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Water Quality Evaluation of Abakpa River in Ogoja Local Government Area Cross River State

Samuel HS and Etim EE*

Department of Chemical Sciences, Federal University Wukari, Nigeria

***Corresponding author:** Emmanuel E Etim, Department of Chemical Sciences, Federal University Wukari, Taraba State, Nigeria, Email: emmaetim@gmail.com

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Abstract

The quality of water in Abakpa River was investigated in this study. The physical, chemical, and bacteriological parameters were evaluated. The results showed that the temperature, conductivity, total chlorine, free chlorine, nitrate, nitrite were within the recommended WHO and NISDWQ standards and pH result showed a value of 5.72 which is acidic and falls below the recommended standards of 6.50-8.50 by WHO and NISDWQ. The total dissolved solids, and total suspended solids, were below the permissible limits by WHO standards. Bacteriological parameters showed that the water sample had no coliform (total coliform) and Ecoli contamination; hence, water from the river is suitable for consumption. In order to maintain the current quality status of the river water in the area, sewage and refuse disposals should be avoided, regular monitoring by relevant authorities concerned as well as proper treatment of the water before making it available to the public were suggested. The results of this study may vary with other research, due to changes in environmental factors, climate change and hence indigenes should be sensitized on the health hazards associated with the direct or indirect pollution of the river to protect the health and well-being of the community.

Keywords: Water Quality Evaluation; Abakpa River; Cross River State

Introduction

Water is the most abundant chemical compound on the earth. It covers about 70% of the earth surface, appears in nature in all three common forms of matters (solid, liquid, gas); water vapour and cloud in the sky, seawater in the oceans, icebergs in the Polar Regions, fresh and salt water lakes, rivers and aquifers in the ground. Rivers are large natural stream of water emptying into an ocean, lake, or other bodies of water and usually fed along its course by converging tributaries. Although they contain only about 0.0001% of the total amount of water in the world at any given time, rivers are vital carriers of water and nutrients to areas all around the earth. The water within a river is generally collected from precipitation through surface runoff, groundwater recharge and release of stored water in natural reservoirs, such as a glacier. Anthropogenic influences as well as natural processes degrade surface waters and impair their use for drinking, industrial, agricultural, recreation or other purposes.

The importance of water cannot be over emphasized as it is use in domestics, industries, chemically as it is a good solvent for dissolving many solid, serving as an excellent coolant both mechanically and biologically and acting as reactants in many chemical reactions among others and the importance of water cuts across every fields of study. It's notable that humans can survive without food for certain periods but cannot survive without water hence the need for safe and clean drinking water.

However, strictly speaking Surface water bodies

are highly prone to pollution, and this coupled with the anticipated future development of the area make it necessary to carry out a baseline water quality evaluation study. The objectives of the present work are.

- Collection of water samples from Abakpa River in Cross River State of Nigeria.
- Analysis of a few quality parameters viz., pH, total hardness, free chlorines, nitrites, nitrate, total coliform, turbidity, electrical conductivity, *E Coli*, temperature, total dissolved solids and total suspended solids
- Assessment of the suitability of Abakpa river for human consumption based on World Health Organization and Nigerian Standard for Drinking Water Quality.

Materials and Methods

Study Area

Ogoja is a Local Government Area in Cross River State, Nigeria. It is located at the Northern part of Cross River State. It's headquarter is in the town of Ogoja, in the north-east of the area near the A4 highway latitude 6° 37'52N and longitude 8° 49'24'E. it has an area of 972km^2 and a population ranging from 5,000 to 10,000 at the 2006 Census [1-9]. The town was one of the providences during pre-colonial independence [10-13]. The Abakpa River located in Abakpa community, is a free-flowing surface water (fresh water). Abakpa River in Ogoja Local Government Area is a perennial stream with its characteristic meanders [14]. The major activities in and around the river include fishing, sand dredging, pumping water for artificial irrigation, industrial and constructional purposes. Other activities include nursing of improved palm seeds, farming, making of vegetable gardens, laundry activities, domestic waste disposal and washing of automobiles (Figure 1). There is also an abattoir at some point upstream. Observation showed that there is direct defecation into the river at all seasons but becomes more obvious during the dry season as a result of drop in river stage [15-16].

