Biotechnol Res 2017; Vol 3(1):20-24
eISSN 2395-6763

ORIGINAL RESEARCH

Assessment of Water quality from Sagbama Creek, Niger Delta, Nigeria

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• *Received: 28 October 2016* • *Revised: 23 December 2016* • *Accepted: 04 January 2017* • *Published: 10 January 2017* •

ABSTRACT
This study evaluated the physico-chemical properties of Sagbama creek. Samples were collected from 5 locations at sub depth of 5 to 15cm in triplicate. The water was analyzed using standard procedures. Resulted showed that pH (6.13 to 6.95). Temperature (26.6 to 27.2^{0}C), Turbidity (21.80 to 23.03NTU), Conductivity (60.57 to 67.33 µhmoscm^{-1}), Dissolved oxygen (6.13 to 8.01mg/l), Total hardness (3.10 to 3.82mg/l), Total dissolved solid (30.09 to 33.52mg/l), Nitrate (0.12 to 0.13mg/l), Nitrite (0.07 to 0.10mg/l), Sulphate (0.52 to 2.62mg/l), Chloride (2.27 to 3.33mg/l), Sodium (1.40 to 2.18 mg/l), Potassium (0.64 to 1.06mg/l), Calcium (1.01 to 2.22 mg/l), Magnesium (0.63 to 0.85mg/l), Iron (0.02 to 0.35mg/l) and Manganese (0.01 to 0.02mg/l). Analysis of variance showed that there is significance difference ($P<0.05$) among the various parameters except for temperature, pH and turbidity. High turbidity is an indication of pollution. Instances of pH and iron exceeding permissible limit recommended by Standard Organization of Nigeria suggests contamination.

KEY WORDS: *physico-chemical water parameters, Sagbama creek, surface water, water pollution*

Introduction

Surface water sources include rivers, streams, creeks, creeklets, ponds and lakes (Agedah *et al*., 2015; Izah and Srivastav, 2015; Izah and Ineyougha, 2015; Izah *et al*., 2016). Like groundwater, surface water are also a source of potable water supply in Nigeria especially river and streams. Surface water is usually drunk in communities aligning surface water, and area groundwater supply (i.e. borehole) is inadequate or not available. Generally, water quality is a challenge confronting many countries especially in developing country like Nigeria (Chukwuma *et al*. 2013; Izah *et al*., 2016). For instance, poor quality potable water supply is linked to low budgetary funding, inefficient government policies, corruption, drought and other anthropogenic factors (Galadima *et al*., 2011).

The surface water resources often get contaminated by several factors. Runoff resulting from precipitation could wash the different substances in the environment into the water body. In coastal region, different type of municipal wastes is discharged into surface water especially in coastal communities in the Niger Delta. Market activities also discharge various wastes stream into water ways. According to Izah and Angaye (2016) waste management and surveillance is grossly inadequate in developing country like Nigeria. Wastes in water could lead to variation in the water quality parameters. Depending on the concentration of the substances washed into the water, it could affect the aquatic biota such as fisheries (Dabai *et al*. 2013; Izah and Angaye, 2016) and aquatic weeds especially in water bodies with low current.

Water quality parameters are used to ascertain various indices of the water including its suitability for consumption,

aquatic life such as fisheries, pollution indices.

Several studies have been carried out on water quality of several river and creek within Bayelsa state including Kolo creek (Ogamba *et al*., 2015a; Aghoghovwia and Ohimain, 2014), Nun River (Ogamba *et al*., 2015b; Agedah *et al*., 2015; Nyananyo *et al*., 2007), Ikoli creek (Ogamba *et al*., 2015c). But information about water quality of Sagbama creek is scanty in literature, hence the need for this study.

Materials and Methods

Study Area

Sagbama Creek is one of the numerous creeks in Bayelsa state. Sagbama creek is a tributary of River Nun and its close to Obuluru Camp, Gberude Camp and Torugbene. Sagbama creek is located in Sagbama Local Government Area of Bayelsa State. Like other region in the Niger Delta, Nigeria, Sagbama creek area shares similar environmental and climatic condition peculiar to the Niger Delta region of Nigeria.

