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DETERMINATION OF THE PHYSICAL AND CHEMICAL PROPERTIES OF OKUMESHI RIVER

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ABSTRACT

Four water samples (two from upstream and two from downstream) were collected at the Okumeshi River and were tested for their physical and chemical properties. The physical properties analyzed for are total dissolved solid (TDS), turbidity, conductivity and pH while the chemical properties include sulphate, nitrate, sodium, potassium, iron, zinc, lead, calcium and magnesium. Results of analyses showed that the pH range from 7.01 – 7.06 for upstream and 7.11 – 7.14 for downstream with corresponding means of 7.40 and 7.10; TDS 291 and 293mg/L for upstream and 276 and 278mg/L for downstream with corresponding means of 292 and 277mg/L; conductivity 568 and 571µs/cm for upstream while 562 and 566µs/cm was detected at downstream with corresponding means of 570 and 564µs/cm; sulphate 57 and 56mg/l for upstream and 61.2 and 62.4 for downstream with corresponding means of 56.50 and 61.80mg/L; nitrate 16.70 and 18.20mg/L upstream and 21.1 and 20.2mg/L downstream with corresponding means of 17.50 and 20.70mg/L; magnesium 28.40 and 31.10mg/L upstream while downstream was 31.60 and 29.40mg/L with corresponding means of 27.50 and 30.50mg/L y; calcium 14.70 and 15.11mg/L upstream and 16.4 and 16.1mg/L downstream with corresponding means of 14.90 and 16.30mg/L; 9.20 and 10.70mg/L upstream and 8.11 and 10.09mg/L for downstream with corresponding means of 9.95 and 9.51mg/L while Iron, Zinc, and Lead recorded concentrations of 0.01mg/L upstream and downstream. River water pollution is not only an aesthetic problem, but a serious economic and public health problem as well. The results obtained in this research work provide that the characteristics of all the water parameters are within the permissible limits of the WHO.

Keywords: Upstream, Downstream, Pollution, Contamination And Water.

I. INTRODUCTION

Having safe water and basic sanitation is a human need and right for every man, woman and child. People need clean water and sanitation to maintain their health and dignity. Having better water and sanitation is essential in breaking the cycle of poverty since it improves people's health, strength to work, and ability go to school. Yet 884 million people around the world live without improved drinking water and 2.5 billion people still lack access to improved sanitation, including 1.2 billion who do not have a simple latrine at all (WHO/UNICEF, 2008). Many of these people are among those hardest to reach: families living in remote rural areas and urban slums, families displaced by war and famine, and families living in the poverty-disease trap, for which improved sanitation and drinking water could offer a way out. The World Health Organization (WHO) estimates that 88% of diarrhea disease is caused by unsafe water, inadequate sanitation and poor hygiene and as a result, more than 4,500 children die every day from diarrhea and other diseases. For every child that dies, countless others, including older children and adults, suffer from poor health and missed opportunities for work and education. The aim of the research is to determine the physical and chemical properties of Okumeshi in Amai in Ukwani West Local Government Area of Delta State, Nigeria

II. METHODOLOGY

Sampling

Four water samples were collected at the Okumeshi River. Two were collected from upstream while the other two were collected downstream making a total of four. Immediately after the collection, they were labeled and transported to the laboratory for physical and chemical analysis.

Heavy metals analysis

100mL each of water samples was analyzed for iron (Fe) zinc (Zn), lead (Pb), calcium (Ca) and copper (Cu) by using UV/Visible Spectrophotometer. Each of the metal standards was used to calibrate the instrument after which each sample was then tested by reading the absorbance at a specific wavelength of the parameter under analysis (Ekeayanwu et. al., 2010).

