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RESEARCH ARTICLE

THE STUDY OF THE PHYSICOCHEMICAL AND MICROBIAL PARAMETERS OF UGWUOMU RIVER

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A B S T R A C T

The study examined the comparative analysis of Ugwuomu River in Nigeria. The physical, chemical and microbiological characteristics of the water samples were determined using the American Society for Testing and Materials (ASTM) procedures. The following parameters were determined as follows: pH values, colour, odour, total, calcium and magnesium hardness, acidity, heavy metals such as iron, lead, cadmium, arsenic, copper, aluminium, and presence of faecal contaminants (Coliforms) and their results; the pH and acidity of the samples were very low with some samples having a pH of 3.9 and acidity of 0.1 but not within the WHO permissible level (6.5-8.5). The samples were odour free, the total hardness of the water samples were not within the WHO permissible level of 80mg/l and also the magnesium level for the five water samples do not fall within the WHO permissible level of 0.2 but are closed to the WHO range. Samples used for domestic purpose were found to heavily polluted with cadmium (0.351 mg/l) as compared to WHO standard 0.005mg/l. Contamination of water by heavy metals could cause the following diseases such as, damaged or reduced mental and central nervous function, lower energy levels, and damage to blood composition, lungs, kidney, liver and other vital organs. Test for faecal contaminants shows that the water samples contain faecal contaminants which may be capable of causing harm to the human host (i.e. Gram negative bacilli). Based on the comparison, a conclusion was drawn that Ugwuomu River is not portable for domestic, human and animal use.

INTRODUCTION

Water is super abundant on the planet as a whole, but fresh potable water is not always available at the right time or the right place for human or ecosystem use. The importance of water is underscored by the fact that many great civilizations in the past sprang up along or near water bodies. River pollution has several dimensions and effective monitoring and control of river pollution requires the expertise from various disciplines. Pollution of river is a global problem. These physico-chemical characteristics in many ways have significant influence and impact on aquatic life (Nwakanma *et al*., 2013). Any alteration in these parameters may disturb the quality of water. Dissolved oxygen is of great importance to all the living organisms and is considered to be the sole parameter which to a large extent can reveal the nature of whole water body. Eutrophic water bodie29s have a wide range of dissolved oxygen and as such oligotrophic water bodies have narrow range of dissolved oxygen (Rucinski *et al.,* 2010). For more organic matter, more oxygen is required by bacteria for its decomposition. This results in release of organic nutrients in water bodies resulting in death of organisms thriving on water (Rustum *et al*., 2008). The magnitude of BOD is related to the amount of organic material in waste water. The strength of waste water is expressed in terms of BOD level. Water pollution is generally indicated by the presence of harmful and harmless microbes. Therefore, the aim of this study is to determine the physicochemical and microbial parameter of Ugwuomu river and to ascertain if there is negative impact on man and animal.

MATERIALS AND METHODS

Water samples were collected from five different spots between 10 and 12am on the 13th of April, 2015. The first spot labelled Ag, the second spot Bg, the third Cg, the fourth Dg and the fifth Eg. Spot Ag and Bg is the water used for domestic purposes including drinking, bathing, cooking, washing etc, the spot Cg is the water used for irrigation purposes and spot Dg and Eg is used as source of sharp sand and gravels for building.Samples were collected following the standard sampling guidelines and methods (APHA, 1998). The samples collected were from 1 to 2m depth from the water surface. The samples were taken into pre- sterilize bottles, samples for microbiological analysis were collected into sterilized plain glass bottles kept in ice boxes and transported immediately to the laboratory for physicochemical and microbial parameters analysis. Media were prepared, inoculate and incubated and the media was prepared according to the manufactures. Multiple tube technique was used to detect the presence of coliform bacteria (indicators of

faecal contamination), the Gram negative, spore forming bacilli that ferment lactose (carbon source) with the production of acid and gas. This test involves the presumptive (i.e. determination of total coli form) and confirmatory test (i.e. determination of faecal contaminants or coliform confirmatory test).

