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# Analysis of chemical contaminants of cross river lotic water system at Oferekpe in Ikwo l. G. A., Ebonyi State

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**ABSTRACT**

*Chemicalcontaminants of water samples from lotic water system at Oferekpe in Ikwo Local Government, Ebonyi State, Nigeria, were studiedusing both classical and spectrophotometric methods. The mean values of results obtained showed the ranges for pH (6.5-8.5), temperature (27.00-28.00$^{o}$C), colour (5.0 HU), turbidity (3.00-6.00 NTU),total dissolved solid (25.00-85.00 mg/L),electrical conductivity (0.10-0.25 µS cm$^{-1}$), total hardness (0.31-1.68 mg/L), calcium hardness (0.11-0.24 mg/L) and magnesium hardness (0.07-1.65 mg/L).Similarly, the results of the heavy metals and nutrients loads showedthe ranges for Zn (0.07- 1.65 mg/L), Fe (0.00- 0.01 mg/L), Mn (0.02-0.20 mg/L), Cl$^{-}$(50.00-300 mg/L), $NO_3^{-}$(0.00-20.00 mg/L) and $SO_4^{2-}$(0.01-2.00 mg/L).The results when compared to World Health Organization (WHO) and Standard Organization of Nigeria (SON) water quality standards showed that they were within permissible limits,except the pH and Cl$^{-}$. Although, the results do not presently indicate serious pollution, continuous monitoring is necessary to maintain quality and protect public health.*

**Keywords:**Chemical contaminants, lotic, water qualitystandards, Oferekpe.

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## INTRODUCTION

The quest for quality water has drawn the attention of many environmental researchers. This water quality is often described in terms of its physical, chemical and biological characteristics. Surface waters are the most vulnerable when you talk about the changes that occurs in them, both natural and manmade[10].The exploitation of the environment has been seen as one of major contributors of contamination of water bodies.Moreover, the rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture have caused heavy and varied pollution in aquatic environment leading to the deterioration of water quality and depletion of aquatic biota[9].Although, much investigation have been carried out, water quality parameters still calls for routine survey as they are constantly in random variation. Over the years, varying degrees of water-related diseases ranging from cholera, typhoid fever, cancer, [2], metal poisoning etc., have invaded different people at different times while many are still ignorant of the causative agents[8] Hence, it has become expedient to once in a while carry out a periodic study to update the public on the dangers of drinking contaminated water.

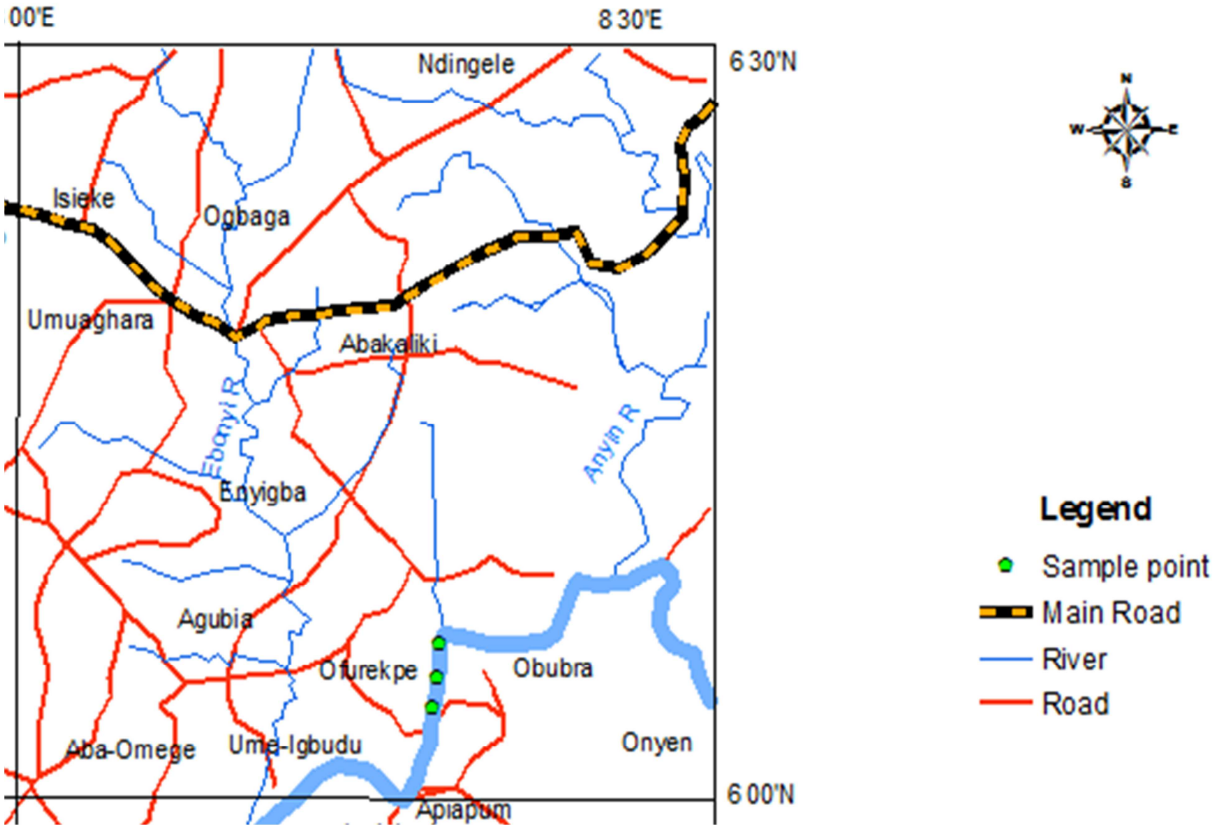
Ebonyi State is one of the states in the south eastern part of Nigeria surrounded by both lentic and lotic water bodies [15]. The quality of surface water is largely affected by natural processes such as weathering and soil erosion as well as anthropogenic inputs (municipal and industrial wastewater discharge). The anthropogenic discharges represent a