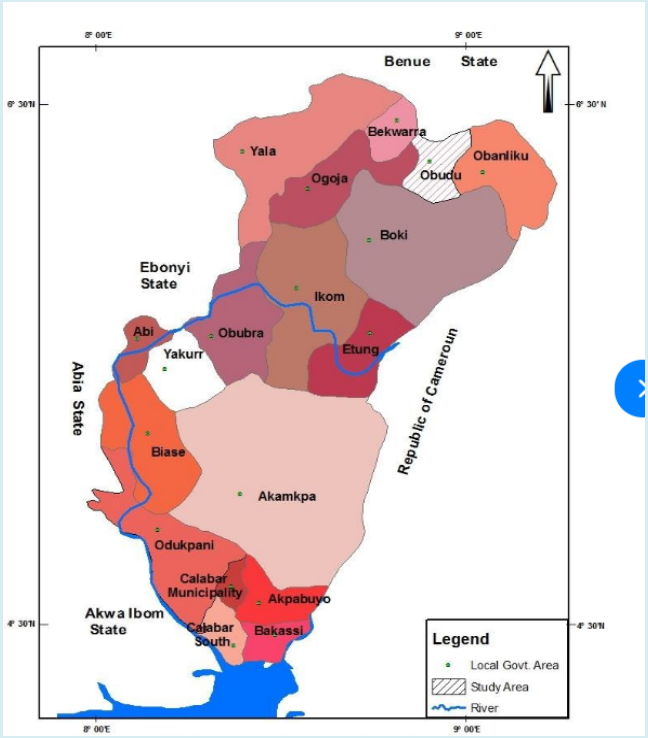

Figure 1: Map of Cross River State showing the study area (Ogoja LGA) [17].

Sample Collection

The Samples were collected and stored in a 250-mL plastic bottles. The plastic bottles were pre-treated by washing with dilute HCl (0.05m) and later rinsed with distilled water and the river water sample. The samples were collected by taking few steps into the water body, rinsing the plastic bottles with the river water and finally filling the bottle with the sample.

Physio-Chemical Analysis

The physical and chemical properties were determined and they include Temperature (^{0}C), pH, Conductivity(µs/

cm), Turbidity (NTU), Total dissolved solid (mg/L), Total suspended solid (mg/L), free chlorine (mg/L), total chlorine (mg/L), and total hardness (mg/L). The following analysis was carried out using modified procedures described in [18-20].

Biologhical Analysis

Total coliform (CFC/100mL), and E.coli CFC/100mL are the biological parameter that was considered in this study.

Results and Discussion

The results obtained in Table 1 shows the physio-chemical and bacteriological values from the water sample obtained in Abakpa River, whereas, Table 2 shows the water quality standard from the World Health Organizations (WHO) and Nigerian Industrial Standard for Drinking Water Quality (NISDWQ) [20-21]. The result of the analysis showed that the temperature value obtained is 27.7°C and the temperature range from the WHO standard ranges from 25-35°C, whereas they are no guidelines for the NISDWQ. The temperature value obtained shows that it falls within the WHO standard [22]. According to Missouri Department of Natural Resources and Environmental Service Programme, water temperature can fluctuate hourly, daily, monthly and seasonally due to spring discharge, the quantity and velocity of stream flow and over hanging canopy of stream vegetation providing shades that help buffer the effect of temperature changes [23].

S/N	Parameter(Units)	RW
1	Temperature(^{0}C)	28
2	pH	5.7
3	Conductivity (ms/cm)	24
4	Turbidity (NTU)	9
5	Total dissolved solid(mg/L)	6.6
6	Total suspended solid(mg/L)	0.2
7	Free chlorine(mg/L)	Nil
8	Total chlorine(mg/L)	Nil
9	Nitrate(mg/L)	50
10	Nitrite(mg/L)	50
11	Total hardness(mg/L)	17
12	Total coliform(CFC/100ml)	0
13	E.Coli (CFC/100ml)	0

Table 1: Physical and chemical concentration of water sample obtained from Abakpa River.

Parameters/unit	WHO	NIS
Conductivity(us/cm)	1-500	1000
Turbidity(NTU)	0-5	0-5
Temperature (^{o}C)	25-35	No guideline
pH	6.5-8.5	6.5-8.5
Colour (HU)	Jan-20	Jan-20
Free chlorine (mg/L)	0.2	0.2
Total chlorine(mg/L)	0.5	0.5
Total dissolved solids(mg/L)	1000	500
Total suspended Solids(mg/L)	0.2	0.01
Magnesium(mg/L)	No guideline	100
Calcium(mg/L)	No guideline	75
Total hardness(mg/L)	No guideline	100
Iron(mg/L)	No guideline	0.03
Manganese(mg/L)	0.5	0.05
Sulphate (mg/L)	500	100
Nitrate(mg/L)	50	10
Nitrite(mg/L)	50	0.02
Chloride(mg/L)	250	100
Fluoride(mg/L)	1.5	1.5
Nickel(mg/L)	0.02	0.02
Ammonia(mg/L)	No guideline	1
Lead(mg/L)	0.01	0.01
Cobalt(mg/L)	No guideline	0.1
Chromium(mg/L)	0.05	0.05
Copper(mg/L)	2	1
Total heterotrophic count 100ml	0	0
Total coliform count/100ml	0	0
Faecal coliform count/100ml	0	0

Table 2: Drinking water standards, recommended by World Health Organization and Nigerian Industrial Standard for Drinking Water Quality [19].

The pH value can be depicted to the acidicity or alkalinity of the water sample and in this study, pH was found to be 5.72.

