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Research Article

Total Hydrocarbon in Surface Water of Taylor Creek in the Niger Delta Region of Nigeria

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Abstract

Hydrocarbon is among the environmental contaminants especially in the crude oil and natural gas producing areas. This study assessed the level of total hydrocarbon in surface water of Taylor creek, Niger Delta, Nigeria. Triplicate water samples were collected from 12 locations in Taylor creek along Polaku and Agbia in Yenagoa local government area of Bayelsa state between November 2013 to July 2014. The hydrocarbon was extracted using n-hexane and analyzed using spectrophotometer. The total hydrocarbon content ranged from 0.48 – 1.30 mg/l across the 6months and 12 locations of study. Analysis of variance showed that there was significant variation ($p<0.05$) among the various locations for each of the months. Based on months, the highest values during the dry season occurred in January (0.85±0.19 mg/l) and wet season in June (0.79±0.03 mg/l). The total hydrocarbon content was lower than World Health Organization limits of 10 mg/l for inland water resources, an indication of low hydrocarbon contamination in the creek. Hence, anthropogenic activities that could impact on the hydrocarbon content is very minimal in the surface water of Taylor creek. In addition, the values were apparently lower in dry season compared to wet season which was not significant ($p>0.05$) indicating no major variation due to season.

Keywords: Aquatic Ecosystem; Hydrocarbon; Niger Delta; Surface Water Contaminants

Introduction

The threat to the various ecosystems and their resources has increased probably due to increased environmental degradation. Authors have reported that anthropogenic activities (due to industrialization, urbanization, unsustainable agricultural practices) as the leading factor contributing to environmental degradation and to a lesser extent through natural affects [1, 2]. Previous research reported that human activities such as deforestation, logging, bush burning has long term impacts on the environment and its useful resources that play several ecological roles to humans [2,3].

Surface water resources abound in the Niger Delta and they are called by different names depending on their size including rivers, streams, creeks, creeklets, rivulets, lakes and ponds. In many areas, each of these surface water resources have specific names which is often named according to community/state or name of prominent feature in the area. Izah and Srivastav [4] reported that about 10 Nigerian states are named after water bodies. These surface water bodies are grouped into estuarine, fresh and brackish water. The basic differences are majorly due to salt concentration and other vital characteristics. The surface water is home to several plankton (phytoplankton, zooplankton and algae), fishes, aquatic mammals, sea birds etc [4]. In many part of Nigeria, surface water especially (fresh water) is used for domestic purposes (cooking, washing, bathing) and drinking. The potability of surface water resources have been widely studied with regard to microbial [5], heavy metals [6] and general physicochemical characteristics [7-9].

In the coastal region of Nigeria especially in Bayelsa state, many surface water receives waste stream from several human activities including markets and household [10-12]and slaughterhouse [8, 13]. Even sewage are directly discharged into the surface water through the use of pier toilet system in some coastal water ways in Bayelsa state [1, 7, 9, 14].

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The Niger Delta is the Nigerian oil and gas province. The resources of the area (petroleum) is majorly used in financing Nigerian government budgets. The exploration and transportation of crude oil is carried out in both onshore and offshore in the area. The pipelines cut across several geographical features such as surface water. In addition, instances of crude oil spill resulting from equipment failure and vandalisms have been reported to impact on the receiving environment (soil, water) [2, 15-17].

Several human activities are carried out in banks of rivers including automobile workshops and dumps of different wastes with diverse constituents, and through runoff these wastes could end up in surface water resources. Hence there is the need to frequently assess water quality. Several parameters such as physicochemical, microbial, heavy metals and hydrocarbon content are commonly used to assess the quality of water resources. Specifically, hydrocarbon especially polycyclic aromatic provides information about genotoxic, mutagenic, carcinogenic of these environmental contaminants that can persist in the ecosystem. In the environment, degradation due to the activities of indigenous degrading microbes, volatilization and phytolysis do occur. These changes have the tendency to alter the constituents of hydrocarbon in the environment. Hence, this present study aimed at determining the level of total hydrocarbon in surface water of Taylor creek in the Niger Delta region of Nigeria.

