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Physicochemical Analysis of Iyiba stream in Umuopia-Akokwa Imo state, Nigeria

Peace Ebubechukwu Anyalebechi [1,*], Eugenia Nonye Ojiako [2], Oluwasogo Isaac Adedokun [3], Ewemade Cornelius Enabulele [4], Ifechi Ezinne Nwaeze [5], Oluwasegun Temitope Adefemi [6] and Sunday Kaura [7]

[1] *Chukwuemeka Odumegwu Ojukwu University, Department of Pure and Industrial Chemistry, Faculty of Physical Science, Uli, Anambra State, Nigeria.*
[2] *Chukwuemeka Odumegwu Ojukwu University, Department of Pure and Industrial Chemistry, Faculty of Physical Science, Uli, Anambra State, Nigeria.*
[3] *Obafemi Awolowo University, Department of Pharmacy, Faculty of Pharmacy, Ile Ife, Osun State, Nigeria.*
[4] *Federal University of Technology, Department of Civil Engineering, School of Engineering and Engineering Technology, Akure, Ondo State, Nigeria.*
[5] *Chukwuemeka Odumegwu Ojukwu University, Department of Geology, Faculty of Physical Science, Uli, Anambra State, Nigeria.*
[6] *Federal University of Technology, Department of Biomedical Technology, School of Basic Medical Science, Akure, Ondo State, Nigeria.*
[7] *Veritas University, Department of Biochemistry, Faculty of Natural and Applied Science, Abuja, Nigeria.*

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Abstract

The physicochemical analysis of Iyiba Stream in Umuopia-village Akokwa was carried out using quantitative and qualitative analysis to analyze the physical parameters. It showed that parameters such as Turbidity (5.0 NTU), Conductivity (20.90 µs/cm), Hardness (402 g/l), Chlorine (58 g/l), Temperature 930.7 0C), Alkalinity (32 mg/l), Sulphate (171.19 mg/l), Total Dissolved Solids (37.82 mg/l), Total Suspended Solid (5.96 mg/l), Nitrate (1.50 mg/l) were within the World Health Organization (WHO) permissible limits for drinking water. While pH (6.11) of the water sample shows acidic and below the World Health Organization (WHO) standard limit which is against the World Health Organization (WHO) standard limit of 6.5 to 8.5. Also, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) with the values of 57. 40 (mg/l) and 149.33 (mg/l) respectively are above the WHO permissible limit which is against the WHO standard of 10 mg/l for BOD and 10-20 mg/l for COD. This might be due to the water been polluted by numerous debris or by anthropogenic activities. Hence all parameters determined were within or slightly above WHO safe limit for potable water. Low pH in the water sample can be treated by addition of lime in order to improve the water quality and make is safe for drinking.

Keywords: Waterborne; Pollution; Disease; Physicochemical

1. Introduction

Water is the major component of the earth's surface. It has been recognized as a major, if not the important societal need. It is indispensable to the efficient functioning of the ecosystem (Harter, T. 2003). It is a medium of life, more than 90% of the weight of any cell is made up of water and all metabolic processes or reactions are based on water. Water is a universal solvent, it is very important to all forms of life and it is the main natural resources affected by global warming (Ofoegbu, C.1998). Water contains a variety of dissolved and suspended substances. However, water for drinking must

* Corresponding author: Peace Ebubechukwu Anyalebechi
Chukwuemeka Odumegwu Ojukwu University, Department of Pure and Industrial Chemistry, Uli, Anambra State, Nigeria

be safe for human consumption and must be properly assessed to determine its physical, chemical and biological acceptability for intended purposes.

Many diseases in developing countries are caused by drinking contaminated water (Tar et al., 2009). This is because dead vegetation, metal leachates from solid waste dump, leaching of rocks, sewage, industrial wastes and agricultural chemicals return eventually to the river by run-offs (Ademola, 2008). Many diseases in the world today are caused by drinking polluted water and approximately 4 billion cases of diarrhea were reported in 2000 in developing countries (wright et al., 2004). All this happens because of the inability of government to provide clean water. Over one billion people in the world lack access to safe drinking water and 2.5 billion people do not have access to adequate sanitation services (Tar et al., 2009).

Hence the need for water quality studies to determine its potability for human use. This research work is aimed at examining the physical and chemical characteristics of *Iyiba* stream in Umuopia-Akokwa, Imo State as the only source of potable water of the inhabitants of the area. The primary purpose of this analysis of *Iyiba* stream is to ensure that drinking it is safe thereby reducing the problem of water borne diseases in the area.

2. Material and methods

2.1. Study area

Akokwa is situated in Ideato North local government area in Imo State, Nigeria. Its geographical coordinates are 5° 54' 0" North, 7° 7' 0" East. It is a populated town where people live and work.

Figure 1 Map of study area located in Akokwa

2.2. Sample Collection and Pretreatment

The sample container (five litres plastic container with a screw cap) was washed with detergent, leached with a concentrated HNO_3, rinse with distilled water until acid free and finally with the water source and corked tightly. The samples were collected directly from the stream source in Umuopia-Akokwa. The container was labelled with masking tape containing date and time and were kept in the laboratory refrigerator at 4^oC prior the analysis. Samples for heavy metals analysis were preserved by adding three (3) drops of concentrated nitric acid (Manilla and Frank, 2009).