For presumptive test, the following procedures were put in place according to Monica (2010).Put on the Bunsen burner for 10-15 minutes to reduce the microbial load of the environment.Label each sample with the sample code number.Mix thoroughly the sample of water by inverting the bottles several times.Flamed the mouth of the sample bottle and sterilized so as to avoid the introduction of any possible contaminant.With the aid of a sterilized pipette, pipette 1ml of the sample into a sterile test-tube containing 10ml of sterile broth and an inverted Durham tube. This procedure was repeated twice this time with 10ml of the sample to 10ml of the sterile broth with an inverted Durham tube, and 20ml of the sample to 20ml of the sterile broth with an inverted Durham tube respectively.The sample test tube is sealed using a sterile cotton wool with foil to avoid the introduction of contaminants.Incubate the sample for 48 hours at 35° C using an incubator.After incubation, examine and count each bottle which has produced both acid and gas. Acid production will be shown by a change in colour of the MacConkey broth from purple to yellow, and gas production from by collection of bubbles in the Durham tube. For confirmatory test which is used to confirm the presence of coliforms in water samples showing positive or doubtful presumptive test according to Chandrakant, 2007.

The procedure used are: the media was prepared according to the manufactures guilde. The sample which showed a positive lactose broth tube from the presumptive test was introduced by striking onto a sterile Petri dish containing sterile Eosin blue (agar media). Petri dish containing sample was incubated using an incubator for 48 hours at 37° C. After 48 hours of incubation, the sample was examined for any metallic green colouration formed in the colonies present on the media. While the completed test was used as a confirmatory test for the presence of Escherichia coli in water sample. The organisms which grew on the confirmed test media. These organisms are used to inoculate a nutrient agar slant and a tube of lactose broth. After 24 hours at 37°C, the lactose broth is checked for the production of gas, and a Gram stain is made from organisms on the nutrient agar slant. If the organism is a Gram negative, nonspore-forming rod and produces gas in the lactose tube, then it is positive that coliforms are present in the water sample. A slide was prepared using Gram staining method and was viewed under the microscope. The micro organism seen under the slide retained the colour of the secondary dye. (i.e. the bacteria, is a gram negative bacilli).

Test for indole was also carried out which followed the following procedure: Organisms suspected from eosin methylene blue agar were inoculated in the peptone water (rich in tryptophan amino acid). It was incubated for 48hrs at 37˚C before performing the test. 5 drops of Kovac's reagent (isoamyl alcohol, para- dimethylaminobenzealdehyde, concentrated hydrochloric acid) to the culture broth. The Gram staining reaction is used to help identify pathogens in specimens and cultures by their Gram reaction which can be either Gram positive or Gram negative (Monica, 2010).

The method used for the determination of physico-chemical parameters was described by (A.O.A.C.2005). Parameters examined under the physical analysis are: odour, colour and pH, temperature. Parameters examined at this level are: acidity, total hardness, calcium hardness, magnesium hardness, and some heavy metals such as arsenic, lead, iron and others. The heavy metal analysis was conducted using AA240AtomicAbsorption spectrophotometer according to the method of APHA (1998) (American Public Health Association).

RESULTS

Table 1 Physical Analysis Of Water

Sample	Spots	Colour (hu)	Odour
Ag	Drinking, bathing	0.471	-
Bg	Drinking, bathing	0.465	-
Cg	Irrigation	0.471	-
Dg	Sharp sand and gravels	0.506	-
Eg	Sharp sand for building	0.472	-
WHO STD		5-15	Unobjectionable

Any range outside the WHO Standard is not acceptable.

Table 2 Hydrogen Log Concentration

Sample	Ph	Acidity (mg/l)	Alkalinity
Ag	4.0	0.5	12.8
Bg	4.2	0.1	7.1
Cg	4.2	0.4	7.7
Dg	4.1	0.5	8.2
Eg	3.9	0.5	9.7
WHO STD	6.5-8.5	4.5-8.2	100-200

pH less than 6.5-8.5 shows that the water is acidic.
Acidity: 0.04 is accepted while 5.2 is unacceptable.
Alkalinity: 1.2 is accepted while 212.8 is unacceptable.

