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PHYSICO-CHEMICAL ANALYSIS OF OGUTA LAKE WATER AND ITS EFFECT ON PHYTOPLANKTON POPULATION

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Abstract

Samples were collected from the three sampling stations namely; Up, Mid and Downstream respectively to investigate the effect of nutrients concentration on the phytoplankton in Oguta Lake. The methods used were electrometric, argentometric titration, phenate spectrophotometric, colorimetric, cadmium reduction and acetone extraction spectrophotometric methods were used to determine the pH of water sample, chlorides, sulphate, ammonia, phosphorus, nitrate, nitrite, chlorophyll-A, conductivity, turbidity, chemical oxygen demand, copper, colour, total dissolved solid, respectively. However, serial dilution was carried out using the spread plate or pour plate method was used to determine the microbial analysis of the sample. At the end of these researches, the Physico-chemical parameters analysed showed that Oguta Lake had total dissolved solids values of 6.50 ± 0.06mg/l, 6.50 ± 0.14 and 6.50 for upstream, mid stream and downstream respectively. The result showed there was no significance total dissolved solids difference between the various stream points

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Key Words: Physico-chemical analysis, Oguta Lake, Effects, Phytoplankton, Population.

(P>0.05). the colour of the Lake showed significant difference ranging from 17.00 ± 1.41 and76.00 V 1.41 in upstream and downstream and the lowest value at upstream. The pH range in this study indicates that the water may be acidic (5.54-7.31). Phytoplankton assemblages obtain across the three stream points showed only three divisions and 78 species. The identified divisions and species are comprised of Eurcharyta (44), Cyanophyta (25) and Chlorophyta (9). Eurkaryta recorded 100%, 5% and 15% abundance in upstream, midstream and downstream respectively, while Cyanophyta recorded the highest abundance at downstream with 75%, Chlorophyta only was identified at the midstream and was least abundance with 23%. The phytoplankton diversity indices done showed that downstream was most diverse having the highest Shannon Weiner Index and Evenness Index of 3.631 and 1.212 respectively. In relation to physicochemical and phytoplankton abundance, the findings in this study is contradictory to some researches. They reported positive correlation of phytoplankton with phosphate and nitrate. There was negative correlation of phosphate with Eurkaryta and Chlorophyta, except for Cyanophyta that showed positive correlation with phytoplankton but not very significant. These low levels of phosphate and nitrate may be the cause of low phytoplankton levels.

Introduction

Phytoplanktons are important and vital aquatic organisms which act as producer to the primary food supply in any aquatic ecosystem. Through the food chain they are the initial biological components from which the energy is transferred to higher organisms (Tiwari and Chauban 2006; Saifullah *et al.*, 2014). The major factors that control the dynamics and structure of the phytoplankton of aquatic ecosystem are thw physic-chemical parameters (Hulyal and Kaliwal, 2009). Adverse changes in the physic-chemical parameters of ecosystems have a substantial or considerable impact on the species that live within them. Seasonal variations in these parameters have an important role in the distribution, periodicity and quantitative and qualitative composition of freshwater biota.

There has been less research carried out on physic-chemical analysis of Oguta Lake water and their effects on phytoplankton. In view of this, the numerous benefits of the phytoplankton has not been utilized or discovered. Most of these organisms lie in the river, lakes, seas and ocean. Unidentified and their usefulness or the high standard products that can be gotten from them – has not been researched. Seasonal variations affect the physic-chemical variables thus causing variation in phytoplankton population. Human activities (agricultural and industrial) going on along Oguta Lake introduces waste into it which could affect the physic-chemical variables from season to season and from shallow to mid stream and to up stream. These therefore cause variation in phytoplankton and zooplankton populations and distribution.

Inspite of many studies conducted in the past on the phytoplankton population in the Oguta Lake, there is no recent study on the effect of physic-chemical analysis or parameters on the phytoplankton population. There is therefore a need to come up with information on the current state of this water body for proper management of the lake. There is no information on the water quality of this lake. This study attempts to provide such vital information for future references. The main aim of the study is to determine the physic-chemical properties of Oguta Lake. The specific objectives of the study include: (a) to determine the physic-chemical properties of the shallow stream, mid stream and up stream, (b) to evaluate the effect of these physico-chemical properties on the phytoplankton populations of Oguta lake.

Materials and Methods

The experiment was conducted at Oguta lake. Oguta lake is the largest lake in Imo State, Southern Nigeria. It is bounded by latitudes 5.41° N 5.44° N and longitudes 6.41° E and 6.5° E with an elevation of 50m above sea level. It occupies a surface area ranging between 1.8km^2 and 2.5km^2, a shoreline length of 10km, and maximum and mean depths of 8.0m and 5.5m respectively. The lake is of immense value to the indigenes, because they draw their water from it. Get 80% of their protein from it. The lake serves as a septic pool for domestic urban sewage. The local people also dredge the lake for sand, which is used in the construction industry.