Materials and Methods

Study Area

According to Alagoa [18], Taylor creek is a lotic, non-tidal fresh water resource that stretch from Biseni Clan to Gbarian clan in Yenagoa local government area of Bayelsa State. The creek is a tributary of Orashi River and empties into the River Nun. A total of 12 sampling locations viz: A (Izewaribi), B (Oku-oba), C (Amase-pou), D (Imbiyai-oba), E (Kala-oba), F (Obunagha), G (Opu-oba), H (Pini-oba), I (Court Kiri), J (Ogboloma), K [Etelebou (Kemie)] and L (Unka) was established between Polaku and Agbia in Yenagoa Local Government Area of Bayelsa State, Nigeria. In the study area, some common activities include boating, fishing and artisanal dredging are frequently carried out in the creek. Wastes are discharged into the creek by some residents close to surface water resources. Two predominant seasons occur in the area including wet season (April to October) and dry season (November to march of the following year). The relative humidity and temperature of the area is 50- 95% and 29±8^{o}C, respectively all year round.

Sample Collection

Pre-rinsed 1liter container was used to collected water samples (in triplicate) from the sampling locations (A – L) at a depth of 20 – 30 cm from Taylor creek in the Niger Delta between November 2013 and July 2014 covering the 2 major seasons (wet and dry). The samples were immediately transported to the laboratory in an ice box.

Total Hydrocarbon Content Determination

Total hydrocarbon content was determined using e-hexane as extraction solvent. Then after spectrophotometer was used to determine the total hydrocarbon content at wavelength of 420nm following the method previously described by Dumka and Kingdom [19].

Statistical Analysis

Statistical package for social science (SPSS) was used for the statistical analysis. The data were expressed as mean ± standard error. One way analysis of variance was carried out at p = 0.05, and Duncan multiple range test was used to discern the source of the observed variations. The chart was plotted using Graph Pad Prism 5.

Materials and Methods

Total Hydrocarbon content in surface water of Taylor creek in the Niger Delta region of Nigeria is presented in Table 1. The values ranged from 0.52-0.86 mg/l in November, 0.51-0.88 mg/l in December, 0.48-0.83 mg/l in January, 0.56-0.86 mg/l in May, 0.57-1.30 mg/l in June, 0.53-1.15 mg/l in July. There was significant difference ($P<0.05$) at all locations of study for each of the months studied. The mean values are presented for each of the months in Figure 1. In November, December, January, May, June and July the mean concentrations of total hydrocarbon were 0.69±0.02 mg/l, 0.68±0.02 mg/l, 0.85±0.19 mg/l, 0.71±0.02 mg/l, 0.79±0.03 mg/l and 0.71 ± 0.03 mg/l, respectively. Statistically, there was no significant variation ($p>0.05$) across the various months of study. In summary the total hydrocarbon content in this study ranged from 0.48 – 1.30 mg/l. The values of total hydrocarbon content in the surface water was lower than World Health Organization limit of 10 mg/l for inland water resources [19].

The values obtained in this study were lower than the values previously reported in surface water system. Wokoma [20] reported total hydrocarbon content in Kua/Kinabere Creek, in Ogoni land – an estuary of the Bonny River, sub- surface seawater in the range of 15.6 – 23.4 mg/l.Clinton et al. [21] reported total hydrocarbon content values of 4.07 – 45.71 mg/l in lower reaches of the New Calablar River in the Niger Delta.Dumka and Kingdom [19] reported total hydrocarbon concentration in Otamiri River (around Isu, Opiro, Umuechem, Nchokocho and Igboh) Rivers State in the range of 3.65 – 17.48 mg/l.

Uzoekwe and Oghosanine [22] reported total hydrocarbon content in Ubeji creek Warri receiving treated refinery and petrochemical effluents in the range of 2.83 – 2.85 mg/l. But close to the values (0.80 – 2.32 mg/l)reported in Kolo creekby Seiyaboh and Yowei [23]. In this study the low values are an indication that the hydrocarbon impact in the creek around the study area is very minimal, possibly caused by non-oil and gas activities in the creek. Basically, hydrocarbon is of environmental interest because they are toxic to human, plants and animals at certain concentrations over a prolonged period of exposure. Beside crude oil exploration, hydrocarbon could leach into the ecosystem through poor management of oily wastes, spillage of crude oil products during transportation especially in the inland water ways. Surface run-off from mechanic workshops, domestic waste that contain hydrocarbon could also be a source of hydrocarbon in aquatic ecosystem. Based on season, the values were lower during the dry season compared to wet season. The higher values in wet season could be due to increased activities and/ or run off resulting from anthropogenic activities close to the surface water resources.

