Assessment of Physicochemical Quality of Sediment from Kolo Creek, Niger Delta

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ABSTRACT

This study investigated the physicochemical characteristics of sediment from Kolo creek, Niger Delta Nigeria. The samples were collected between August to September 2015 and analyzed using standard procedures. Results showed that pH, conductivity, total Nitrogen, total organic Carbon, total Hydrocarbon, Calcium, Potassium, Sodium, Magnesium, Nitrate, Phosphate, Sulphate and Chloride concentration of the sediments ranged from 6.74 - 6.82, 228.32 - 225.03 μScm^{-1} , 5.36 - 6.01%, 6.00 - 6.42%, 6.66 - 7.00%, 10.23 - 11.12 mg/kg, 6.66 - 7.33mg/kg, 8.63 - 9.31 mg/kg, 4.27 - 5.08mg/kg, 6.03 - 6.82mg/kg, 4.77 - 5.62mg/kg, 5.89 - 7.66 mg/kg and 5.96 - 6.31 mg/kg respectively. Analysis of variance showed that there are no significant variations ($P>0.05$) among the locations for each of the parameters. High concentration of nutrients (cations and anions) suggests the influence of anthropogenic activities on the sediment quality of Kolo creek.

Keywords:

Environmental Contaminants, Kolo creek, Physico-chemical assessment, Surface water

INTRODUCTION

The Niger Delta region is one of the most productive regions in Nigeria. The region has several square kilometers of wetland, surface water, oil and gas facilities. As such, the region contributes significantly to Nigeria's foreign earnings. Besides oil and gas facilities, the region has several biodiversity including aquatic and terrestrial mammals, aves and reptiles and medicinal plants. Several plant species found in the region have medicinal properties including antimicrobial, anti-oxidants, pest repellent among others. However, probably due to over exploitation most of the biodiversity are threatened with some gone on extinction.

Due to industrialization and urbanization, the rate of environmental pollution has increased. Environmental contaminants are majorly caused by human activities and to a lesser extent natural effects (Ogamba *et al.*, 2016). Also, it appears that human activities on the ecosystem are increasingly leading to environmental pollution (Izah *et al.*, 2015). Among the environmental pollutants, the aquatic ecosystem appears to be the major recipient of both natural and human induced environmental pollutants. This is because soil and air - based contaminants could also be deposited in the surface water after precipitation via runoff.

The constituents of substances that could contaminate the environment determine its impacts. Most substances that cause environmental pollution especially in the aquatic ecosystem have physical, biological and chemical characteristics. Human activities on the water ways including swimming, fishing, boating/water transportation etc., affect the quality of the water and its associated sediments.

Sediments are earth materials such as sand, clay, silt that settles at the bottom of the water bodies. They are derived from several materials including decaying plants and animals, weathering processes, waste materials deposited on the surface water. Depending on the sediment characteristics or composition, it can either appear as suspended or deposited form.

Several water bodies exist in the Niger Delta. The characteristics of the water bodies have been severally reported in literature. For instance, in Bayelsa state some of the rivers that have been studied include River Nun (Agedah *et al.*, 2015; Ogamba *et al.*, 2015a), Ikoli creek (Ogamba *et al.*, 2015b; Seiyaboh *et al.*, 2016a), Kolo creek (Ogamba *et al.*, 2015c) Sagbama creek (Seiyaboh *et al.*, 2017a), Efi lake (Angaye and Mieyepa, 2015), Epie creek (Izonfuo and Bariweni, 2001) among others. Since these water bodies contain sediments, its quality has not been assessed as the water itself. Among the few studies that have been carried out on the sediment of water bodies in Bayelsa state are the works of Seiyaboh *et al.* (2017b) on Sagbama creek, Seiyaboh *et al.* (2016b) on Epie creek and Seiyaboh

et al. (2016b) on Ikoli creek. Information about the sediment physico-chemical quality is scanty in literature. As such, this present study investigates the physio-chemical quality of sediments from Kolo creek, Niger Delta region of Nigeria.