Sulphate (SO_4^{2-}) analysis

10mL each of the samples was added with 1mL of 6M HCl followed by 5mL of 70% sorbitol and were properly mixed and sulphates were noted at 470nm wavelength on a spectrophotometer. Standards were prepared with the same procedure and SO_4^{2-} were determined accordingly AOAC, 2003

Nitrate (NO_3^{2-}) analysis

25mL each of the samples was measured into a cylinder followed by the addition of a "Nitraver 6" pillow reagent powder so as to ensure NO_3^{2-} development and were homogenized and subsequently analyzed with a UV/visible spectrophotometer at wavelength of 550nm (HACK, 2002).

pH

The pH meter was standardized with a standard in a standard instrument with pH near that of water sample and then two others to check the accuracy of the electrodes. The water samples were then analyzed. A volume 10 ml each of the water samples were taken in a clean water beaker and pH measured by pH meter using Fisher Automatic tetrameter model 36-PH meter after standardization (AOAC, 2003)

Determination of total dissolved solids

10 ml each of the well mixed samples were titrated through a standard glass fiber filter and dried to constant weight at 180°C. The increase in dish weight represented the total dissolved solids.

Calculation

(A-B)×100

Mg total dissolved solids/L = sample volume (mL)

A = weight of dried residue + dish (mg)

B = weight of dish (mg)

Turbidity

Turbidity was measured by using turbidity meter Wag-WT-300 by taking 1ml water sample in cuvette. The result was displayed by Turbidity meter and noted (AOAC, 2003).

Electrical Conductivity (EC)

10mL each of the water samples were taken into a tube and the EC of all the water samples were determined by using EC meter LF-91

Statistical Analysis

Date from the experiment were presented as mean triplicate of analysis and were compared to the World Health Organization standard for portable water to check the waters portability and make logical conclusions about their safety.

III. RESULTS

Table 1: Results of physical properties of Okumeshi River

Location	pH	TDS (mg/L)	Turbidity (NTU)	Conductivity (µs/cm)
Upstream A	7.06	291	1.0	568
Upstream B	7.01	293	1.0	571
Downstream A	7.11	276	1.0	562
Downstream B	7.14	278	1.0	566

Table 2: Mean physical properties of Okumeshi River in comparison with WHO standard

Location	pH	TDS (mg/L)	Turbidity (NTU)	Conductivity (µs/cm)
Upstream	7.40	292	1.0	570
Downstream	7.10	277	1.0	564
WHO	6.5 – 8.5	500	5.0	1000 – 1500

Table 3: Results of chemical properties of Okumeshi River

Parameters	Upstream A	Upstream B	Downstream B	Downstream B
Sulphate	57	56	61.2	62.4
Nitrate	16.70	18.20	21.10	20.20
Sodium	28.40	31.10	29.70	30.40
Potassium	9.1	10.70	8.11	10.90
Iron	0.01	0.01	0.01	0.01
Zinc	0.01	0.01	0.01	0.01
Lead	0.01	0.01	0.01	0.01
Calcium	14.70	15.11	16.40	16.10
Magnesium	26.40	28.60	31.60	29.40

Table 4: Mean chemical properties of Okumeshi River in comparison with WHO standard

Parameters	Upstream	Downstream	WHO
Sulphate	56.5`	61.8	61.8
Nitrate	17.50	20.70	45
Sodium	29.80	30.50	30.50
Potassium	9.95	9.50	12
Iron	0.01	0.01	0.30
Zinc	0.01	0.01	15
Lead	0.01	0.01	0.05
Calcium	14.90	16.30	100
Magnesium	27.50	30.50	45

IV. DISCUSSION

Table 1 and 3 above showed the results of the physical and chemical properties of Okumeshi River with their corresponding means in tables 2 and 4

pH

The pH of the water ranged from 7.01 – 7.06 for upstream and 7.11 – 7.14 for downstream with corresponding means of 7.40 and 7.10 respectively. The pH of the water was in safe condition when compared with WHO range of between 6.5 and 8.5. The water is therefore slightly alkaline. In general, water with low pH (<6.5) could be acidic, soft and corrosive and these could leach metal ions such as Fe, Mn, Cu, Pb, and Zn from the aquifer. Such water with low pH could contain elevated levels of toxic metals, cause premature damage to metal piping and have associated aesthetic problems such as a metallic or sour taste, staining of laundry and the characteristics "blue-green" staining of sinks and drains. It is therefore pertinent that the waters analyzed which is acidic need to be treated by the use of a neutralizer which would help to prevent the water from reaction leading to further problems (Amjad et. al., 2010).

