PHYSICAL, CHEMICAL AND MICROBIOLOGICAL PARAMETERS OF IYI OKAI STREAM IN ABIRIBA, OHAFIA LOCAL GOVERNMENT AREA, ABIA STATE, NIGERIA

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ABSTRACT

In this study, water samples from Iyi-Okai stream in Abiriba, Ohafia Local Government Area of Abia State, Nigeria were collected from six location and analyzed for physical, chemical and microbiological parameters including pH, appearance, total hardness, bicarbonate, carbonate, dissolved oxygen, biological oxygen demand, total suspended solid, turbidity, total dissolved solids, alkalinity, metals, total heterotrophic count, total fungal count, total coliform count, were measured using standard methods .Possible heavy metals contamination of the stream were assessed after Nitric acid digestion by means of Atomic Absorption Spectrophotometer. The results revealed a pH range of 6.01-7.27 for the six sample sites which is within the WHO limit of 6.5 – 9.2 with a mean temperature range of 27.7^{o}C. Other physico-chemical parameters monitored including total suspended solid (<0.001-2.23mg/l), electrical conductivity, (21.28-206.0µs/cm), biochemical oxygen demand (0.05=3.38), chemical oxygen demand (0.10-15.0mg/l), exceeded the recommended level for surface water quality under WHO limit. Parameters such as turbidity, Alkalinity, Phosphate, Temperature were within the WHO standard. Results also revealed there was no heavy metal contamination of the stream. The result of bacteriological analysis including total heterotrophic count, total coliform count and total fungal count revealed a high level of pollution of the river. It was inferred that the stream is polluted and is bacteriologically contaminated and unsafe for human and animal consumption and will need proper treatment before use.

Keywords: Physico-chemical, bacteriological, water analysis, water quality, pollution.

INTRODUCTION

The Iyi Okai stream is a major source of drinking water in Abriba which is a semi-urban town in Ohafia LGA, Abia State, Nigeria and with the location of the School of Midwifery and secondary schools as well as banks, there is the need to ascertain the portability of the stream.

Water which is a simple chemical compound with the chemical formula H_2O, containing one oxygen and two hydrogen atoms in a molecule connected by covalent bonds (Henniker, 2011) and existing as a liquid at temperature above O^{0}C (273.15K, 32^{0}F) at sea level, often co-exists on earth with its solid state, ice and gaseous state (water vapour or steam) also existing in a liquid crystal state near hydrophilic surfaces (Gerardi and Zimmerman, 2012) is very important in the sustenance of life on earth. This is because water is one of the most important and abundant compounds of the ecosystem. All living organisms on the earth need water for their survival and growth. As of now only earth is the planet having about 70% of water. (Basavaraja *et al*., 2011).

But due to increased human population, industrialization, use of fertilizers in the agriculture and man-made activity it is highly polluted with different harmful contaminants. Therefore it is necessary that the quality of drinking water should be checked at regular time interval, because due to use of contaminated drinking water human population suffers from varied of water borne diseases such as cholera, Hepatitis, Shigellosis, Typhoid Fever (Petrini, 2006). It is difficult to understand the biological phenomenon fully because the chemistry of water reveals much about the metabolism of the ecosystem and explain the general hydro-biological relationship (Basavaraja *et al.*, 2011).

Rivers and streams are the most important freshwater resource for man, unfortunately, stream waters are being polluted by indiscriminate disposal of sewage, industrial waste and plethora of human activities, which affects their physico-chemical characteristics and microbiological quality (Koshy and Nayer, 2013).Generally a pollutant refers to the degradation of water quality. From a public health of ecological views, a pollutant is only biological, physical and chemical substance that in identifiable excess is known to be harmful to other desirable living organisms (Nnorom, 2010). Water pollution is a major global problem which requires ongoing evaluation and revision of water resource policy at all levels (international down to individual aquifers and wells). It has been suggested that it is the leading worldwide cause of death and diseases that it accounts for the deaths of more than 14,000 people daily (Pink and Daniel, 2006).

Pollution of the aquatic environment is a serious and growing problem. Increasing numbers and amounts of industrial, agricultural and commercial chemicals discharged into the aquatic environment have led to various deleterious effects on aquatic organisms. Aquatic organisms, including fish, accumulate pollutants directly from contaminated water and indirectly from contaminated water and indirectly via the food chain (Hammer, 2014).