This shows that the pH range obtained for the river water samples 5.72 falls below the recommended range of 6.50 to 8.50 [24] hence it is acidic. High pH levels are undesirable since they may impart a bitter taste to the water due to the alkalinity. Furthermore, the high degree of mineralization associated with alkaline water will result in the encrustation of water pipes and water-using appliances. High pH levels lower the effectiveness of disinfection by chlorine, thereby requiring the use of additional chlorine or longer contact times [25]. The pH of most natural water bodies range from 6.5 to 8.5 while the deviation from neutral pH is as a result of free carbon dioxide or bicarbonate in the water body [26]. The ability of that water to conduct electricity is determined by the use of a conductivity meter. Its unit is micro Siemens per centimeter (μs/cm). Table 1 shows the conductivity value obtained from the analysis as 23.8, and this value is within the WHO and NISDWQ standards and hence cannot pose any aquatic damages.

Turbidity refers to the degree of cloudiness in the water and occurs as a result of suspended solids and dissolved solids in the water. The turbidity affects the clarity of the water and presents an unpleasant look of the water. From the data collected using a turbidity meter, the value obtain was 9.01 NTU which shows the water was turbid compared to the standard from WHO and NISDWQ. The increase in turbidity of the river is caused by different factors such as soil particles, and plankton through sediment runoff that enters the river bank, erosion and farming activities etc. The total dissolved solid and total suspended solid shown in table 1 is 6.60 and 0.2 respectively. The total suspended solid refers to the concentration of suspended solids or particles in constant random motion in the water sample. The suspended solids is said to affect the turbidity of a sample. It is determined by measuring the difference between the weight of a filter paper before and after filtering the water sample whereas the total dissolved solids refers to all dissolved solutes present in water and it makes up about 60% of the conductivity value.

The WHO and NISDWQ standard ranges for TDS is 1000 and 500mg/L respectively and this shows that the water sample is below the range hence, it is good but for the total suspended solids, the data obtained in table 1 shows the value meets the WHO standard and is beyond the NISDWQ range and can still be considered good for drinking [27]. The concentration of free chlorine and total chlorine in water was 0.2 and 0.5mg/L respectively in accordance with WHO (2011) and NISDWQ standards respectively. The free chlorine and the total chlorine for this analysis was found to be 0.00mg/L as shown in Table 1 which is within the WHO and NISDWQ standard. Excess of chloride in inland water is usually taken as an indication of pollution; Chlorides are the most stable components in water with concentration usually unaffected by most natural physio-chemical or biological processes. Nitrate concentration depends on the activity of nitrifying bacteria which in turn get influenced by the presence of dissolved oxygen. In the present study the values of nitrate obtained were within the recommended standards for the water samples analyzed which shows a range of 50mg/L. Generally water bodies polluted by organic matter exhibit higher values of nitrate [28].

Total hardness of water is caused principally by the presence of calcium, magnesium, cations, other contributing cations include; iron, manganese, and aluminum. The associated anions are usually sulphate, chlorides, nitrates and bicarbonates. The presence of the above compounds in water normally causes it to react with soap to produce precipitate that appears as scum or curd on the water surface .Until enough soap has been dissolved to react with these compounds no lather is formed. Water which behaves like this is said to be hard. From the value obtained in table 1 it shows the total hardness is 17.0 mg/L and there is no standard from the WHO and the value falls within the range of standard from NISDWQ standard [29]. The bacteriological analysis was also carried out to test for the total coliform and E coli. Coliform are a family of bacteria commonly found in soils, plants and animals. One can come in contact with these bacteria by drinking (ingesting) contaminated waters in rivers.

The presence of coliform in water indicates the possibility, but not the certainty that disease organisms may also be present in the water. When total coliforms are absent there is a very low probability of disease organisms being present in the water [30]. Several methods are used to test for the microbes present in the water and few of these methods include; Membrane filtration techniques, plate count method and most probable number (MPN) but for the purpose of this analysis, membrane filtration technique was used [31]. This technique of microbial analysis is applicable for water sample that is non-turbid. Table 1 shows the absence of Total coliform and E.Coli which is within the limits of the WHO and NISDWQ standards, hence indicating the water were bacteria-free. But this is not a yardstick that the way is always coliform and E coli free, this result shows that when the sample was taken and analyzed they were no bacteria present. The water may contain bacteria as a result of activities such as runoff, domestics, human faeces etc [32-38].

Conclusion

Based on the assessment conducted on the water quality in Abakpa River, it can be deduced that the river's water quality parameters such as temperature, conductivity, total hardness, free chlorine, nitrate, nitrite, and TDS passed the assessment test whereas pH is below the acceptable

standard. From previous literatures it has been explained that a high level of pollution are caused by human and industrial activities within the watershed, including agricultural runoff, wastewater discharges, and improper disposal of solid waste. The levels of physical, chemical, and biological parameters analyzed in the water samples obtained showed that Abakpa River's water was fit for human consumption and other domestic purposes. Although, futre research may say otherwise due to other environmental factors and climate change. Therefore, it is important for the government and other relevant stakeholders to take immediate actions in enacting and enforcing strict laws concerning industrial and human activities around the river. Also, stakeholders should embark on public sensitization campaigns to educate the people on sustainable behavior toward the water bodies. These interventions will go a long way in improving the water quality of Abakpa River and safeguarding the ecosystem's integrity.

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