Sample Collection

A field sample collection was undertaken between June and July 2014 to Sgabama creek. Five sampling location was established including Tungbo, Tungabiri, Bolou, Agoro and Kabi. The sampling bottles/containers were rinsed three with the water at each sampling spot before the collection of sample. In each location water sample were collected as subsurface (i.e. depth of about 5 – 15cm below surface) in triplicates including upstream, mid-stream and downstream using 1 Litre container. The water samples were preserved accordingly depending on the parameter to be analyzed. The samples were transported in ice blocks cooler to the laboratory prior to the analysis.

Physicochemical and heavy metal analysis

The physico-chemical parameters such as pH, temperature, turbidity, conductivity were analyzed in-situ using digital meter, while total dissolved solids, dissolved oxygen, chemical oxygen demand, nitrate, nitrite, chloride, sulphate, total hardness, calcium, magnesium, sodium, iron and manganese were analyzed following the method previously described by Ademoroti (1996), APHA (1998).

Statistical analysis

SPSS software was used to carry out the statistical analysis. A one-way analysis of variance was carried out at P = 0.05, and mean separation was carried out using Duncan multiple range test statistics.

Results and Discussion

Table 1 presents the physico-chemical properties of Sagbama creek. The pH ranged from 6.13- 6.95. There was no significant variation (P>0.05) across the various station. The pH value in this study suggests that the water is near neutral. This findings is comparable to previous works on surface water in Bayelsa state including Kolo creek (Ogamba *et al*., 2015a; Aghoghovwia and Ohimain, 2014), Nun River (Ogamba *et al*., 2015b; Agedah *et al*., 2015; Nyananyo *et al*., 2007), Ikoli creek (Ogamba *et al*., 2015c). Apar from Agoro, the pH of the water is within 6.5 – 8.5 limits for drinking water as specified by SON (2007).

Temperature ranged from 26.6 to 27.2^{0}C, being not significantly different (P>0.05) across the various station. Temperature trend in this study is has some similarity with previous works on surface water in Bayelsa state including Nun River (Ogamba *et al*., 2015b; Agedah *et al*., 2015), Ikoli creek (Ogamba *et al*., 2015c), but lower than the values previously reported in lower Kolo creek by Aghoghovwia and Ohimain (2014). The temperature of the water is within the ambient air temperature of the region (Agedah *et al*., 2015). Again, the water temperature is ambient depending on the period of the day and prevailing climatic condition during sampling exercise.

Turbidity ranged from 21.80 – 23.03NTU, being not significantly different (P>0.05) across the stations during the study. The absence of significant variation suggests that the water polluted frequently from wastes materials. The turbidity in this study is lower than values of previous works on surface water in Bayelsa state including river nun and some its tributaries like river Igbedi (Agedah *et al*., 2015), Kolo creek (Aghoghovwia and Ohimain, 2014; Ogamba *et al*., 2015a), Nun river (Ogamba *et al*., 2015b), The variation in turbidity values might be a reflection of anthropogenic activities of the inhabitants aligning the coastal settlement (Agedah *et al*., 2015; Ogamba *et al*., 2015b). Again variation could be due period/season sampling. Turbidity concentration exceeds 5NTU recommended by Son (2007) for drinking water.

Conductivity value range from 60.57 to 67.33 µhmoscm^{-1}, being significantly different (P<0.05) among the various locations. The conductivity in this study is similar to the work

Table 1: Physico-chemical parameters of water samples from Sagbama creek, Bayelsa state