Prevention of stream pollution requires effective monitoring of physico-chemical and microbiological parameters (Chandra *et al*., 2013). In most countries, the principal risks to human health associated with the consumption of polluted water are microbiological in nature (World Health Organization, 2010). The bacteriological examination of water has a special significance in pollution studies, as it is a direct measurement of deleterious effects of pollution in human health (APHA, 2014).Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world. But approximately one billion people still lack access to adequate sanitation (Berati, 2010).

Water pollution is of various kinds. Surface water and groundwater have often been studied and managed as separate resources, although they are interrelated. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources. Sources of surface water pollution are generally grouped into two categories based on their origin (Agarwal and Manish, 2011).

Point source water pollution refers to contamination that enters a waterway from a single, identifiable source, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain. The U.S clean Water Act (CWA) defines point source for regulatory enforcement purposes (clean water Act, 2010). The CWA definition of point source was amended in 1987 to include municipal storm sewage systems, as well as industrial storm water, such as from construction sites (CWA, 2010).

Nonpoint source pollution refers to diffuse contamination that does not originate from a single discrete source. NPS pollution is often the cumulative effects of small amounts of contaminants gathered from a large area. A common example is the leaching out of nitrogen compounds from fertilized agricultural land. Nutrient runoff in storm water from "sheet flow" over an agricultural field or a forest is also cited as example of pollution (CWA, 2010).

The pollution of streams and rivers is often caused by a variety of factors with some differences with the pollution of other sources of water. Contaminants may include organic and inorganic substances. Organic water pollutants include:

a. Detergents
b. Disinfection by-products found in chemically disinfected drinking water, such as chloroform.
c. Food processing waste, which can include oxygen demanding substances, fats and grease.
d. Insecticides and herbicides, a huge range of organ halides and other chemicals compounds.
e. Petroleum hydrocarbons, including fuels (gasoline, diesel fuel, jet fuel oil) and lubricants from storm water runoff (Allen and Robert, 2013).
f. Tree and bush debris from logging operations.
g. Volatile, organic compounds (vocs), such as industrial solvents, from improper storage.
h. Chlorinated solvents, which are dense non-aqueous phase liquids (DNAPLS), may fall to the bottom of reservoirs, since they don't mix well with water and are denser.
i. Polychlorinated biphenyl (PCBS)
j Per chlorate
k. Various chemical compounds found in personal hygiene and cosmetic products.
l. Drug pollution involving pharmaceutical drugs and their metabolites (Allen and Robert, 2013).

Inorganic pollutants include

a. Acidity caused by industrial discharges (especially sulfur dioxide from power plants)
b, Ammonia from food processing waste.
c. Chemical waste as industrial by-products.
d.Fertilizers containing nutrients- nitrates and phosphates – which are found in storm water runoff from agriculture, as well as commercial and residential use (Allen and Robert, 2013).
d.Heavy metals from motor vehicles (via urban storm water runoff (Schlueler and Thomas, 2010) and acid rain drainage.
e. Silt (sediment) in runoff from construction sites, logging, slash and burn practices or land cleaning site. (Schueler and Thomas, 2010).

Thermal pollution is the rise or fall in the temperature of a water natural body of water caused by human influence. Thermal pollution, unlike chemical pollution, results in a change in the physical properties of water. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers.

Elevated water temperatures decreases oxygen levels, which can kill fish, and can alter food chain composition, reduce invasion by new thermopholic species (Goel, 2009). Urban runoff may also elevate temperature in surface waters (Kannish and Michael, 2008).Thermal pollution can also be caused by the release of very cold water from the bused of reservoirs into warmer rivers onto warmer roars (Edward, 2012).

MATERIALS AND METHOD

SELECTION OF SAMPLING STATIONS

Six points were selected and marked along Iyi-okai stream. The six stations were within the approximately 100-200 meters distant away from each other, these sampling stations were selected to reflect progression of pollution.The selected sites include Isi-Okai 1 and Isi-Okai 2 in the Upper stream, Agbor Ogbor 1 and Agbor Ogbor 2 in the Mid stream and Usumani and Akakpo sites in the down stream.

COLLECTION OF WATER SAMPLES

A well washed 3-litre plastic bottles were used to collect the water samples. The samples were then transferred to the center of research for further elemental analyses.

SAMPLES PRESERVATION AND STORAGE

Due to the nature of the parameter to be analyzed. The samples were kept in a cool and dry container so as to maintain the temperature and other conditions necessary to keep the physical and chemical properties intact. (APHA,2014).

