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Physicochemical Assessment of the Akpor Stretch of the New Calabar River, Port Harcourt: Implications for Water Safety and Public Health

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Abstract
This study investigates the physicochemical parameters and heavy metal levels in New Calabar River, Rivers State, Nigeria. Water, samples were collected from three different locations (Mgbuodahia, Ogbogoro and Rumuopkparali) in the akpor stretch of the (NCR). Physicochemical parameters were analysed using American Public Health Association, heavy metals by atomic absorption Spectrophotometry (AAS). The results of the analysis showed that of the physicochemical parameters in the dry season were in the following ranges: pH (6.55–9.40), Temperature (28.80 - 29.50) EC (980.17–2380.87 uµ/cm), BOD (24.73 - 96.77 mg/L), COD (12.02 - 24.06 mg/L), In the wet season the ranges were: pH (5.89 - 8.23), Temperature (27.81 - 28.35) EC (586.60 - 1751.62 uµ/cm), BOD (18.13 - 72.00 mg/L), COD (7.31 - 18.47 mg/L) of these only (pH) was within the limits set by WHO. The dry concentrations in ranges of heavy metal in surface water recorded; Pb: 1.65±0.20 - 2.30±0.53; Fe: 10.48±0.28 - 2.42±0.11; Cr: 0.42±0.06 - 0.04±0.0, while in the wet season concentrations they were; Pb: 0.45±0.02 - 1.54±0.08; Fe: 7.23±0.29 -1.14±0.11; Cr: Nd - 0.11±0.02 mg/l. It was observed that Pb and Fe exceed the WHO threshed limit. Assessment based on contamination factor (CF) of the river water in the dry season occurred also in the following ranges between Pb: (165 – 230), Fe: (8.07 – 34.9), Cr: (0.8 -8.4), while in the wet season they were Pb: (85 – 154), Fe: (3.8 – 24.1), Cr: (ND – 2.2). The results indicate that Pb was above the WHO limit and contaminated the river water compared to the other metals thus, posing potential risks to aquatic life and human health. The CF analysis showed the river water was slightly contaminated. The results generally impede continuous monitoring to ensure that vital water resources, health safety and well-being of users and local communities are protected.

Keywords: Physicochemical Parameters, Heavy metals, New Calabar River, Assessment, Contamination Factor

Introduction

The physico-chemical parameters analysis is very essential and important to water, before it is used for drinking, domestic, agricultural or industrial purpose. The physical and chemical properties of water greatly influence its uses, distribution and richness of the biota (Unanian & Apkan 2006). Water quality parameters are parameters in which the assessment of water quality is based. Water quality parameters are divided into three (3) categories; physical, chemical and biological parameters. Some of the physico-chemical parameters include turbidity, temperature, electrical conductivity (EC), Total suspended solids (TSS), pH, Dissolved oxygen (DO), nitrates, nitrites, phosphates, biochemical oxygen demand (BOD), etc. Water is adjudged safe if these parameters fall within certain range that is tolerable by living organism within the aquatic environment (WHO, 2010). The physico-chemical parameter analysis is very important to ascertain the exact qualities that can idea about the quality analysis to protect the natural ecosystem (Patil et al., 2012). Water as one of the essential elements naturally abundant and readily available is a vital natural resource and essential for the survival of plants and animal. It covers approximately three quarters of the earth's surface. In spite of this obvious abundance several factors serve to limit the amount of water available for human use. Over 97% of the total supply is contained in the oceans and other saline bodies for most purposes. Of the remaining three (3%), over two percent (2%) is tied up in the ice caps and glaciers alongside with atmospheric and soil moisture. Hence, humans for their general livelihood and the support of their varied technical and agricultural activities must depend upon the remaining 0.62% found in fresh water lakes, rivers and groundwater supplies.

The main causes of water pollution emanated primarily from local sources such as population growth, poor land use system, and agricultural activities, industrialized and other anthropogenic impacts (Aremu et al., 2011). Some solutions preferred by water scientist to control the problems due to poor environment are characterized by numerous activities that are yet to meet the healthy condition of the people (Okoh et al., 2007; Aremu & Inajoh, 2007). Water pollutants are directly or indirectly discharged into water bodies without adequate treatment to remove harmful substances. Water pollution affects plants and animals living in these water bodies, and also, affects other aquatic biota. Globally, the most prevalent water quality problem is eutrophication. The present study therefore, is to assess the levels of physico-chemical parameter and heavy metals in river water in the akpor stretch of the New Calabar River, in Port Harcourt, Rivers State, Nigeria.

