,b}	584.93±283.21 ^b
C	10.55±3.92 ^b	4.52±3.01 ^c	204.22±127.85 ^c
D	1.39±1.39 ^c	1.44±1.44 ^d	2.23±2.23 ^d
Total	10.59±2.73^a	6.14±1.93^b	495.49±198.34^b

Data were expressed as mean ± Standard Error of mean; Different alphabets along the column indicate significance difference ($p < 0.05$) using Duncan Multiple Range Test (DMRT).

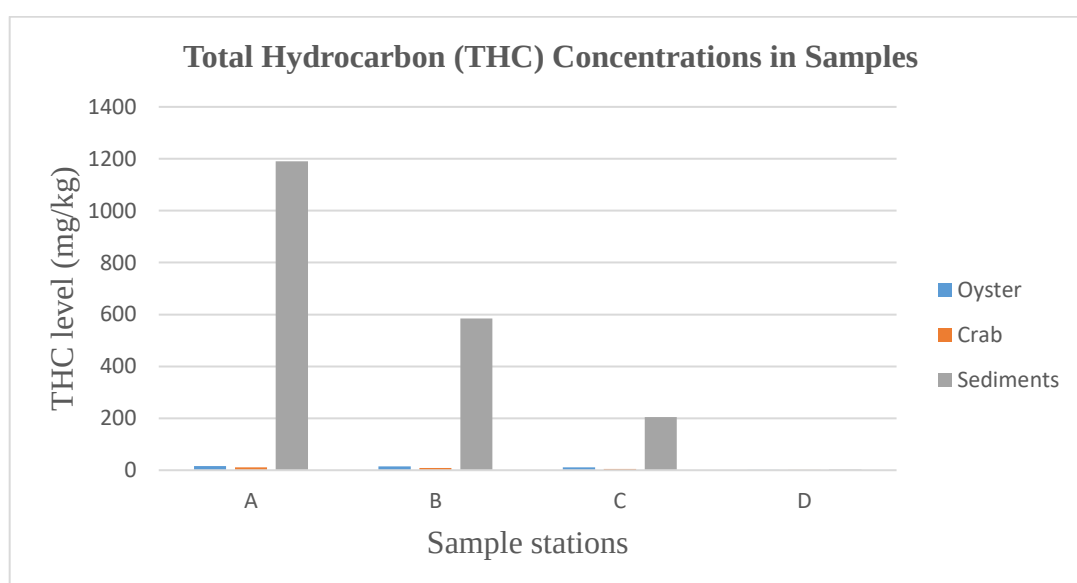


Figure 2: Total Hydrocarbon (THC) Concentrations in Samples across Sampling Stations

The result shows that sediment had the highest overall concentration (495.49±198.34 mg/kg) followed by oyster (10.59±2.73 mg/kg) while crab (6.14±1.93 mg/kg) has the least THC level.

Total hydrocarbon values were generally high within the biota found at *SSA*, *SSB*, and *SSC* than the corresponding control station *SSD*, thus indicating differences in the severity of impact. High hydrocarbon content causes oxygen deterioration by reduction in gaseous diffusion through the surface film of oil far reaching implications for the flora and fauna of the affected area (Osuji, 2004).

The mean value of THC level in oyster is higher than that of crab in all the stations under study, this explained that oyster is sedentary and grew on mangrove root, pillars of bridges and any permanent structure in the marine environment (Patricio, 2002). Consequently, oyster often gets contact with oil spillage during filter feeding process thus accumulate more hydrocarbons. In contrast, crab accumulate large quantities of particulate due to their

habitat and feeding nature. They are regarded as benthic feeders. This is of great concern due to high local consumption and commercial value of these organisms.

The higher concentration of THC in the sediment as compared to the organism is an indication that sediment is an important sink and repository for metals and PAH emitted from natural and anthropogenic sources. The variation in the pattern of the total hydrocarbon within study area implies that most of the hydrocarbons in sediment and biota were as a result of various human activities on going at the Creek. The lower levels in the control station (SSD) and in the least station (SSC) show that these were the concentration generally present in the area and anthropogenic sources may have added to the marine organism burden of THC in the environment. WHO permissible limit of total hydrocarbon (THC) in seafood is 0.001 mg/kg (Olaife, 2004). This suggest that the study area was generally contaminated with petroleum products. However, normal functioning of feeding, respiration and movement of marine organism may be adversely affected and continuous consumption of seafood from this area may pose some health risk implication in man.

The THC level in the sediment of this study was similar to the level (523.25 µg/g) reported by Ideriah (2006) and the level (339.2 µg/g) reported by Eja *et al.* (2003) in the Niger Delta. However, the THC level (495.49±198.34 mg/kg) in the sediment of this study was lower when compared to the values (1,403±80.61 – 3,755±113.144 mg/kg) reported by Wokoma (2015) and (400-6,205 mg/kg) by Adesuyi (2016) in other tidal creeks in the Niger Delta.

Elsewhere, Adenji *et al.* (2019) recorded 1107±22.10 µg/kg and 112.30±17.07- 657.30±95.14 µg/g reported by Howard *et al.* (2012), this notwithstanding, is higher than 2.15-36 µg/kg reported by Olayinka *et al.* (2018) in Atlas Cove, Lagos.

More so, the observed THC in the tissue of the media from this study was very low when compared with the 1098.5 µg/g reported by Asagbra *et al.* (2015) but higher to the findings of Gijo *et al.* (2016) who recorded a range of 0.017-0.023 mg/kg. The concentration of THC was above the permissible limit (0.001 mg/kg) set by WHO. Thus, the level in the organism calls for concern as it can have some health risk in man who is the final consumers.

Conclusion

In conclusion, sediment shows higher level of THC in all sampling station except that of control. Levels of THC in biota species investigated justified the claim on hydrocarbon bioaccumulation potentials, which could have been acquired through ingestion and feeding habit of the aquatic biota. Thus, these biological organisms (crab, oyster) have been identified as standard bio-indicator of aquatic pollution owing to their capability to bioaccumulate and bioconcentrate organic pollutant.

Recommendation

Based on the findings and conclusion drawn from this research, the following recommendations were suggested:

- The need for regular monitoring of petroleum products contaminated area is very necessary and must be encouraged for risk assessment purpose;
- Rural dwellers need to be sensitized on the danger of transportation of illegal refined petroleum products and indiscriminate discharge of crude oil spillage from oil bunker and domestic waste which may impact the creek negatively;
- Aquatic biota which are sources of food in this community are encouraged to be regularly checked for bioaccumulation and biocentration of petroleum hydrocarbon which may pose severe threat to their health when consumed.

Conflict of Interest

The authors declare, there are no competing interest in submission and publication of this article.

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