LABORATORY ANALYSIS OF WATER SAMPLES

The analysis of samples was carried out in Golden years Limited in River State. Twenty five parameters were analyzed. These include:

Appearance, pH, Temperature ^{o}C, Electrical conductivity, µ.S/cm, Total Dissolved solids, mg/z, Total suspended solids, mg/l, Turbidity, NTU, Acidity, Mg/l, Bicarbonate, mg/l Alkalinity, Carbonate mg/l, Hardness, Dissolved Oxygen (DO), Biochemical oxygen demand (BOD), Chemical oxygen demand, phosphate, Sulphate and metals using standard methods

pH of the samples were determined using a Win Lab pH meter. Alkalinity was determined by the titrimetric method according to (API-RP45) as shown in ALPHA 2320-B Method of 2012 and total hardness by EDTA titrimetric Method as described in ALPHA 2340-C Method (2012). Temperature was measured with a simple Celsius thermometer. Turbidity was assessed by the Nephelometric Method (ALPHA-214A) while total dissolved solids were measured using HACH TDS meter according to ALPHA- 209C Method of 2012.Conductivity was determined using a HACH- CAMLAB conductivity meter, total suspended solids was measured by a gravimetric method according to ALPHA-209D.

Dissolved oxygen, Biochemical oxygen demand(BOD) and chemical oxygen demand (COD) were measured according to Winkler, 2009, ALPHA 508 and Dichromate Method (ALPHA-422B**)** respectively.

Sulphate was assessed by the ALPHA 427C while bicarbonate was measured by titrimetric method and total phosphate by the Ascorbic Acid Method (ASTM,ALPHA- 425C) . Metals were measured. For the assessment of possible metal contamination, the concentrations in mg/L of all the metals analyzed in the collected samples were determined (after nitric acid digestion) by means of an atomic absorption spectrophotometer (biotech Engineering Ltd.

AA - 3890). Specific metal standards in the linear range of the metal were used to calibrate the equipment. The metals were analyzed by direct air-acetylene flame method (APHA 3111-B). The concentrated and digested samples were then aspirated and the actual concentration were obtained by referring to the calibration graph and necessary calculations. Acidity was determined by titrimetry using an electrotitrator with a standard pH metre.

Micrbiological Analysis

Water samples were collected using sterile containers and were promptly transported to the laboratory. They were analysed in terms of total heterotrophic bacteria counts, total coli form count and total fungal count by using the method of cappuccino and Sherman (1998).
Total heterotrophic counts were detected by serial dilution method on nutrient agar while total coli forms were done using maccaonkey agar. Total fungal counts were carried out using sabauraud dextrose agar (S.D.A). All the agar used were weighed and autoclared according to the manufacturer's specialization. The water samples were incubated at 37^0c and 44.5^0c respectively for 48hrs for these counts. They were also identified using Gram stain reaction, and biochemical tests such as catalase, oxides and sugar fermentation test according to the method of Okereke and Kanu (2006) and the effects of vibrations that disturb the surface visibility of the sample will give false results. "True colour" that is water colour due to dissolved substances that absorb light, causes measured turbidities to below. This effect usually is not significant in the case of treated water, proportional to the oxygen content of the sample.

concentrations as determined from the calibration curve are recorded in mg/l.

STEPS: Measure 50ml of the sample and add 8mls of mix reagent. Allow the colour Development for 15 minutes. Then read absorbance at 880mn. Express results in mg/l obtained from the calibration curve.

Results of acidity determinations are usually expressed in terms of calcium carbonate equivalent.

$$\text{Acid mg/l } CaCO_3 = (\text{ml x N}) \frac{\text{NaOH x 50,000}}{\text{ml sample}}$$

IDENTIFICATION OF THE ORGANISMS

Water samples were collected using sterile containers and were promptly transported to the laboratory. They were analysed in terms of total heterotrophic bacteria counts, total coli form count and total fungal count by using the method of cappuccino and Sherman (1998).
Total heterotrophic counts were detected by serial dilution method on nutrient agar while total coli forms were done using maccaonkey agar. Total fungal counts were carried out using sabauraud dextrose agar (S.D.A). All the agar used were weighed and autoclared according to the manufacturer's specialization. The water samples were incubated at 37^0c and 44.5^0c respectively for 48hrs for these counts. They were also identified using Gram stain reaction, and biochemical tests such as catalase, oxides and sugar fermentation test according to the method of Okereke and Kanu (2006)

RESULTS AND DISCUSSION

Result for various physical and chemical parameters of Iyi-oka stream in Abiriba Ohafia Local Government Area, Abia State.