2.3. Experiment

pH was measured by electrometric method using laboratory pH meter Hanna model H1991300 (APHA; 1998). Electrical Conductivity was measured with conductivity meter (APHA: 1998). Total dissolved solid was determined using APHA 2510 A TDS 139 tester (APHA: 1998). Total solids and Total Dissolved Solids were measured by gravimetric method (Wright et al., 2024). Total suspended solid was determined by subtracting the result of total dissolved solids from total solid. Total solids (TS)-Total dissolved solids (TDS) = Total Suspended solids (TSS) (APHA; 1998). Total Hardness was

done using titration method. Biochemical Oxygen Demand Determination was analysed using winkler method. Chloride and sulphate were determined according to APHA standard method (APHA: 1998). Nitrate was determined using PD303 UV spectrophotometer (APHA,1998). Chemical oxygen demand and dissolved oxygen was also analysed. Heavy metal analysis was analysed using Varian AA240 Atomic Absorption Spectrophotometer (AAS) according to the method of APHA 1998 (American Public Health Association).

3. Results

Table 1 shows the results of physicochemical and heavy metallic content analysis of *Iyiba* stream to access the quality of the water for domestic consumption.

Table 1 Physicochemical and heavy Metal Parameters of *Iyiba* Stream Sample

Parameters	**Concentration**
pH	6.11
Colour	Colourless
Turbidity NTU	5.0
Conductivity us/cm	20.90
Hardness mg/l	402
Chloride mg/l	58
Temperature ^{0}C	30.7
Taste	Non-objectionable
Alkalinity mg/l	32
Acidity mg/l	52.50
Sulphate mg/l	171.18
Total dissolved solid mg/l	37.82
Total solid mg/l	43.78
Total suspended solid mg/l	5.96
Nitrate mg/l	1.50
Oxygen demand mg/l	28.40
CO_2	57
Chemical oxygen demand mg/l	149.33
Chemical oxygen demand mg/l	57.40
OD_1	138.40
OD_5	81
Iron ppm	0.175

4. Discussion

The water sample was assessed based on many parameters on their physical and chemical contents of the samples, using World Health Organization (WHO) standard approved for drinking water. The results of the physicochemical analysis (Table 1) of the water shows that the water is colourless, odourless. tasteless and at room temperature, hence there were no deviations from the approved standards. It shows that most of the parameter fall within the standard value which shows that the water is relatively safe for human consumption though the water is not 100% pure when all the obtained values from the physical parameters which include odour, taste, colour, temperature were compared

with the standard values from the World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ).

The values obtained from the chemical parameters conducted on the water sample were compared with the standard values and nearly corresponds with the values approved by World Health Organization (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) except for the pH which shows acidic and fall below the World Health Organization permissible limit against the standard limit of 6.5 10 8.5, BOD, COD, and OD parameters were above the World Health organization (WHO) standards. Their concentrations were BOD (mg/l) = 57.40, COD (mg/l) = 149.33 and OD (mg/l) = 28.40 while the World Health Organization (WHO) standard limits is BOD (mg/l) =10, COD (mg/l) =10-20 and OD (mg/l) = 6.0. The acidity test conducted on the water samples show that mostly water samples contain little acidic property. This is in accordance with World Health Organization (WHO). Hence, the water can be treated with the addition of lime in order to improve its pH and make it safe for drinking.

Finally, with the use of Atomic Absorption Spectrophotometer (AAS), values obtained from the measurement of heavy metals such as iron, which has the amount of 0.175 ppm falls within the recommended standard limits of World Health Organization (WHO) and Nigerian standard for Drinking Water Quality (NSDWQ) of 0.3 ppm of iron suitable in any drinking water. The variation in the result of the stream water sample and that of the world Health Organization (WHO) approved standard values may be as a result of the water being polluted by numerous contaminants. Water pollution occurs where body of water is adversely affected due to addition of large amount of material to the water. When water is unfit for its intended use, water is considered polluted. Many causes of pollution including sewage and fertilizers which contains plants nutrients such as nitrate and phosphate.

In excess levels, nutrient over stimulate the growth of aquatic plant and algae exclusive growth of those types of organisms consequently clogs the water ways, this in turn proves very harmful to aquatic organism as it affects those organisms that live in water. Poultry farming is the source of many organic and inorganic pollutants in surface water and ground water. These contaminants include both sediment from erosion cropland and compounds of phosphorous and nitrogen that partly migrate in animal wastes and commercial fertilizers. Animal waste is high in oxygen demanding materials, nitrogen and phosphorous and they harbour pathogenic organisms. Wastes from commercial feeders are contained and disposed off on land. Their main threat to natural water therefore is from runoff and leaching.

5. Conclusion

This research revealed the physicochemical analysis of *Iyiba* Stream in Umuopia-Akokwa. From the obtained results of the physical and chemical analysis, it could be seen that the water is safe for human consumption although not 100% pure due to the BOD and COD which were high above the World Health Organization (WHO) maximum permissible limits. Hence for it to be declared 100% safe and pure for drinking, such water should undergo some certain level of treatment. This conclusion was drawn from the fact that nearly all the results of the analyzed parameters of the stream water were in accordance with that of the World Health Organization (WHO) standard.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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