MATERIALS AND METHODS

Study Area

Kolo creek transverse through several communities; Otuasaga, Oruma, Imiringi (Ineginte *et al.*, 2010), Amurukani, Kolo 1, Kolo 2, Kolo 3, Emeyal 1, Emeyal 2 etc. Kolo creek is a non-tidal fresh water that has been urbanised and industrialized due to the presence of oil and gas infrastructure in the area (Ineginte *et al.*, 2010). Other economic activities carried out around Kolo creek include fishing, dredging, boating etc. Kolo creek is a major recipient of effluents from several anthropogenic activities (Ineginte *et al.*, 2010), and a breeding ground for several fish species (Seiyaboh *et al.*, 2016a). Kolo creek shares similar climatic conditions with other areas around Bayelsa state. Furthermore, the climatic condition of different areas in Bayelsa state has been widely reported in literatures by authors (Seiyaboh *et al.*, 2016a-c, 2017a,b; Ogamba *et al.*, 2015a-c, 2017; Agedah *et al.*, 2015; Aghoghovwia and Ohimain, 2014).

Sample collection and preparation

Triplicate sediment samples were obtained from three locations along Kolo creek including Kolo, Imiringi and Otusega using sediment grab in August to September 2015. The samples were properly labeled and packaged with aluminum foil. The samples were shade - dried and sieved using mesh prior to analysis.

Physico-chemical analysis of the sediment

The various parameters were analyzed based on standard analytical procedure previously described in literatures. Total hydrocarbon content was analyzed using ASTM D 9071B – 7 (Soxhlet Extraction Method) previously described by Aigberua *et al.* (2016a) and conductivity were analyzed based on the method described by Aigberua *et al.* (2016b). Other analytical procedures were employed for other parameters which include nitrate, sulphate, phosphate (Dewis and Freitas, 1970), calcium, potassium, sodium, magnesium (Nwakaudu *et al.*, 2012), pH (Bates, 1954), organic carbon (Akubugwo *et al.*, 2007; Osuji and Adesiyani, 2005) and nitrogen (Udoh and Ogunwale, 1986).

Statistical Analysis

Statistical analysis was carried out using SPSS. Data was expressed as mean $\pm$ standard error. One way

analysis of variance was used to show significance difference at $P=0.05$, and Duncan multiple range test statistics was used to show source of the observed difference.

RESULTS AND DISCUSSION

Table 1 presents some of the physico-chemical properties of the sediment samples from Kolo creek, Niger Delta Nigeria. The pH, conductivity, total nitrogen, total organic carbon and total hydrocarbon concentration ranged from 6.74 - 6.82, 228.32 - 225.03 μScm^{-1} , 5.36 - 6.01%, 6.00 - 6.42% and 6.66 - 7.00 mg/kg respectively. The concentration of calcium, magnesium, sodium and potassium ranged from 10.23 - 11.12 mg/kg, 6.66 -

7.33mg/kg, 8.63 - 9.31 mg/kg and 4.27 - 5.08 respectively. Nitrate, Phosphate, Sulphate and Chloride concentration ranged from 6.04 - 6.82 mg/kg, 4.77 - 5.62 mg/kg, 5.90 - 7.66 mg/kg and 5.96 - 6.31 mg/kg respectively. There was no significant variation ($P>0.05$) in the different locations for each of the parameters. Lack of variations among the various locations for each of the parameters studied is an indication that the anthropogenic natural activities in the locations the samples were obtained from were basically the same. Higher nutrient (cations and anions) could be due to runoff resulting from rainfall. Wastes discharge into the water could also settle at the bottom of the surface water to form sediment (Seiyaboh *et al.*, 2017b). High concentration of total hydrocarbon content suggests the effects of oil field facilities in Kolo creek.

Table 1: Physiochemical properties of sediment samples from the study area

Parameters	Station 1	Station 2	Station 3
pH	6.82±0.42a	6.74±0.11a	6.75±0.05a
Conductivity, μScm^{-1}	234.33±36.14a	228.32±35.59a	225.03±34.20a
Total nitrogen, %	6.01±1.54a	5.78±1.88a	5.36±1.73a
Total organic carbon, %	6.42±0.67a	6.23±0.49a	6.00±0.36a
Total hydrocarbon, mg/kg	7.00±0.99a	7.18±0.81a	6.66±0.75a
Nitrate, mg/kg	6.82±0.09a	6.29±0.25a	6.03±0.32a
Phosphate, mg/kg	5.62±0.41a	5.16±0.47a	4.77±0.46a
Sulphate, mg/kg	7.66±0.11a	6.36±0.53a	5.90±0.46a
Chloride, mg/kg	6.31±0.24a	6.27±0.24a	5.96±0.14a
Calcium, mg/kg	10.23±5.45a	10.57±5.49a	11.12±5.70a
Magnesium, mg/kg	6.66±0.58a	6.88±0.64a	7.33±0.58a
Sodium, mg/kg	8.63±0.56a	8.91±0.64a	9.31±0.70a
Potassium, mg/kg	4.27±0.27a	4.67±0.35a	5.08±0.36a