Table 1

Parameters	Isi-Okai 1	Isi –Okai 2	Agbor Ogbor1	Agbor Ogbor2	Usumani Amamba	Akapo
pH	7.27	6.01	7.11	6.14	6.70	6.79
Temperature, °C	27.7	28.1	28.1	28.0	28.0	27.9
Electrical conductivity, µs/cm	21.28	18.00	67.40	143.0	182.0	206.0
Total dissolved Solids, mg/L	11.29	12.00	35.72	98.00	118.0	133.0
Total suspended solids, mg/L	<1.00	8.20	1.10	4.83	7.27	2.23
Turbidity, NTU	<0.01	12.3	0.52	7.25	10.9	3.35
Acidity, mg/L	2.96	8.02	3.02	8.04	7.06	6.07
Bicarbonate, mg/L	4.28	23.22	10.12	25.40	26.18	26.84
Alkalinity, mg/L	4.84	19.03	12.05	20.82	21.46	22.00
Carbonate, mg/L	<0.01	10.99	<0.01	15.55	15.98	16.02
Hardness, $caco_3$, mg/L	2.00	8.00	5.00	12.00	28.00	68.00
Dissolved oxygen, mg/L	5.71	8.96	5.41	10.26	10.16	10.09
Biochemical oxygen Demand, mg/L	0.05	2.04	0.10	4.89	4.44	3.38
Chemical oxygen Demand, mg/L	0.10	10.00	0.14	17.00	16.76	15.00
Phosphate, mg/L	<0.001	0.091	<0.001	0.017	0.016	0.072
Sulphate, mg/L	1.04	0.061	2.41	0.082	0.101	0.103
Iron, mg/L	<0.001	0.041	<0.001	0.032	0.061	0.041
Cadmium, mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	< 0.001
Zinc, mg/L		0.101	<0.001	0.014	0..114	0.122
Lead, mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Nickel, mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Mercury, Mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Platinum, Mg/L		<0.001	<0.001	<0.001	<0.001	<0.001
Paladium, Mg/L		<0.002	<0.001	<0.001	<0.001	<0.001
Arsenic, Mg/L		<0.001	<0.001	<0.001	<0.001	<0.001

Note: BDL- Below Detection Limit (<0.001 mg/l)

Table 2:Microbial Counts of Various Samples (Stream Water)

Source	**NA Total Heterotrophic count (THC)**	**MAC Coliforme (TCC)**	**SDA Fungi (TFC)**
Isi Okai 1	8.7×10^6 cfu/ml	1×10^5 cfu/ml	7.8×10^4 cfu/ml
Isi Okai 2	27×10^6 cfu/ml	1×10^6	1×10^2 cfu/ml
Agbor Ogbor 1	5.5×10^6 cfu/ml	9×10^5 cfu/ml	4.2×10^5 cfu/ml

Agbor Ogbor 2	$1.7x10^6$ cfu/ml	Nil	Nil
Usmani Amamba	$12x10^6$ cfu/ml	Nil	Nil
Akapo	$30x10^6$ cfu/ml	$2x10^6$ cfu/ml	$1x10^2$ cfu/ml
WHO standard	1.0×10^2	Zero	Zero
EPA standard	1.0×10^2	Zero	zero

THC- total heterotrophic count, Tcc-total coliform court, TFc-total fungal count, NA-Nutrient agar, MAC- Macconkey, SDA-sabauraud Dextrose agar, Cfu/Ml colony forming unit per/ml.

Table 3: Bacterial Isolates (Stream Water)

SOURCE	TYPES
Isi-Okai 1	Actinomyces, staphylococcuss spp.,pseudomonas spp.
Isi-Okai 2	Streptococcus spp, staphylococcus spp, Enterobacter spp, pseudomonas spp Klebsiella spp, bacillus spp.
Agbor Ogbor 1	Baccilus spp., staphylococcus spp.,Escherichia coli, Actinomyces spp.,Achromobacter spp.
Agbor-Ogbor2	Streptococcus spp, staphylococcus spp, Enterobacter spp, pseudomonas spp, Klebsiella spp, bacillus spp.
Usmani Amamba	Streptococcus spp, staphylococcus spp, Enterobacter spp, pseudomonas spp, Klebsiella spp, bacillus spp.
Akapo	Streptococcus spp, staphylococcus spp, Enterobacter spp, pseudomonas Klebsiella spp, bacillus spp, shigella spp.