Water samples and phytoplanktons were collected from three different locations namely, the upstream, midstream and downstream. This was monitored for a period of six months by taking the samples twice in every month. Collected samples were subjected to filtration prior to chemical analysis while pH was determined in the field. The pH electrode used in the pH measurement was a combined glass electrode. It consists of sensing half cell and reference half cell, together form an electrode system. The sensing half cell was a thin pH sensitive semi permeable membrane, separating two solutions, viz: the sample to be analyzed, and the internal solution, enclosed inside the glass membrane and has a known pH value. An electrical potential was developed inside and another electrical potential outside, the difference in the potential was measured and was given as the pH of the sample.

Conductivity was measured with a probe and a meter. A voltage was applied between the two electrodes in the probe, and then immersed in the sample water. The drop in voltage caused by the resistance of the water was used to calculate the conductivity per centimeter.

In obtaining the total solids, the sample was evaporated in a weighted dish on a steam bath and was dried to a constant mass in an oven either at 103-105°C. Total solid or residue was calculated from increase in mass. The total suspended solid was obtained by calculating from the difference between the total solid and total dissolved solids. Biological Oxygen Demand (BOD) was determined using electrometric and incubation method. Presence of Calcium, Magnesium, Nitrogen, Ammonia, Nitrate, Nitrite, Carbonate, Total Organic Carbon, Chemical Oxygen Deman (COD), Chlorides, Phosphorus were also determined. Sodium was estimated by Colorimetric method based on modified Maruna and Trinders methods.

For the plankton study, the types of plankton determine the type of net to be used (5-80μm). Phytoplankton samples collected were fixed in 10% formalin. For phyto-study best preservative is Lugol's Iodine solution. It stains the cell wall better for identification. Samples were well labeled and sent to Laboratory for analyses. During laboratory analysis, samples were allowed to settle at least overnight and excess water at the surface was carefully decanted to a volume of 10 or 20ml. Then the sample was mixed gently and 1ml was poured into the counting chamber (Sedgewick-Rafter counting slide) for identification and counting.

The data obtained for physiochemical parameters were subjected to one way ANOVA using Minitab 17. Mean, standard deviation, bar chart and coefficient was done using Excel 2007. Diversity Indices were also done using species Richness Index, Shannon Weiner Index and Evenness Index. Sorenson's coefficient was used to estimate the stream point similarity in diversity.

RESULTS

Table 1 shows the mean (±SD) of the physiochemical parameters analyzed. The Total dissolved solids had same mean values 6.5±0.06mg/l, 6.50±0.14 and 6.50 for upstream, midstream and downstream respectively. ANOVA result showed there was no significance Total dissolved solids difference between the various stream points ($P>0.05$). The colour of the lake showed significance difference ($P>0.05$) with their mean value ranging from 17.00±1.41PCU in upstream to 76.00±1.41PCU in downstream.

Table 1: Mean (±SD) of Some Physiochemical Parameters in Oguta Lake

Parameter	WHO STD 2013	Upstream	Midstream	Downstream	P-value
		Mean±SD	Mean±SD	Mean±SD	
Total Dissolved Solid, mg/l	500.00	6.50±0.06	6.50±0.14	6.50±0	1.000
Colour, PCU	15.00	17.00±1.41	31.00±0.01	76.00±1.41	0.003
pH	6.5 – 8.5	4.54±0.01	4.98±0.01	6.52±0.01	0.000001
Conductivity, μS/cm	1000.00	10.00±0	10.00±0	10.00±0	ND

Turbidity, NTU	5.00	3.31±0.01	4.24±0.03	6.33±0.01	0.000001
Total Chloride, mg/l Cl^-	250.00	161.95±0.10	207.94±0.04	191.94±3.37	0.000358
Chemical Oxygen Demand, mg/l COD	30.00	0.48±0.01	2.40±0.28	1.60±0.14	0.004247
Biochemical Oxygen Demand, mg/l BOD	10.00	0.30±0.14	1.50±0.14	1.00±0.14	0.007895
Mercury, mg/l Hg	0.001	1.378±0.001	0.851±0.001	1.131±0.001	1E-07
Nickel, mg/l Ni	0.02	0.342±0.001	0.282±0.001	0.272±0.001	3.38E-05
Copper, mg/l Cu	0.1	0.065±0.001	0.090±0.001	0.172±0.001	1.05E-05
Phosphate, mg/l PO^{-3}_4	5.00	1.60±0.14	1.60±0.57	2.00±0.28	0.198725
Sulphate, mg/l SO^-_4	200-400	0	0±	0	ND
Nitrate, mg/l NO_3^-	50.00	30.10±0.14	92.50±0.11	29.80±0.14	3.9E-08
Iron, mg/l Fe	0.30	0.06±0.03	0.06±0.03	0.04±0.01	0.677553
Ammonia, mg/l NH_3	0.30	0.07±0.01	0.03±0.01	0.03±0.01	0.102846
Lead, mg/l Pb	0.05	0.237±0.002	0.421±0	0.873±0.001	1.13E-07
Cadmium, mg/l Cd	0.01	0.027±0	0.130±0.001	0.012±0.001	3.77E-06
Arsenic, mg/l As	0.2	0.076±0.002	0.208±0.003	0.033±0.002	0.000504
Cobalt, mg/l Co	NS	0	0/017±0.001	0.026±0.001	0.130701