constant polluting source, whereas surface runoff is a seasonal phenomenon, largely affected by climatic conditions [2].

Oferekpe is one of the villages in Ikwo Local Government Area of Ebonyi State that houses the major water schemes of the state. The village being an agrarian area and located very close to mineral mining sites and hence prone to contamination from anthropogenic activities needs routine study of the physico-chemical parameters of the water sourced from the area so as to ensure that the quality parameters do not exceed the tolerable limits. Hence, this study has the objective of assessing the physicochemical, nutrient and selected metalconcentration of the water samples and compare the result with Word Health Organization (WHO) and Standard Organization of Nigeria (SON) guideline limit for potable water.

## MATERIALS AND METHODS

**Sampling Area/Procedures:**
Cross River – Oferekpe Lotic water is located at $5^{o}$ 56 49'' N, $8^{o}$ 34' 29''E global coordinates. The map of Abakaliki showing oferekpe, the samplinglocations is shown inFig. 1




**Procedure:**
Carefully cleaned and sterilized high density polythene containers with screw caps were used for the collection of the samples[3]. The samples were collected in the dry season(January,2012).Prior to other sterilization, all sample containers used for collection and storing of samples were washed with phosphate free detergent, soaked in 10% HCl for 24 hrs and finally rinsed severally with double distilled water [17, 11].The collection of the samples was done by simply and carefully dipping the container slowly alongside the current without disturbing the surface and development of any air bubble in the collection spot and in the container [5].A total of four samples (labeled A, B, C and D) were collected following strictly the above method of sampling.

To avoid the loss of some of the nutrients and trace metals of interest in the sample to bacteria and other micro-organism, the samples were stored in the refrigerator at the temperature of 4$^{o}$C.Furthermore, to prevent precipitation, adsorption of certain cations such as aluminum, cadmium, copper, iron, lead, manganese, silver and zinc [7] and maintain the stability of the oxidation states of the trace metals in the samples, few drops of 2 M $HNO_3$was[4] and also to maintain the sample pH below 2.0 [8].

**Analytical Procedures**

The chemical and physicochemical parameters determinations were carried out according to standard methods:

Parameters like temperature, pH, turbidity, total dissolved solid (TDS) and electrical conductivity (EC) were all determined in-situ using appropriate probes (all made by Hach Company, Loveland Colorado, USA).