Table 4: Fungal Organisms Isolated

Sources	Types
Isi-Okai1	Aspergillus, mucor, fusanim spp, penicillus spp.,
Isi-Okai 2	Candida spp, phycomyces spp, Aspergollus spp, penicillium spp.
Agbor-Ogbor1	Mucor, fusani spp.,penicillium spp.
Agbor-Ogbor	Candida spp, phycomyces spp, Aspergillus spp, penicillium spp.
Usmani Amamba	Candida spp, phycomyces spp, Aspergillus spp, penicillium spp.
Akapo	Candida spp, phycomyces spp, Aspergillus spp, penicillium spp.

Table 5 :WHO Water Limit

PARAMETERS	**WHO LIMIT**	**FME_{nv} LIMIT**
pH	6.5-9.2	6.6-9.0
Temperature, °C	25.0	40
Electrical conductivity, µs/cm	N/A	N/A
Total suspended solids, mg/L	N/A	30
Turbidity, NTU	25.00	N/A
Dissolved oxygen, mg/L	4.0-5.0	N/A
Odour	Odourless	N/A
Chloride, mg/L	600.00	600
Ammonia-Nitrogen, mg/L	N/A	N/A
Nitrate= Nitrogen, mg/L	10	20
Available phosphate, mg/L	N/A	5
Chemical oxygen Demand, mg/L	N/A	80
Biochemical oxygen demand, mg/L	N/A	30
Total Hydrocarbon content, mg/L	0.30	10
Iron, mg/L	1.00	20
Zinc, mg/L	15.00	< 1.0
Lead, mg/L	0.05	< 1.0
Copper, mg/L	1.50	<1.0
Cadmium, mg/L	0.01	<1.0
Nickel, mg/L	N/A	<1.0
Manganese, mg/L	0.5	5
Vanadium, mg/L	N/A	N/A
Mercury, mg/L	N/A	0.05
Alkalinity, mg/L	500.00	N/A
Total Dissolved solids, mg/L	1500	2000
Hardness	N/A	N/A
Acidity	N/A	N/A

DISCUSSION OF RESULTS

The result are discussed on the following sub-heading (1) Physical Parameters (2) Chemical Parameters

PHYSICAL PARAMETERS
GROSS APPEARENCE ODOUR AND TASTE

Water samples from river water were highly turbid and foul smelling, which appears aesthetically objectionable for human and animal use.

Temperature: The temperature of Isi-Okai 1 is 27.7°C. (Table 2). Which is above the WHO standard of 25.0°C and below the FME_{nv} limit of 40°C (Table I). the temperature of Isi-Okai 2 is 28.1°C (Table 2) which is above the WHO standard of 25.0°C and below the FME_{nv} limit of 40°C (Table 1). The temperature of Agbor 1 is 28.1°C (Table 2) which is above the WHO standard of 25.0°C and below the FME_{nv} 40°C (Table 1). The water temperature controls the rate of all chemical reactions, and affects fish growth, reproduction and immunity. Drastic temperature changes can be fatal to fish. The high temperature may be due to increase in atmospheric temperature. However, the observed range of the temperature allows for optimum proliferation of most of the bacterial isolated from the water samples. Enterobateriaceac and mesophiles most of which grows optimally at temperature range of 20^{o}C and 32^{o}C (Fransolet *et al*., 2006).

Turbidity:- Isi-Okai 1 has <0.01mg/L which was below detection limit of WHO standard 25.00mg/L (Table 1) Isi-Okai 2 (12.3mg/L) Agbor Ogbor 1 (0.52mg/L), Agbor-Ogbor 2 (7.25mg/L) (Table 1) are below the WHO standard of turbidity 25.00mg/L (Table 1) are below the WHO standard of turbidity 25.00mg/L (Table 1). Turbidity in water may be caused by growth of Phytoplankton. Human activities that disturb land such as construction, mining and agriculture, can lead to high sediment levels entering water bodies during rain storms due to storms water run off (EPA, 2002).