On the other hand, if the water in basic or alkaline (pH>8.5) which all the water are not, showed that such water is hard though does not pose a health risk but can cause scale formation and could make coffee taste bitter; this could also cause wastage of soap and detergents as foaming would be made difficult.

Exposure to extreme pH values results in irritation of the eyes, skin and mucous membranes. Eye irritation and exacerbation of skin disorders have been associated with pH greater than 11 while exposure to pH below 4 causes redness and irritation of the eyes (WHO, 1999).

Turbidity

Turbidity is a measurement of the cloudiness of water. It is measured by passing a beam of light through the water and measuring photometrically the light scattered at right angles to the beam. Result is expressed in nephelometric turbidity units (NTU). Water cloudiness is caused by material suspended in water. In this present study, the turbidity of the water was found to be 1.0NTU for both upstream and downstream samples with corresponding means of 1.0NTU which were found to be in safe limit compared with 5.0NTU maximum acceptable limit by WHO for portable water.

Total dissolved solid (TDS)

The TDS for the Okumeshi River was found to be 291 and 293mg/L for upstream and 276 and 278mg/L for downstream with corresponding means of 292 and 277mg/L respectively. The means obtained were within the acceptable standard of WHO which 500mg/L. Total dissolved solids levels less than 500 mg/L are considered to be good. Total dissolved solids indicate the amount of chemical substances dissolved in the water. At increasing levels, palatability decreases. Levels in excess of 1000 mg/L may produce a bad taste. Water used for irrigation can vary greatly in quality depending upon type and quantity of dissolved salts. Salts are present in irrigation water in relatively small but significant amounts. They originate from dissolution or weathering of the rocks and soil, including dissolution of lime, gypsum and other slowly dissolved soil minerals. These salts are carried with the water to wherever it is used. In the case of irrigation, the salts are applied with the water and remain behind in the soil as water evaporates or is used by the crop. A salinity problem exists if salt accumulates in the crop root zone to a concentration that causes a loss in yield. Yield reductions occur when the salts accumulate in the root zone to such an extent that the crop is no longer able to extract sufficient water from the salty soil solution, resulting in a water stress for a significant period of time. If water uptake is appreciably reduced, the plant slows its rate of growth. Water with TDS less than 450 mg/L is considered good and that with greater than 2000 mg/L is unsuitable for irrigation purpose

Electrical conductivity

The Electrical conductivity of the Okumeshi River was found to be 568 and 571µs/cm for upstream while 562 and 566µs/cm was detected at downstream with corresponding means of 570 and 564µs/cm respectively. The most influential water quality guideline on crop productivity is the water salinity hazard as measured by electrical conductivity (EC) (Ahmed et. al., 2016) The primary effect of high EC water on crop productivity is the inability of the plant to compete with ions in the soil solution for water (physiological drought). The higher the EC, the less water is available to plants, even though the soil may appear wet. Because plants can only transpire "pure" water, usable plant water in the soil solution decreases dramatically as EC increases. Water with EC less than 98.6 µs/cm is considered good and that with greater than 581 µs/cm is unsuitable for irrigation

Sulphate

Sulphate concentration in this study was found to be 57 and 56mg/l for upstream and 61.2 and 62.4 for downstream with corresponding means of 56.50 and 61.80mg/L respectively. The recommended maximum concentration is 500 mg/L. Excess sulphate levels may have a laxative effect on new users and produce an objectionable taste. Regular users tend to become accustomed to high sulphate levels. High concentrations of sulphate in drinking water have three effects: (1) water containing appreciable amounts of sulphate (SO4-2) tends to form hard scales in boilers and heat exchangers; (2) sulphate cause taste effects and (3) sulphate can cause laxative effects with excessive intake. The laxative effect of sulphate is usually noted in transient users of a water supply because people who are accustomed to high sulphate levels in drinking water have no adverse response. Diarrhea can be induced at sulphate levels greater than 500 mg/L but typically near 750 mg/L. While sulphate imparts a slightly milder taste to drinking water than chloride, no significant taste effects are detected below 300 mg/L. Sulphate cannot readily be removed from drinking water, except by expensive process such as distillation, reverse osmosis, or electrodialysis