Data is expressed as mean $\pm$ Standard deviation; the same letters across the row is not significantly different ($P>0.05$) according to Duncan Multiple Range Test (DMRT) statistics

The values observed in this study has most of its parameters higher than the values previously reported in sediments in other surface water in Bayelsa state. Seiyaboh *et al.* (2016b) reported pH (6.67– 6.77) total nitrogen (2.64– 9.20%) which is close to the values of this study, conductivity (435.17– 1189.50 μhmosc^{-1}) which is higher than the values of this study, and nitrate (2.87– 7.59 mg/kg), sulphate (1.06 – 3.81mg/kg), (phosphate (0.09– 0.42mg/kg), calcium (3.92– 6.88mg/kg), magnesium (2.46–4.82mg/kg), sodium (2.18 – 4.82mg/kg), potassium (1.59–3.34mg/kg), total organic carbon (8.48- 22.5 4%) and total hydrocarbon content (1.20–4.68 mg/kg) which were lower than the values of this present studies. Seiyaboh *et al.* (2016c) also reported physicochemical quality of sediments from Ikoli creek to have values of 6.46 – 7.25 (pH) and 134.33

– 600.00 μhmosc^{-1} (Conductivity) which are within the values obtained in this study, 2.11 –3.15mg/kg (nitrate), 0.13 –0.39mg/kg (phosphate), 0.28–1.31 mg/kg (sulphate), 2.53- 6.76mg/kg (calcium), 1.07 -1.76mg/kg (potassium), 1.07- 2.84 mg/kg (sodium), 1.21– 3.82 mg/kg (magnesium), 2.31- 6.81 mg/kg (total hydrocarbon) and 3.35 -8.27% (organic carbon) which is lower than the values obtained in this present study. Seiyaboh *et al.* (2017b) reported sediments from Sagbama creek to have a value of 6.73 – 6.87, 423.53 – 2033.56 μhmosc^{-1} , 2.43 – 4.57mg/kg, 1.30 – 4.20mg/kg, 2.43 – 5.10mg/kg, 4.04 – 6.20mg/kg, 4.77 – 6.12mg/kg, 4.21 – 8.62mg/kg, 1.65 – 2.80mg/kg, 3.35 – 5.50% and 6.73 – 10.73 % for pH, conductivity, nitrate, sulphate, phosphate, calcium, magnesium, sodium, potassium, total nitrogen and organic carbon. Among the

parameters determined by Seiyaboh *et al.* (2017b), potassium, calcium, sulphate, nitrate were lower compared to the findings of this study, while sodium, magnesium, phosphate, total organic carbon and pH were close to the values recorded in this study. Differences in the physicochemical quality of the sediments from this study compared to previous studies could be attributed to variation in anthropogenic activities carried out in the different water bodies. Typically, sediment quality of water bodies is influenced by human activities and natural effects. Since the study area compared and literature values used for comparison (Sagbama creek, Epie creek and Ikoli creek) has similar climatic requirements. As such the variation is due to human activities.

CONCLUSIONS

The Niger Delta region of Nigeria has several surface water in different sizes including river, pond, creeks, lake, creeklets, stream etc. Surface water are the major recipient of environmental contaminants, which are washed into the water through runoff resulting from precipitation. This study assessed the physico-chemical quality of sediments from Kolo creek. Results showed that the sediment of the creek is high in nutrient (cations and anions), which suggested the effect of runoff and anthropogenic activities in the creek. The concentration of total hydrocarbon content were high indicating the impacts of oil field facilities along Kolo creek. Since surface water contains sediments, which act as habitat to several benthic organisms. Therefore, it is necessary to assess the concentration of minerals and other possible contaminants of surface water and sediment to avoid potential effect on organisms found in surface water and its sediment.

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