Total Dissolved Solids:- The rang of total dissolved solids of Isi-Okai 1 is 11.29mg/L (Table 2) which is below the WHO standard of 1500mg/L and below the FME_{nv} limit of 2000mg/L (Table 1) Isi-Okai 2 (12.00mg/L), Agbor ogbor 1 (35.72mg/L), Agbor ogbor 2 (98.00), Usumani Amamba (118.0mg/L), Akapo (133.0mg/L) are below the WHO standard of 1500mg/L and below the FME_{nv} limit of 2000mg/L (Table 1). The presence of high levels of TDS in water may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes, heaters, boilers, and household appliances some dissolved organic matter may contribute to increased level of TDS which also indicating that water is polluted (Navneet *et al*., 2010). While water with extremely low concentrations of TDS may also be inacceptable to consumers because of its flat and insipid taste. High TDS might be due to the presence of large number of organic salt as carbonate, bicarbonate sodium, potassium and calcium and also some non-volatile substance which one solid at room temperature (Prasanthi *et al*., 2012).

Total Suspended Solids:- The value of total suspended solids of Isi-Okai 1 is <1.00mg/L which is below detection limit, and below the FME_{nv} limit of 30mg/L (Table 1). TSS are indicative of materials carried in suspended and solid respectively (Oladiji *et al*., 2007). Suspended solids in streams are often as result of sediments carried by the water whose source includes natural and anthropogenic (human) activities in the water shed, such as natural or urban run-off of phytoplankton growth (United States Environment Protection Agency, 2006). TSS and TDS are indicative of materials carried in suspension and solid respectively (Oladiji *et al*., 2007).

Electrical Conductivity:- Electrical Conductivity of Isi-Okai 1 is 21.28µg/cm (table 2) which is not acceptable with the WHO and FME_{nv} limit (Table 1). High conductivity increases corrosive nature of water (Naveet *et al.*, 2010). The high electrical conductivity value might be due to the presence of high amount of dissolved inorganic substances in ionized form.

CHEMICAL PARAMETERS

pH:- The range of Isi-Okai 1 is 7.27 (Table 2). The pH is in accordance with WHO limit of 6.5 – 9.2 and FME_{nv} limit of 6.6 – 9.0 (Table 1). Isi-Okai 2 (6.14), Usumani Amamba (6.70), Akapo (6.79) all are in accordance with WHO limit of 6.5 – 9.2 and FME_{nv} Limit of 6.6 -9.0 (Table 1). pH is most important in determining the corrosive nature of water. Lower the pH value higher is the corrosive nature of water. pH was positively correlated with electrical conductivity and total alkalinity (Gupta *et al.*,2009). Dissolved gases such as carbon (IV) oxide, hydrogen sulphide and ammonia also affect the pH of water. One of the significant environmental impacts of pH is the effect that it has on the solubility and thus the bioavailability of other substance (Khan *et al*., 2012).

Acidity: The acidity level of Isi-Okai 1 is 2.96mg/L (Table 2) no guideline in WHO standards. Acidity levels in wastewater indicates its corrosive properties and can take a leading role in regulating biological processes as well as in chemical reactions coagulation and flocculation (Prasanthi *et al*., 2012).

Alkalinity:- The alkalinity of water samples examined was, Isi-Okai 1 4.84mh/L (Table 2), which is below the WHO standard of 500.00mh/L (Table 1). Isi-Okai 2 (19.03), Agbor Ogbor 1 (12.05mg/L), Agbor Ogbor 2 (20.82mg/L), Usumani Amamba (21.46mg/L), Akapo (22.00mg/L) (Table 2) are below the WHO standard. Alkalinity is important for fish and aquatic life because it protects or buffers against rapid pH changes. The value of alkalinity may be due to high temperature and increased level of bicarbonate because of high rate of photosynthesis (Hujare, 2008).

Hardness:- The result of Isi-Okai 1 is 2.00mg/L (Table 2) classification of water by hardness content $CaCO_3$(mg/L). water hardness is due to the presence of multivalent metal ions which comes from minerals dissolved in the water. The most important impact of hardness on fish and other aquatic life appears to be the effect, the presence of these ions has on the other more toxic metals such as Lead, Cadmium, Chromium and Zine. Generally, the harder the water, the lower the toxicity of other metals to aquatic life (Navneet *et al*., 2010).