Materials and Methods

The New Calabar River is bordered on longitude $7°60'E$ and latitude $5°\,45'N$ in the coastal region of Rivers State, Niger Delta, Nigeria. The river releases its water to the Atlantic Ocean. The Rumuolumeni/Akpor area where the river cut across is one of the industrial hubs of the state, and next to Trans Amadi Industrial Layout. Industries situated along its bank discharge their effluents into it. The river is under constant stress dredging and forest operations (transportation of log of wood) and sea transportation among other anthropogenic activities taking place within the river, In addition to illegal oil bunkering activities in the river (Dienye, 2015). The New Calabar receives fresh water, industrial effluent and domestic water from water front settlement and communities along river (Kpee, 2012). Industries and companies that indulge in the discharge of wastes into New Calabar River include among others Indomie, Eagle Cement, Agip Oil, Wilbros Nigeria etc. Obio-Akpor is a local government area in the metropolis of Port Harcourt, one of the major centers of economic activities in Nigeria, and as well as major cites of the Niger Delta, located in Rivers State. It is popularly known as gate- way Local Government Area, because of its strategic location. It has a land mass of approximately 311.71 square kilometers and accessible by road, sea and air transportation. Obio- Akpor was created on the 3rd of May 1989. The local government area covers 260 km. The 2006 Census held a Population of 464,789. The Local Government Area is rich with natural resources, such as land, soil, vegetation, water, coal, petroleum, gas, animals, wildlife, air, wind and atmosphere, clay, sand and gravel. Historically Obio –Akpor people are descendants of aro migrators who moved inland. Obio-Akpor is bounded by Port Harcourt (Local Government Area) to the south, Oyigbo and Eleme to the east, Ikwerre and Etche to the north, and Emohua to the west (Okoh, 2003)

A total of three different sampling stations were selected from the New Calabar River (NCR) within Obio-Akpor Local Government Areas, they include; Mbuodohia, Ogbogoro and Rumukparali, in Port Harcourt, Rivers State, Nigeria. Surface Water samples collected randomly at five different sampling points (10-25 cm) into sterile polyethylene glass bottles fitted and then closed underwater. The containers were prewashed with 20% analytical grade nitric acid and were rigorously rinsed with distilled deionized water prior to sampling. The containers were pre-rinsed again twice with the same water sample they are to contain before the sample was taken. The sample was collected below the surface film of the water. Samples were stored in an ice-chest container and transported to the laboratory for analysis. Sample was persevered by analytical grade nitric acid to give pH < 2 to minimize precipitation and sorption losses to the container walls.

The surface water sample collected was pre-concentrated following a standard procedure described by Essen et al. (2008) and Ramesh et al. (2001). Two polyethylene bottles with snap caps were first treated with dilute HNO_3 and subsequently washed with a warm organic detergent dissolved in distilled water. Therefore, roughly 100 mL of water samples from each location (PS-A (Choba), PS-B (Rumuokparaeli), PS-C (Ogbogoro), PS-D (Mgboduhai), PS-E (Rumuolumeni) were filtered using a 0.2µm filter to remove any suspended matter and then stored in a prepared polyethylene bottles. After filtration, the filtrates were treated separately with concentrated HNO_3 to adjust their pH value to 4.00 ± 0.05 before they were buffered with 2 ML of 0.1M Potassium hydrogen phthalate of 1% (w/v) methanol solution of sodium di-benzyl di-thiocarbonate was added to each filtrate, and the solutions were stirred intermittently for roughly 18-20 min. Each solution was eluted with 4M HNO_3 and the acid elutes was stored for metal analysis.

The determination of various physico- chemical parameters, namely pH, temperature, electrical conductivity, biochemical oxygen demand (BOD), chemical oxygen demand (COD), and heavy concentration lead (Pb), Iron (Fe), chromium (Cr), were carried out as per the method described in (APHA, 1998; APHA,1992) and guide

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manual (Manivaskam et al., 2011). The instruments used were in the limit of précised accuracy. The chemicals used were of AR grade. Due care was taken during sampling to avoid any possibility of contamination.