In the laboratory, the samples were filtered using Whatman filter paper No. 42 and thereafter, the samples were divided into two parts, one for anoins and physicochemical parameters and the other, acidified with $HNO_3$ for metal analysis[2].Chloride ion wasdetermined by Mohr's method using 0.02 M silver nitrate solution as titrant and potassium chromate as indicator[7]. Total Hardness, Calcium ion $Ca^{2+}$hardness, and $Mg^{2+}$hardness, were determined by standard complexometric titrimetric methods [4] at the pH of 10 and 12 respectively. Nutrients like nitrate ($NO_3^-$ - N)and sulfate $SO_4^{2-}$ were evaluatedusing brucine and turbidmetric methods and concentrations determined at 410 and 495 nm respectively. Trace metals, Fe, Zn and Mn were also determined using atomic absorption spectrophotometric method [20] at wavelengths of 248.3 nm, 213. 9 nm and 220 nm [10].Reagents used for the analysis were allof analyticalgrade while distilled water used for the preparation of reagents were double distilled.

## RESULTS AND DISCUSSION

Tables 1 and 2 show the mean results of the physico-chemical and chemical parameters of the studied Oferekpe lotic River respectively as compared to standards.

**Table 1: Results of the Physico-chemical Parameters of the analyzed samples as compared with Standards (±%RSD) (n = 5)**

| Parameters Analyzed | Results Obtained | | | | WHO/SON Guideline |
|---|---|---|---|---|---|
| | Sample A | Sample B | Sample C | Sample D | |
| Colour (HU) | 5.0±0.00 | 5.0±0.00 | 5.0±0.00 | 5.0±0.00 | 15 |
| Temperature ($^{o}$C) | 27.0±0.00 | 28.0±0.00 | 28.0±0.00 | 28.0±0.00 | Ambient |
| pH | 7.2±0.40 | 6.8±0.40 | 6.9±0.36 | 8.5±0.00 | 6.5-6.9 |
| $Ca^{2+}$ Hardness (mg/L) | 0.11±1.00 | 0.24±1.00 | 0.25±1.00 | 0.11±1.00 | 75 |
| $Mg^{2+}$ Hardness (mg/L) | 0.07±0.65 | 1.65±0.05 | 0.15±0.65 | 0.12±0.48 | 50 |
| EC ($\mu S\ cm^{-1}$) | 0.21±0.10 | 0.10±0.00 | 0.10±0.00 | 0.25±0.00 | 1000 |
| Turbidity (NTU) | 3.00±0.20 | 5.00±0.30 | 6.00±0.30 | 5.00±0.30 | 5 |
| TDS (mg/L) | 30.0±0.40 | 26.0±0.40 | 25.0±0.50 | 85.0±0.50 | 500 |
| Total Hardness (mg/L) | 0.18±0.18 | 1.68±0.04 | 0.40±0.001 | 0.31±0.09 | 150-200 |

**Table 2: The Mean Concentrations of Nutrient and Heavy Metal loads of the analyzed samples as compared to Standards (±%RSD) (n = 5)**

| Parameters Analyzed | Results Obtained | | | | WHO/SON Standards |
|---|---|---|---|---|---|
| | Sample A | Sample B | Sample C | Sample D | |
| Chloride (mg/L) | 50.0±0.20 | 200.0±0.05 | 300.0±0.20 | 200±0.20 | 200 – 250 |
| Nitrate (mg/L) | 10.0±1.00 | 20.0±1.00 | 0.0±2.00 | 0.01±2.00 | 50 |
| Sulfate (mg/L) | 0.05±0.04 | 0.01±0.04 | 1.0±0.005 | 2.0±0.05 | 100 |
| Zn (mg/L) | 0.07±0.65 | 1.65±0.05 | 0.15±0.65 | 0.12±0.48 | 50 |
| Fe (mg/L) | 0.01±0.00 | 0.01±0.00 | 0.01±0.00 | 0.00±0.00 | 0.3 |
| Mn (mg/L) | 0.03±0.00 | 0.05±0.03 | 0.02±0.3 | 0.20±0.00 | 0.2 |

From Table 1 above, it could be seen that all the physico-chemical parameters except for turbidity and pH, of the studied river were all within the recommended guideline of the WHO, 2011 and SON 2007. The excess turbidity observed in sample C could be because of the increase loads of suspended matters in the water body. These suspended matters often include mud, clay and silt [7].Moreover, the slight increase in the pH could be linked to the anthropogenic activities going on around the tributaries of the river.

Although, excess of some of the physic-chemical parameters do not show adverse pollution in the water body[10], it is aesthetically not acceptable hence, serves as alarm that alert the public of the prevailing negative changes in the water body [11].