Dissolved Oxygen:- The dissolved oxygen content of Isi-Okai 1 is 5.71mg/L (Table 2) which is slightly above the WHO standard of 4.0 – 5.0mg/L (Table 1). Isi-Okai 2 (8.96mg/L), Agbor Ogbor 2 (10.26mg/L), Usumani Amamba (10.16mg/L), Akapo (10.09mg/L) and above the WHO standard of 4.0 – 5.0mg/n far dissolved oxygen. DO is one of the most important parameter. Its correlation with water body gives direct and indirect information e.g. bacterial activity, photosynthesis, availability of nutrients, stratification, DO corrode water lines, boilers and heat exchangers at low level, marine animals cannot survive (Premlata, 2009). Variation in dissolved oxygen might be due to temperature, photosynthesis, respiration, aeration, organic water and sediment concentration (Budget and Verma, 2006). The reduced dissolved oxygen may affect the aquatic life.

Biochemical Oxygen Demand:- The BOD demand of the Isi-Okai 1 is 0.05mg/L (Table 2) which has no acceptable value for WHO standard, but below the FME_{nv} limit of 30mg/L (Table 1). Isi-Okai 2 (2.04mg/L), Agbor Ogbor 1 (0.10mg/L), Agbor Ogboe 2 (4.89mg/L), Usumani Amamba (4.44mg/L), Akapo (3.38mg/L) are below the FME_{nv} limit of 30mg/L (Table 1). Also high BOD decrease level of dissolved oxygen (Prasanthi *et al*., 2012).

Chemical Oxygen Demand:- COD ranged between 0.10 to 15.00 mg/l (Table 2), which is not acceptable with WHO limit and FMEnv limit 80mg/l (Table 1). COD is the amount of dissolved oxygen required to cause chemical oxidation of the organic material in water. High COD has undesirable consequence on aquatic life such as leading to production of amounting and effect on fish. (Boyd and Lichikoppler, 2008).

Sulphate:-The range of sulphate examined in the water sample are 1.04 to 0.103 Mg/L. Sulphate in water containing calcium forms hard scale in steam boilers. In large amount, sulphate in combination with other constituents gives a bitter taste to water. And also act as formative in humans (Chapman, 2006).

Microbial Analysis Results

Heterotrophic count (HPC) measures a range of bacteria that are naturally present in the environment (EPA, 2002) the total microbial count for all the water samples were generally high exceeding the limit of 1.0 x 10^2 Cfu/ml (Table 3) which is the standard limit of heterotrophic count for drinking water. The high total heterotrophic count is indicative of the presence of high organic and dissolved salts in the water. The primary source of these bacterial in water are animal and human waste. These sources of bacterial contamination include surface runoff, pasture and other land areas where animal wastes facilities and natural soil/ plant bacterial (EPA, 2002). These contaminant) are reflected in the highest bacterial load obtained in this study for the water samples from six different locations of the stream in Abiriba community.

Accordingly, the total colliform count for all samples were exceedingly high the EPA maximum contamination level (MCL) for Coliform bacteria in drinking water of zero. Water sources are facecally contaminated (EPA, 2002). Agbor ogbor 1 and 2 complies with EPA and WHO standard. Other bacteria isolated from all water samples such as *staphylococcus, Pseudomonas* Spp are also of public health significance. *Staphylococcus* known to produce Enterotoxin (Aydin, 2007). Proteins spp. Belongs to the enterobacterarognes, isolated from the water samples are examples of non fecal coliform and can be found on vegetation and soil which serves as sources by which the pathogens enters the water (Schlegel, 2006)

CONCLUSION

This pollution impact study has proven that the Iyi-Okai stream segment is indeed polluted. The study has been able to track the type of pollution, by the evolution of the bacteriological quality of the river water samples. Non-point sources of pollution which includes the agricultural activities (pesticides and crop wastes) and domestic activities by the poorly planned settlers nearby the river. Overall the water in all the sites is not fit for human consumption without prior treatment. The water quality parameters of concern were microbial continuation, physical and chemical parameters such as pH, Dissolved oxygen (DO) chemical oxygen demand (COD), BOD etc. the people in these rural area therefore live in constant risk of contracting water-borne and/ or sanitation-related diseases as high lighted by the microbiological quality of the water they use for drinking and other domestic uses. Proper treatment is imperative for the river to be appropriate for potable, domestic and industrial purposes

It is therefore recommended to coordinate different efforts at the level of the community dwellers and the government to rescue the Iyi-okai stream from different current hazard and to provide good portable water for the dwellers. Regular estimation of the above mentioned parameters would be helpful to improve water quality.

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