Nitrate

Nitrate was found to be 16.70 and 18.20mg/L upstream and 21.1 and 20.2mg/L downstream with corresponding means of 17.50 and 20.70mg/L respectively. The maximum acceptable amount of sodium in water by the WHO is 45mg/L which is in safe condition. It should be noted that when the level of nitrate exceeds the permissible limit, then the primary health hazard from drinking water with nitrate-nitrogen may occur when nitrate is transformed to nitrite in the hemoglobin of the red blood cells to form methemoglobin and causes methemoglobineria or blue baby syndrome (a situation in which blood lack the ability to carry sufficient oxygen to the individual body cells causing the vain and skin to appear blue) (Yang et. al., 1999)

Magnesium

The amount of magnesium in the water analyzed was found to be 28.40 and 31.10mg/L upstream while downstream was 31.60 and 29.40mg/L with corresponding means of 27.50 and 30.50mg/L respectively. Magnesium content of water is considered as one of the most important qualitative criteria in determining the quality of water for irrigation. Generally, calcium and magnesium maintain a state of equilibrium in most waters. More magnesium in water will adversely affect crop yields as the soils become more alkaline.

Calcium

Calcium content in Okumeshi River was found to be 14.70 and 15.11mg/L upstream and 16.4 and 16.1mg/L downstream with corresponding means of 14.90 and 16.30mg/L respectively. All the water samples were within the recommended limit of WHO with 200mg/L which showed that the waters are in safe condition. Calcium plays an important role in bone structure, muscle contraction, nerve impulses transmission, blood clotting and cell signaling; 99% of calcium is in bone and teeth and the remainder is in soft tissue. Low intake of calcium is associated with osteoporosis, rickets and hypertension. Consumption in drinking water also reduces the risk of kidney stone (Kurtz and Morns, 1993) Above the recommended limit of WHO (200mg/L) it could create the problem of deposition in water system and excessive scales formation

Potassium

The concentration of potassium in the Okumeshi River was found to be 9.20 and 10.70mg/L upstream and 8.11 and 10.09mg/L for downstream with corresponding means of 9.95 and 9.51mg/L respectively which were in safe condition when compared with the WHO standard of 12mg/L. Excessive loss of extra cellular fluid may result in potassium deficiency and the loss could be attributed to vomiting, diarrhea, excessive diuresis or prolonged malnutrition. The chief feature of deficiency is muscular weakness and mental apathy. In hypocalcaemia, cardiac attack can result from depletion of ionized potassium in heart muscle (Vogel et. al., 1999).

Iron, Zinc, and Lead

Metals such as iron, zinc and lead were found to be 0.01mg/L for all the samples which were in safe condition when compared with the WHO standard for portable water.

Zinc found in some natural waters, most frequently in areas where it is mined. It is not considered for good health when occurs in water at high concentrations. It imparts an undesirable taste to drinking water. For this reason, the secondary maximum contaminant level (SMCL) of zinc in water was set 5.0 mg/L

Iron is essential for good health as it helps to transport oxygen in the blood through dissolve ferrous. Iron gives disagreeable taste and when iron combines with tea, coffee and other beverages, it produces an inky, black appearance and a harsh unacceptable taste (Amjad et. al., 2010)

Lead broadly affects human organs and systems and the most sensitive in the Central Nervous System particularly in children. Lead can also damage kidney and immune system and exposure of unborn children due to mother is also dangerous which results harmful effect such as premature birth, smaller babies, decreases mental ability in infants, learning difficulties and reduce growth in young children (Yang et. al., 1999)

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V. CONCLUSION

River water pollution is not only an aesthetic problem, but a serious economic and public health problem as well. The results obtained in this research work provide that the characteristics of all the water parameters are within the permissible limits of the WHO. The Okumeshi River is therefore found to be contaminated with the parameters analyzed most especially at the downstream. Periodical monitoring of the water quality is thus required to assess the condition of surface water. This will be helpful in saving the river from further degradation. Discharge of unwanted materials that could pollute water bodies should be discouraged

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