Table 3 Hardness Analysis

Sample	Total hardness (mg/l)	Calcium hardness (mg/l)	Magnesium hardness (mg/l)
Ag	19.6	14	5.6
Bg	12.6	16	-3.4
Cg	4.66	14	-9.34
Dg	5.2	15.2	-10
Eg	2	41.2	-39.2
WHO STD	500	75.0	0.2

Total Hardness: 80 accepted while 560 is unacceptable.
Calcium Hardness: 36 accept, 86 unacceptable.
Magnesium Hardness: 0.12 accept, 44 unacceptable

Table 4 Heavy Metals Concentration

Sample	Arsenic (mg/l)	Lead (mg/l)	Cadmium (mg/l)	Iron (mg/l)	Copper (mg/l)	Aluminium (mg/l)
Ag	0.00	0.00	0.351	0.00	0.00	0.00
Bg	0.00	0.00	0.004	0.00	0.00	0.00
Cg	0.00	0.03	0.00	0.00	0.00	0.00
Dg	0.00	0.29	0.00	0.00	0.006	0.00
Eg	0.00	0.00	0.00	0.00	0.00	0.00
WHO STD	0.05	0.05	0.005	0.3	1.0	0.2

Table 5 1 Ml of Sample to 10 Ml of Broth

S/n	Test-tube number	Volume of media added (ml)	Volume of sample added (ml)	Gas formed
1	Sample Ag	10	1	+
2	Sample Bg	10	1	++
3	Sample Cg	10	1	++
4	Sample Dg	10	1	++
5	Sample Eg	10	1	+

Table 6 10ml Of Sample To 10ml Of Broth

S/n	Test-tube number	Volume of media added (ml)	Volume of sample added (ml)	Gas formed
1	Sample Ag	10	10	++
2	Sample Bg	10	10	+
3	Sample Cg	10	10	+
4	Sample Dg	10	10	+
5	Sample Eg	10	10	+

Legend: + showing light yellow colouration showing the presence of slightly populated lactose fermenter.
++ showing showing deep yellow colour ie densely populated lactose fermenter

Table 7 20ml Of Sample To 20ml Of Broth

S/n	Test-tube number	Volume of media added (ml)	Volume of sample added (ml)	Gas formed
1	Sample Ag	20	20	+
2	Sample Bg	20	20	++
3	Sample Cg	20	20	++
4	Sample Dg	20	20	++
5	Sample Eg	20	20	++

Legend = ++ deep yellow colouration showing the presence of densely populated lactose fermenter
= + light yellow colouration showing the presence of slightly populated lactose fermenter
= - indicating the absence of lactose fermenter

Table 8 Result For Gram Staining Reaction

S/n	Test-tube number	Metallic green sheen	Gram reaction	Micro-organism
1.	Sample Ag(1+10)	Negative	-	-
2.	Sample Bg (1+10)	Positive	Gram negative bacilli	*Escherichia coli*
3.	Sample Cg (1+10)	Positive	Gram positive cocci	*Streptococcus*
4.	Sample Dg (1+10)	Positive	Gram negative bacilli	*Escherichia coli*
5.	Sample Eg (1+10)	Negative	-	
6.	Sample Ag (10+10)	Positive	Gram negative bacilli	*Escherichia coli*
7.	Sample Bg (10+10)	Negative	-	-
8.	Sample Cg (10+10)	Negative	-	-
9.	Sample Dg (10+10)	Negative	-	-
10.	Sample Eg (10+10)	Positive	Gram negative bacilli	*Escherichia coli*
11.	Sample Ag (20+20)	Negative	-	-
12.	Sample Bg (20+20)	Positive	Gram negative bacilli	*Escherichia coli*
13.	Sample Cg (20+20)	Positive	Gram negative bacilli	*Esherichia coli*
14.	Sample Dg (20+20)	Positive	Gram negative bacilli	*Esherichia coli*
15.	Sample Eg (20+20)	Positive	Gram positive cocci	*Streptococcus*

Indole test: a positive pink colour forms as a result of series of reaction showing the presence of *Esherichia coli.*