Results

The concentrations (mean±SD) of the physicochemical parameters in water for dry seasons from New Calabar River are presented in Tables 1. Table 2, presents the wet season concentrations (mean±SD) of physicochemical parameters in water from the studied locations. Table 3: showed Dry season concentrations (mean±SD) of heavy metals in water samples from the studied locations (mg/L). Table 4**,** showed wet season concentrations (mean±SD) of Heavy metals in water samples from the studied locations (mg/L) Table 5, present the Dry Season Contamination Factor of heavy metals in surface water from the New Calabar River. Table 6, recorded the wet season contamination factor of heavy metals in sediment from New Calabar River.

Table 1: Dry season concentrations (mean±SD) of some physicochemical parameters in water from the studied locations

Sampling points	pH	Temp °C	EC us/cm	BOD mg/L	COD mg/L
Mgbuodohia	8.23±0.11	29.40±0.24	1750.62±1.04	96.77±2.04	24.06±1.11
Ogbogoro	9.40±0.42	29.46±0.32	2380.87±193.74	37.20±0.75	15.35±0.13
Rumuokparali	7.88±0.09	28.80±0.11	1954.53±56.22	72.00±0.16	19.55±1.08

Note: pH = potential Hydrogen, EC = Electrical Conductivity; BOD =Biochemical oxygen demand; COD = Chemical Oxygen demand; Mgbuodohia SP-A, Ogbogoro – SP-B and Rumuokparali SP-C

Table 2: Wet season concentrations (mean±SD) of some physicochemical parameters in water from the studied locations

Sampling points	Ph	Temp °C	EC µs/cm	BOD mg/L	COD mg/L
Mgbudahia	7.72±0.26	28.70±0.14	980.17±10.20	72.00±0.16	18.47±0.69
Ogbogoro	8.23±0.11	28.01±0.05	1751.62±1.04	24.73±0.16	9.73±0.22
Rumuokparali	6.55±0.09	27.81±0.13	1348.37±4.02	43.98±0.29	15.35±0.13

Table 3: Dry season concentrations (mean±SD) of heavy metals in water samples from the studied locations (mg/L)

Sampling points	Pb	Fe	Cr
Mgbudahia	2.30±0.53	2.42±0.11	0.42±0.06
Ogbogoro	1.65±0.20	7.33±0.24	0.12±0.01
Rumuokparali	2.27±0.41	10.48±0.28	0.04±0.01

Table 4: Wet season concentrations (mean±SD) of heavy metals in water samples from the studied locations (mg/L)

Sampling points	**Pb**	**Fe**	**Cr**
Mgbudahia	0.85±0.06	1.14±0.11	0.11±0.02
Ogbogoro	1.34±0.07	4.72±0.09	0.09±0.01
Rumuokparali	1.54±0.08	7.23±0.29	ND

Table 5: Dry Season Contamination Factor of heavy metals in surface water from New Calabar River

Sample Site	Pb	Fe	Cr
Mgbudahia	230	8.07	8.4
Ogbogoro	165	24.4	2.4
Rumuokparali	227	34.9	0.8

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Table 6: Wet season contamination factor of heavy metals in sediment from New Calabar River

Sample Site	Pb	Fe	Cr
Mgbuodahia	0.069	0.0002	0.010
Ogbogoro	0.089	0.0003	0.005
Rumuokparali	0.102	0.004	0.002

Discussion

Dry season concentrations (mean±SD) for the physicochemical parameters in water from the studied location as presented in Table 1. pH recorded a mean pH levels of 8.23±0.11 for SP-A (Mgbudohia), 9.40 ± 0.42 for Ogbogoro (SP-B), and 7.88±0.09 for Rumuokparali (SP-C) locations. SP-C (Rumuokparali) recorded the lowest value while SP-B (Ogbogoro) recorded the highest value. These pH levels and their mean values were within the permissible limit of potential hydrogen (pH) in drinking water set by WHO (2005). The lower values of pH may cause tuberculosis. Higher values of pH may produce incrustation, sediment, deposition and some difficulties in chlorination for disinfections of water (Asaolu, 2004). Temperature recorded mean values of 29.40±0.24 for (SP-A), 29.46±0.32 for (SP-B), and for 28.80±0.11 (SP-C). Ogbogoro (SP-B) location recorded the highest value of 29.46±0.32 °C while SP-C (Rumuokparali) recorded the lowest value of 28.80±0.11°C. The observed water temperature were however above the 25°C acceptable limit for no risk, recommended in the South African water quality Guidelines for aquatic ecosystems (Department of Water Affairs and Forestry (DWAF,1996a). Electrical Conductivity (EC) recorded mean values 1750.62±1.04 for (SP-A), 2380.87±193.74 for (SP-B), and 1954.53±56.22 for (SP-C). Ogbogoro (SP-B) recorded the highest value while Mbuodahia (SP-A) recorded the lowest value. These results were higher than the WHO permissible limit of 500µs/cm. High conductivity could be attributed to the iron and metal work in some industries close to the river. Biochemical oxygen demand (BOD) differed from 96.77±2.04 for (SP-A), 37.20±0.75 for (SP-B), and 72.00±0.16 for (SP-E). Mgbudahia (SP-A) recorded the highest mean value 96.77±2.04 while Ogbogoro (SP-B) recorded the lowest mean 37.20±0.75. The BOD of the various locations was more than the approved limit of 4mg/L set by WHO. Chemical oxygen demand (COD) occurred between 24.06±1.11 for (SP-A), 15.35±0.13 for (SP-B), and 19.55±1.08 for (SP-C). Mgbudahia- SP-A (24.06±1.11) recorded the highest value while SP-C, Rumuokparali recorded the lowest value (19.55±1.08).