Chemical parameters such as nitrates, sulfates, chlorides and phosphates and trace metals occurin water as a result of the underlying rocks and other geological formation that characterize the water course and the anthropogenic activities within and across the tributaries of a water [ 6, 16]**.**The results of the nutrient loads were within prescribed limits except for chloride in sample C which is a bit above the permissible limit. Also, from Table 2, one could see that all the metals analyzed were all below the specified standards. However, accumulation of the nutrients over time will eventually result in eutrophication. Hence, it calls for regular monitoring.

**Table 3: Correlation Matrix of the Physico-chemical Parameters of the studied Lotic River. Significant level (0.5 < r < 1.0)**

| Parameters | Temp. | pH | $Ca^{2+}$ (mg/L) | $Mg^{2+}$(mg/L) | EC (µS $cm^{-1}$) | Turb (NTU) | TDS (mg/L) | TH (mg/L) |
|---|---|---|---|---|---|---|---|---|
| **Temp.** | 1.00 | | | | | | | |
| **pH** | 0.13 | 1.00 | | | | | | |
| **$Ca^{2+}$ (mg/L)** | 0.58 | -0.73 | 1.00 | | | | | |
| **$Mg^{2+}$(mg/L)** | 0.37 | -0.47 | 0.56 | 1.00 | | | | |
| **EC (µS $cm^{-1}$)** | -0.39 | 0.86 | -0.98 | -0.58 | 1.00 | | | |
| **Turb (NTU)** | 0.93 | -0.05 | 0.70 | 0.17 | -0.53 | 1.00 | | |
| **TDS (mg/L)** | 0.26 | 0.99 | -0.64 | -0.35 | 0.78 | 0.06 | 1.00 | |
| **TH (mg/L)** | 0.44 | -0.47 | 0.62 | 1.00 | -0.63 | 0.26 | -0.35 | 1.00 |

**Table 4: Correlation Matrix of the Nutrient and Heavy Metal loads of the analyzed samples. Significant level (0.5 < r < 1.0)**

| Parameters | Chloride (mg/L) | Nitrate (mg/L) | Sulfate (mg/L) | $Zn^{2+}$ (mg/L) | $Fe^{2+}$ (mg/L) | $Mn^{2+}$ (mg/L) |
|---|---|---|---|---|---|---|
| **Chloride (mg/L)** | 1.00 | | | | | |
| **Nitrate (mg/L)** | -0.38 | 1.00 | | | | |
| **Sulfate (mg/L)** | 0.45 | -0.82 | 1.00 | | | |
| **$Zn^{2+}$ (mg/L)** | 0.12 | 0.85 | -0.51 | 1.00 | | |
| **$Fe^{2+}$ (mg/L)** | -0.08 | 0.52 | -0.87 | 0.33 | 1.00 | |
| **$Mn^{2+}$ (mg/L)** | 0.05 | -0.39 | 0.81 | -0.19 | -0.99 | 1.00 |

**Statistical Analysis and Discussion**

From the correlation study, temperature iscorrelated to turbidityand $Ca^{2+}$hardness of the water body (Table3). Similarly, calcium and magnesium hardness is directly correlated with total hardness (Table 3) [19]. Moreover, calcium hardness is correlated to turbidity of the study area. This could be because, turbidity of a water body is as a result of mineralization of an area [13].

More so, from the result (Table 3), it could also be seen that pH has direct link with electrical conductivity and total hardness while electrical conductivity is correlated to TDS of the sampled water [13].

Also, from the correlation matrix, it could be seen that nitrate is correlated to $Zn^{2+}$and $Fe^{2+}$while sulfate is directly correlated to $Mn^{2+}$(Table 4). This may be because of discharge of agricultural or domestic wastes into the water body and the leaching of calcium carbonate and other minerals within the river course [13].

## CONCLUSION

Physicochemical parameters and some trace elements concentrations of the Cross River Lotic River have been assessed in this study. Results of the parameters assessed indicated that apart from chloride (which is slightly above the tolerable limit); other parameters analyzed were all within or below the acceptable limits for drinking water.

Nevertheless, routine monitoring is necessary to ensure that thethose parameters evoked in water quality do not exceed the tolerable limits as water parameters are subject to changes with time and activities(agricultural, industrial and mineral exploitation etc) along the water course.

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