Table 1: Total Hydrocarbon content (mg/l) in surface water of Taylor creek in the Niger Delta region of Nigeria

Locations	November 2013	December 3013	January 2014	May 2014	June 2014	July 2014
Izewaribi	0.86 ± 0.06^{g}	0.88 ± 0.01^{h}	0.78 ± 0.00^{d}	0.82 ± 0.00^{abc}	1.30 ± 0.10^{e}	1.15 ± 0.01^{f}
Oku-Oba	0.64 ± 0.02^{bcd}	0.64 ± 0.01^{c}	0.63 ± 0.03^{bc}	0.66 ± 0.00^{abc}	0.68 ± 0.01^{ab}	0.63 ± 0.02^{c}
Amase-pou (Koroama)	0.71 ± 0.03^{cde}	0.63 ± 0.00^{c}	0.64 ± 0.00^{bc}	0.71 ± 0.03^{ab}	0.77 ± 0.07^{bcd}	0.65 ± 0.01^{c}
Imbiyai-oba (Koroama)	0.58 ± 0.03^{ab}	0.57 ± 0.01^{b}	0.60 ± 0.10^{bc}	0.67 ± 0.07^{a}	0.68 ± 0.03^{ab}	0.58 ± 0.01^{b}
Kala-oba (Obunagha)	0.77 ± 0.07^{efg}	0.71 ± 0.00^{ef}	0.66 ± 0.01^{c}	0.73 ± 0.01^{abc}	0.75 ± 0.01^{bc}	0.68 ± 0.00^{c}
Obunagha	0.52 ± 0.01^{a}	0.51 ± 0.00^{a}	0.48 ± 0.00^{a}	0.56 ± 0.00^{c}	0.57 ± 0.01^{a}	0.53 ± 0.01^{a}
Opu-oba	0.61 ± 0.03^{bc}	0.57 ± 0.01^{b}	0.55 ± 0.03^{ab}	0.58 ± 0.00^{bc}	0.77 ± 0.01^{bcd}	0.74 ± 0.02^{d}
Pini-oba	0.73 ± 0.01^{def}	0.73 ± 0.00^{f}	0.67 ± 0.07^{c}	0.74 ± 0.00^{abc}	0.75 ± 0.02^{bc}	0.68 ± 0.01^{c}
Court Kiri	0.68 ± 0.00^{bcde}	0.69 ± 0.00^{de}	0.63 ± 0.01^{bc}	0.71 ± 0.03^{abc}	0.75 ± 0.02^{bc}	0.66 ± 0.01^{c}
Ogboloma	0.70 ± 0.03^{cde}	0.68 ± 0.00^{d}	0.77 ± 0.01^{bc}	0.66 ± 0.01^{abc}	0.71 ± 0.03^{b}	0.64 ± 0.02^{c}
Etelebou (Kemie)	0.66 ± 0.00^{bcde}	0.67 ± 0.00^{d}	0.83 ± 0.00^{d}	0.77 ± 0.02^{ab}	0.83 ± 0.03^{cd}	0.75 ± 0.01^{d}
Unka	0.83 ± 0.03^{fg}	0.84 ± 0.02^{g}	0.62 ± 0.01^{d}	0.86 ± 0.00^{a}	0.88 ± 0.00^{d}	0.82 ± 0.00^{e}

Data were expressed as mean ± standard error; Different superscript letters along the column indicate significant difference at $p<0.05$ according to Duncan multiple range test statistics

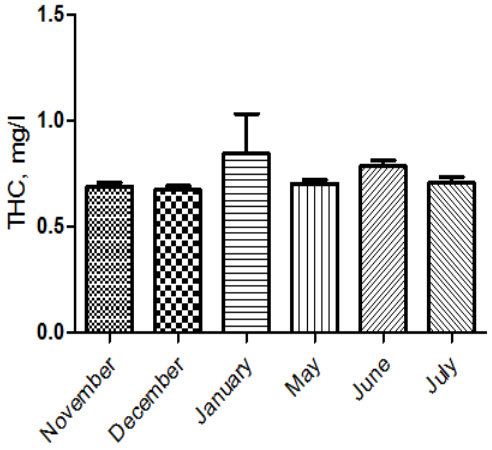

Figure 1: Mean values of Total Hydrocarbon content across the various months of study in the study Area

Conclusion

This study assessed the level of total hydrocarbon in surface water of Taylor creek, Bayelsa state, Nigeria. The results showed that the values were lower than World Health Organization limits of 10 mg/l in inland water resources. This indicates low hydrocarbon level in the surface water of Taylor creek. Though the values were apparently lower during the dry season compared to wet season which was not statistically different ($p>0.05$), an indication of no major seasonal influence.

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