Wet season concentrations (mean±SD) for the physicochemical parameters in water from the studied locations as showed in Table 2. pH had concentration mean value of 7.72±0.26 for SP-A (Mgbuodohia), 8.23±0.11 for Ogbogoro (SP-B), and 6.55±0.09 for Rumuokparali (SP-E) locations. SP-E (Rumuokparali) recorded the lowest value while SP-B (Ogbogoro) recorded the highest value. These pH levels and their mean values were within the permissible limit of potential hydrogen (pH) in drinking water set by WHO (2005). The lower values of pH may cause tuberculosis. Higher values of pH may produce incrustation, sediment, deposition and some difficulties in chlorination for disinfections of water (Asaolu, 2004). Temperature recorded mean values of 28.70±0.14 for (SP-A), 28.01±0.05 for (SP-B), and for 27.81±0.13 (SP-C). Mgbuodohia (SP-A) location recorded the highest value of 28.70±0.14 °C while SP-C (Rumuokparali) recorded the lowest value of 27.81±0.13°C. The observed water temperature were however above the 25°C acceptable limit for no risk, recommended in the South African water quality Guidelines for aquatic ecosystems (Department of Water Affairs and Forestry (DWAF,2011a). Electrical Conductivity (EC) recorded mean 980.17±10.20 for (SP-A), 1751.62±1.04 for (SP-B), and 1348.37±4.02 for (SP-C). Ogbogoro (SP-B) recorded the highest value. These results were higher than the WHO permissible limit of 500 µs/cm. Mgbuodohia (SP-A) recorded the lowest value which was within the WHO set limit. High conductivity could be attributed to the iron and metal work in some industries close to the river. Biochemical oxygen demand (BOD) differed from 72.00±0.16 for (SP-A), 24.73±0.16 for (SP-B) and 43.98±0.29 for (SP-C). Mgbuodohia (SP-B) recorded the highest mean value 72.00±0.16 while Ogbogoro (SP-B) recorded the lowest mean 18.13±0.28. The BOD of the various locations was more than the approved limit of 4 mg/L set by WHO. Chemical oxygen demand (COD) occurred between 18.47±0.69 for (SP-A), 9.73±0.22 for (SP-B), 15.35±0.13 for (SP-C). SP-A (18.47±0.69) recorded the highest value while SP-B (15.35±0.13) recorded the lowest value.

Dry season concentrations (mean±SD) of Lead (Pb) in water as explained in Table 3, ranged between 2.30±0.53 for (SP-A), 1.65±0.20 for (SP-B) and 2.27±0.41 for (SP-C). Ogbogoro (SP-B) recorded the lowest value while Rumuokparali (SP-C) recorded the highest value. The levels of Pb in dry season however were within US EPA limits (<1.0-7.0) mg/L for Pb and (<0.2-2.8 mg/L) for marine/brackish and freshwater for