Parameters	Agoro	Bolou	Kabi	Tungbo	Tungabiri
Temperature (^{O}C)	26.67 ^{a}	27.01^{a}	26.80 ^{a}	27.25 ^{a}	26.93^{a}
pH	6.13 ^{a}	6.87 ^{a}	6.93 ^{a}	6.95 ^{a}	6.86^{a}
Turbidity, NTU	22.17 ^{a}	21.80 ^{a}	22.02 ^{a}	23.03 ^{a}	22.47 ^{a}
Conductivity, µhmoscm^{-1}	67.33 ^{c}	63.77 ^{b}	65.23 ^{bc}	63.40^{b}	60.57 ^{a}
Dissolved Oxygen mg/l	6.13 ^{a}	6.77 ^{b}	6.22 ^{ab}	8.01^{c}	7.40 ^{c}
Total dissolved solid, mg/l	33.52 ^{c}	31.87 ^{b}	32.55 ^{bc}	32.09 ^{bc}	30.23 ^{a}
Biological Oxygen Demand, mg/l	5.03 ^{a}	5.62 ^{ab}	5.32 ^{a}	7.05 ^{c}	6.77^{bc}
Nitrite, mg/l	0.07 ^{a}	0.07 ^{a}	0.08^{ab}	0.10^{b}	0.09 ^{ab}
Nitrate, mg/l	0.12 ^{ab}	0.13 ^{ab}	0.13^{ab}	0.13^{c}	0.12 ^{a}
Chloride, mg/l	2.27 ^{a}	2.57 ^{b}	3.03 ^{c}	3.33^{d}	2.53^{b}
Sulphate, mg/l	2.62 ^{c}	1.71 ^{b}	2.30 ^{c}	1.45^{b}	0.52^{a}
Total Hardness, mg/l	3.10 ^{a}	3.43^{b}	3.20^{ab}	3.82 ^{c}	3.10^{a}
Sodium, mg/l	2.09 ^{b}	1.53 ^{a}	2.18 ^{b}	2.12^{b}	1.40^{a}
Potassium, mg/l	1.06 ^{c}	0.82 ^{ab}	0.94^{bc}	0.93^{bc}	0.64^{a}
Calcium, mg/l	2.09 ^{b}	1.90 ^{b}	2.13 ^{b}	2.22 ^{b}	1.01^{a}
Magnesium, mg/l	0.85 ^{b}	0.76 ^{a}	0.80 ^{b}	0.65 ^{a}	0.63^{a}
Iron, mg/l	0.02 ^{a}	0.10 ^{b}	0.05 ^{a}	0.35 ^{c}	0.10^{a}
Manganese, mg/l	0.01^{a}	0.01 ^{ab}	0.02 ^{bc}	0.02 ^{c}	0.01 ^{ab}

Data is expressed as mean; Different superscript letters along the row indicate significance difference (P<0.05)

of other authors in surface water in Bayelsa state including Tombia bridge construction area (Seiyaboh *et al*., 2013a), dredging area in Igbedi creek (Seiyaboh *et al*., 2013b), river nun (Agedah *et al*., 2015), Ikoli creek receiving effluents (Ogamba *et al*., 2015c), Kolo creek (Ogamba *et al*., 2015a) but lower than the work of Aghoghovwia and Ohimain (2014) in lower Kolo creek. Generally, the magnitude of conductivity is a useful indication of the total concentration of the ionic solutes (Ogamba *et al*., 2015b). Conductivity is within 1000µS/cm specified for drinking water by SON (2007).

Dissolved oxygen ranged from 6.13 – 8.01mg/l. Basically, there was significance difference (P<0.05). The dissolved oxygen in this study is comparable to the concentration previously reported in surface water in Bayelsa state including Kolo creek (Aghoghovwia and Ohimain, 2014), However, the dissolved oxygen were lower than the values reported in River Nun (Agedah *et al*., 2015), dredging area in Igbedi creek (Seiyaboh *et al*., 2013b), Tombia bridge construction area (Seiyaboh *et al*., 2013a). Dissolved oxygen is unstable parameters that could change with prevailing climatic condition. As such the variation could be to the time of the sampling (Agedah *et al*., 2015). The dissolved oxygen observed from this study suggests that the aquatic organism such as fisheries is getting the required oxygen need for survival (Agedah *et al.,* 2015).

Total hardness of the water ranged from 3.10 to 3.82mg/l, being significantly different (P<0.05) among the various locations. The total hardness in this study is similar to the work of previous authors in surface in water in Bayelsa state including River Nun (Ogamba *et al*., 2015b), but lower than the values reported in Kolo creek by Ogamba *et al*. (2015a). The hardness of the water is an indication of the ability of the water to tolerate high soap concentration. The total hardness value observed reflects on the calcium and magnesium content of the water. The concentration of total hardness is far lower than permissible limit of 150mg/l (SON, 2007).