DISCUSSION

Water colour is referred as apparent colour and true colour based on the type of solid material present in it. Apparent colour is the colour of the whole water sample and consists of colour due to both dissolved salt and suspended components (Patil *et al*, 2012). Colour test for the five different samples fell below World Health Organization standard. The pH values for the five water samples did not fall within the WHO permissible level of range 6.5 – 8.5 (Patil, 2012). This means that the water samples were acidic unlike the pH of the Ganga river at Haridwar was slightly alkaline. It ranged from 7.06 to 8.35 (Richard *et a*l., 2007). According to the WHO (2006), health effects are most pronounced in pH extremes. Drinking water with an elevated pH above 11 can cause skin, eye and mucous membrane irritation. The result for calcium hardness of the water samples (14, 16, 15.2mg/l) do not fall within the WHO permissible level of 75.0 mg/l. If it is greater than 75mg/l it should be rejected. The magnesium level for the five water samples do not fell within the WHO permissible level of 0.2 mg/l but are closed with the WHO range and will not display the characteristics of temporal hardness which can be removed simply by boiling or the addition of lime stone. All the samples do not fall within the WHO standard of 1.2 which is to be agreed on. All water samples analyzed were not free from heavy metal contamination for example sample Dg, which is heavily polluted with lead with a value of 0.29 mg/l, and traces of copper 0.006 mg/l, sample Ag is found to be heavily polluted with cadmium with a value of 0.351 mg/l and in trace quantity.

Also, traces of lead were found in sample Cg and Eg with values of 0.03 mg/l and 0.05 mg/l respectively below the WHO permissible level for lead 0.05 mg/l. In the presumptive test, there was acid and gas production in the tube. The colour changes to yellow indicating the production of acid while the Durham's tube raise high above the mixture of sample and broth indicating the production of gas. In the confirmed test, the appearance of metallic green sheen indicate the presence of a Gram negative bacilli which was later confirmed to be *Escherichia coli* in the completed test followed by the Indole's test showing that the water samples are not free from faecal contaminants. The comparison obtained between the result of this study and the WHO standards indicate that Ugwuomu River is not a good source of water for domestic and industrial purposes. Frequent usage of this river without adequate treatment could lead to bioaccumulation of some toxic substances to the human health. The microbiological quality of all the water sources was poor due to direct contamination by animal and human activities.

References

1. American Public Health Association (APHA). (1998). Standard Methods for the Examination of Water and Wastewater. Washington D.C., USA.
2. Association of Analytical Chemistry (AOAC). (2005). Official Method of Analysis. Association of Analytical Chemistry. Wash. Dc, 15th ed. Pp 11-14.
3. Chandrakant, R. k. (2007). Pharmaceutical Microbiology, Microbial Study of Water, Soil, Food and Air 2nd edition pp 162-166.
4. Monica, C. (2010). District Laboratory Practice in Tropical Countries, Second Edition pp 149- 153
5. Nwakanma, C and Oleh, K.F. (2013). Comparative Study of the Physicochemical and Microbial Evaluation of Different Brands of Bottled, Sachet, Tap, Well water in Enugu Metropolis Proceedings of the 2nd Biannual International Conference on Biotectnology National Dev, pp 9-13.
6. Patil, P.N., Sawant, D.V., and Deshmukh R.N. (2012*). International Journal of Environmental Sciences.* 3(3).
7. Richard, Wachman. (2007). Water becomes the New Oil as World Run Dry.

8. Rucinski, D.K., Beletsky, D., DePinto, J.V., Schwab, D.J. and Scavia D. (2010). A Simple1-Dimensional, Climate based Dissolved Oxygen Model for the Central Basin of Lake Erie. J. Great Lakes Res. 36: 465-476.
9. Rustum, R., Adeloye, A.J., and Scholz, M. (2008). Applying Kohonen Self Organising Map as a Software Sensor to Predict the BOD. Water Environ. Res. 80(1): 32-40.
10. Richard, Wachman. (2007). Water becomes the New Oil as World Run Dry.
11. Rucinski, D.K., Beletsky, D., DePinto, J.V., Schwab, D.J. and Scavia D. (2010). A Simple1-Dimensional, Climate based Dissolved Oxygen Model for the Central Basin of Lake Erie. J. Great Lakes Res. 36: 465-476.
12. Rustum, R., Adeloye, A.J., and Scholz, M. (2008). Applying Kohonen Self Organising Map as a Software Sensor to Predict the BOD. Water Environ. Res. 80(1): 32-40.
13. World Health Organization (WHO). (2006). Guildlines for the Safe use of Wastewater Excreta and Grey Water; Use in Agriculture (third edition) Geneva World Health Organization.

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