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marine/brackish (US EPA, 2000) and WHO standard for 0.001 mg/L. Iron (Fe) ranged between 2.42±0.11 for SP-A, 7.33±0.24 for SP-B, 4.28±0.90 and 10.48±0.28 for SP-C. Mgbuodohia (SP-A) recorded the lowest value while Rumuokparali (SP-C) recorded the highest value. According to the WHO (2010) guideline value, maximum contaminate levels of 0. 3 mg/L of (Fe) might lead to pollution of the aquatic environment. From the result of this study, the concentration of iron in water exceeded the guideline limits indicating severe pollution. Chromium (Cr) ranged between 0.42±0.06 for SP-A, 0.12±0.01 for SP-B and 0.04±0.01 for SP-C. Rumuokparali (SP-C) recorded the lowest value while Mgbuodohia (SP-A) recorded the highest value. The values obtained in this study were found to be below the detectable limit of WHO guideline of 50 mg/L.
Wet season concentration (mean±SD) of Lead (Pb) in water as highlighted in Table 4, occurred between 0.85±0.06 for (SP-A), 1.34±0.07 for (SP-B), and 2.03±0.08 for (SP-C). Mgbuodohia (SP-A) recorded the lowest value while Rumuokparali (SP-C) recorded the highest value. The levels of Pb in the wet season however, slightly exceed US EPA limits (<1.0-7.0) mg/L for Pb and (<0.2-2.8 mg/L) for marine/brackish and freshwater for marine/brackish (US EPA, 2000) and WHO standard for 0.001 mg/L. Iron (Fe) ranged between 1.14±0.11 for SP-A, 4.72±0.09 for SP-B and 7.23±0.29 for SP-C. Mgbuodohia recorded the lowest value while Rumuokparali recorded the highest value. According to the WHO (2010) guideline value, maximum contaminate levels of 0. 3 mg/L of (Fe) might lead to pollution of the aquatic environment. From the result of this study, the concentration of iron in water exceeded the guideline limits indicating severe pollution. Chromium (Cr) ranged between 0.11±0.02 for SP-A, 0.09±0.01 for SP-B, and SP-C (Rumuokparali) was not detected (ND). Ogbogoro (SP-B) recorded the lowest value while Mgbuodohia (SP-A) recorded the highest value.

Dry season contamination factor (CF) of heavy metals in surface water at the three sampling locations from the New Calabar River as presented in Table 5. Lead (Pb) ranged from 230 – 165. SP- B (Ogbogoro) recorded the lowest value while SP- C (Rumuopkarali) recorded the highest value. Iron (Fe) differed from 8.07 – 34.9. SP-B (Mgbuodahia) recorded the lowest value, while Ogbogoro (SP-C) recorded the highest value. Chromium (Cr) differed between 8.4 to 0.8. (Mgbuodahia) (SP-A) recorded the highest value (8.4), followed by SP-B (Ogbogoro (2.4), while SP-C Rumukparali (0.8) recorded the least value from the studied locations. Wet season contamination factor (CF) of heavy metals in surface water as recorded in Table 6 from the New Calabar River. Lead (Pb) ranged from 85 – 154 mg/L. Mgbuodahia (SP-B) recorded the lowest value while SP- C (Rumuokparali) recorded the highest value. Iron (Fe) differed from 3.8 – 241. SP-B (Mgbuodahia) recorded the lowest value, while Rumuokparali (SP-C) recorded the highest value. Chromium (Cr) occurred 0.010 - 0.002 (Mgbuodahia) (SP-A) recorded the highest value (0.010), followed by SP-B (Ogbogoro (0.005), while SP-C Rumukparali (0.002) recorded the least value from the studied stations.

Conclusion

The water quality assessment of the New Calabar River (NCR) was carried out to ascertain the quality of the river water. The results revealed that the water is not safe for domestic purposes. This is because of some of the parameters investigated; only potential hydrogen (pH) was found to have concentrations within the limit set by WHO (2010). Other physicochemical parameters, including temperature, biochemical oxygen demand (BOD) chemical oxygen demand (COD) and electric conductivity, exhibited fluctuations beyond acceptable limits, signifying organic pollution and reduced water quality. The water is not only unsafe for domestic purpose. Some heavy metals concentrations in the surface water were within WHO and several other standards shale permissible/ acceptable limits in some parameters while others were slightly above these limits from the study. The surface water contained most of these heavy metals such as (Pb, Fe and Cr.). It was also observed that some of the parameters had higher concentrations of these metals than others; these could be attributed to wastes carrying higher amounts of these heavy metals than others. Metal contaminants in surface water represent a relevant health issue in several areas of the world, in particular, the presence of high iron (Fe) and lead (Pb) etc. The high levels of Fe suggest increased input from corroded metallic materials, soil leaching, and possibly industrial discharges, whereas the elevated Pb levels raise serious environmental and public health concerns, given lead’s toxicity. The surface water, usually linked to the geological characteristic of the territory, is a challenging task for risk managers, especially when alternative sources of water for human consumption are not available. Heavy metals concentrations at the various sampled locations from the New Calabar River were all (except Fe and Pb) in the wet season lower than the recommended or permissible concentrations by the relevant agencies (DPR, China and World average value in shale). Contamination factor (CF) indicated heavy metals contaminated environment, hence posing health risks to humans and harming aquatic ecosystem. Overall, the findings indicated that the Akpor Stretch of the New Calabar River is experiencing substantial anthropogenic pressure, leading to progressive degradation of its physicochemical integrity. The river, in its present state, may not be suitable for direct domestic use or aquatic life sustainability without proper treatment and remediation