Total dissolved solid ranged from 30.09 to 33.52mg/l, being significantly different (P<0.05). The findings of this study has some similarity with previous work on surface water including river Nun (Ogamba *et al*., 2015b; Agedah *et al*., 2015), Kolo

creek (Ogamba *et al*., 2015a), Ikoli creek receiving effluents (Ogamba *et al*., 2015c), dredging area at Igbedi creek (Seiyaboh *et al*, 2013b). but lesser than the value reported in Tombia bridge construction area (Seiyaboh *et al*., 2013a), lower Kolo creek (Aghoghovwia and Ohimain, 2014). Biochemical oxygen demand ranged from 5.03 to 7.05mg/l, being significantly different (P>0.05). The changes in the monthly distribution could be associated to the flow rate of the water during the period as well as the pollution index. The biological oxygen demand in this study is higher than the concentration previously reported in surface water in Bayelsa state including Tombia bridge construction area (Seiyaboh *et al*., 2013a), dredging area in Igbedi creek (Seiyaboh *et al*., 2013b), lower Kolo creek (Aghoghovwia and Ohimain, 2014). This could be associated to the amount of substances that could inhibit oxygen into the water. The total dissolved solid concentration of the water is lower than the allowable limit of 500mg/l for potable as recommended by SON (2007),

Anion parameters studied ranged from 0.12 to 0.13mg/l (Nitrate), 0.07 to 0.10mg/l (nitrite), 0.52 to 2.62mg/l (sulphate), 2.27 to 3.33mg/l (chloride). Basically there was significance difference (P<0.05). The various concentration of anion nutrients reported has some similarity with previous work from surface water in Bayelsa state including Kolo creek (Aghoghovwia and Ohimain, 2014; Ogamba *et al*., 2015a), river nun (Ogamba *et al*., 2015b), Ikoli creek (Ogamba *et al*., 2015c), Tombia bridge construction area (Seiyaboh *et al*., 2013a). The variations that exist could be due to underling anthropogenic activities peculiar to the area. Furthermore, discharge of organic materials into the water and runoff may have resulted to anions found in the water (Ogamba *et al*., 2015b). The various anions concentration is far lower than the permissible limit recommended for potable water by SON (2007).

Cation concentration ranged from 1.40 to 2.18 mg/l (sodium), 0.64 – 1.06mg/l (potassium), 1.01 – 2.22 mg/l (calcium), 0.63 – 0.85mg/l (magnesium). Basically there was significance difference (P<0.05) in the various cation concentrations. The concentration of cations reported this study has some similarity with the work of Ogamba *et al*. (2015a) on Kolo creek; Ogamba *et al*. (2015b) in river nun. The low exchange cations is an indication that aquatic plants such as water hyacinth has taken up most of these nutrients for their growth (Ogamba *et al*., 2015b). Typically, these cations are abundant in the environment including soil and water especially. The various anions concentration is far lower than the permissible limit recommended for potable water by SON (2007).

The heavy metal concentration in the water ranged from 0.02 to 0.35mg/l (iron) and 0.01 – 0.02mg/l (manganese), being significantly different among the various concentration. The concentration observed in this study is comparable to the work of other authors from surface water in Bayelsa state including Kolo creek (Ogamba *et al*., 2015a), 0.023 – 0.463 mg/l from River Nun (Ogamba *et al*., 2015b). Instances of iron exceeding the permissible limit for drinking water (0.3mg/l) as recommended by SON (2007) were observed. Iron is one of major element found in the Niger Delta environment that has been attributed to the Geology of the area (Ohimain *et al*., 2013). But its low concentration in the aquatic ecosystem could due to dilution effects of the river. Basically, iron concentration is a reflection of the acidity of the water (pH). This is in agreement with the pH of the water (Ogamba *et al*., 2015b).

Conclusions

This study investigated the physicochemical quality of Sagbama creek in Bayelsa state. The water samples were within the permissible limit for potable water as recommended by SON apart from few instances such as pH, iron, and turbidity which did not conform to standard. As such the water should not be drinked without appropriate treatment.

Acknowledgements

This publication is based on part of undergraduate project work of Solomon Oweibi supervised by Dr. Enetimi Idah Seiyaboh at Niger Delta University.

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