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Recommendations

1. Immediate action should be taken to identify and control the major sources of Fe and Pb contamination. Industries discharging effluents into the river should be mandated to install and maintain effective treatment systems before release.
2. The Rivers State Ministry of Environment, NESREA, and other relevant agencies should conduct regular monitoring of the New Calabar River to ensure compliance with water quality standards and environmental regulations.
3. Communities depending on the river for domestic purposes should be warned about the potential health risks associated with lead and iron contamination. Provision of alternative potable water sources is highly recommended.
4. Initiate public education campaigns to discourage indiscriminate dumping of wastes, encourage recycling, and promote environmentally safe waste management practices in nearby communities.

References

APHA- American Public Health Association (1992). Standard methods for the examination of water and waste water. In: Greenberg A.E., Clesceri L. S., Eaton A.D., editors. *Apha, WEF and AWWA*. 18th. *American Public Health Association*, 1134.

APHA- American Public Health Association (1998). Standard method for examination of water and wastewater. In Cleseri L. S., Greenberg A. E., Eaton A.D., editors. 20th edition. *American Public Health Association, American water works and water Environmental federation (AHPA-AWWA-WEF).* Published by the America Public Health Association.

Aremu, M. O. & Inajoh A. (2007). Assessment of elemental contamination in water selected sea-food from River Benue, Nigeria. *Current world environment 2*(2), 167-173.

Aremu, M. O. Ozonyia G. & Ikokoh, P. P. (2011). Physiochemical properties of well, bore and stream waters in Kubwa, Bwari Arca council. *Elec J. Environ Agric Food Chem, 10*(6) 2296-2304.

Dienye, H. E. and Woke, E. N. (2015). Physico-chemical parameters of the piper and lowerreach of the New Calabar River. *Journal of Fisheries and livestock Production, 3*, 154.

DWAF (Department of Water Affairs and Forestry, South Africa) (1996a) *South African Water Quality Guidelines, 7,* Aquatic ecosystems. DWAF,

Essen J. P., Essen V. & Olajire A. A., (2009). Heavy metal burdens in patches of asphyxiated swamps areas within the Qua Iboe Estuary mangrove ecosystem. *Environment Resource 109,* 690-696.

Kpee, F. (2012). *Pollution levels of Heavy Metals in sediment, Biota and water of Kalabari Creeks.* Rivers State. www.unn.edu.ng.2018.

Manivaskam, N. (2002). *Physicochemical Examination of Water Sewage and industrial Effluent*. 6th. Meerut.

Okoh, A. (2003). *"Excitement Greets AIT'S aunch in Port Harcourt".* Vanguard.

Patil, P. N. Sawant D. N. and Deshmukh, R. N., (2012). Physico-chemical parameters for testing of water: A review. *Int. J Environ. Sci, 3,* 1194-1207

Ramesh, A. Rama, M. K. Seshaiah, K., & Jayakumar, N.D., (2001). Determination of trace elements by inductively coupled plasma atomic emission spectrometry (ICP-AES) after pre-concentration on a support impregnated with pyridine di-thiocarbonate, *Analytical Letter*, *34*(2), 219-229.

Unanian A. E. & Apkan A. W. (2006). Analysis of physic chemical characteristics of some fresh water bodies in Essien Udim Local Government area of Akwa Ibom State, Nigeria. In proceeding of the 21st annual conference of the fisheries society of Nigeria (F250N) Calabar.

World Health Organization (2005). *World Health Report. Fighting disease, fostering development.* http://www.who.mt.

World Health Organization (2011). Evaluation of certain contaminates in FAO/WHO Experts Committee on Food Additives. *WHO Technical Report series,* 595.

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