Silver, mg/l Ag	0.01	1.080±0.03	0.678±0.02	0.439±0.003	0.038417
Nitrite, mg/l NO_2^-	NS	0.03±0.01	0.03±0	0.01±0	0.142427

Phytoplankton result

The Table 2 shows the total number of individuals and species of phytoplankton, Table 3 shows the abundance of phytoplankton in Oguta lake. However, Table 4 and 5 show the Diversity Indices and Community (phytoplankton) and Stream Points Similarity (Diversity) at the different stream point in Oguta lake. Phytoplankton assemblages obtained across the three stream points showed only three (3) division and 78 species. The identified divisions and species they comprise are Eurkaryta (44), Cyanophyta (25) and Chlorophyta (9). Three Diversity Indices were used to obtain the estimated species diversity in Oguta lake; Species Richness Index, Shannon Weiner Index and Evenness Index. Sorenson's Coefficient was used to estimate the Stream Point Similarity in Diversity.

Table 2: Total Number of Individuals and Species (Phytoplankton)

Sampling point	Phylum	Common name	Species	Count
Upstream	Eurkaryta	Golden algae (Diatom)	*Prymnesium parvum*	8
	Eurkaryta	Dinophyceae (Dinoflagellate)	*Dinophysis acuminate*	4
	Eurkaryta	Golden algae (Diatom)	*Macrocystis nereocystis*	3
	Eurkaryta	Golden algae (Diatom)	*Chaetoceros Spp.*	4
	Eurkaryta	Golden algae (Diatom)	*Macrocystis nereocystis*	6

Midstream	Cyanophyta	cyanobacteria	*Macrocystis gemginosa*	10
	Eurkaryta	Golden algae (Diatom)	*Prymnesium parvum*	11
	Eurkaryta	Golden algae (Diatom)	*Dinophysis acuminate*	3
	Chlorophyta	Spirogyra	*Zygnemataceae*	9
Downstream	Eurkaryta	Golden algae (Diatom)	*Coscinodiseacae centralis*	3
	Eurkaryta	Golden algae (Diatom)	*Pyrocystis lunula*	2
	Cyanophyta	Cyanobacteria	*Macrocystis gemginosa*	11
	Cyanophyta	Cyanobacteria	*Anabaena flosaquae*	4

Table 3: Abundance of Phytoplankton in Oguta Lake

Phylum	Upstream	Midstream	Downstream	Total
Cyanophyta	0	10	15	25
Chlorophyta	0	9	0	9
Eurkaryta	19	20	5	44
Total	19	39	20	78

Table 4: Diversity Index Value of Phytoplankton in Oguta Lake

Index	Upstream	Midstream	Downstream
Richness (S)	19	39	20
Shannon weiner (H)	0	1.03	3.631
Evenness (E)	0	0.281	1.212

Table 5: Stream Points Similarity in Diversity in Oguta Lake

Sampling point	Sorenson's coefficient
Upstream - Midstream	0.67
Upstream - Downstream	0
Midstream - Downstream	0.2

Bacteriological results

Table 6 shows the total bacterial count, coliform count, feacal coliform count and E. coli count of Oguta lake. The total bacterial count ranged from 4.20 – 4.88 Log_{10} CFU/ml. There was no E. coli detected at midstream and downstream.

Table 6: Microbiological Result of Oguta Lake

Sampling point	Total Bacteria count (Nutrient Agar) Log_{10} CFU/ml	Total Coliform count (MAC) Log_{10} CFU/ml	Total Faecal Coliform count (EMB) Log_{10} CFU/ml	Total E. coli Count (EMB) Log_{10} CFU/ml
Upstream	4.88±0.02	4.75±0.21	4.41±0.15	3.00042
Midstream	4.90±0.08	4.56±0.08	4.68±0.17	NG
Downstream	4.20±0.14	4.04±0.08	3.00±0.8	NG
P-value	0.050684	0.031165	0.08405	0.001797

Table 7: Correlation Coefficient of Phytoplankton Abundance and Physico-chemical Parameters in Oguta Lake

Parameters	Eurkaryta	Chlorophyta	Cyanophyta
Total Dissolved Solid, mg/l	ND	ND	ND
Colour, PCU	-0.95861	-0.29029	0.885
pH	-0.963	-0.30542	0.877

Conductivity, µS/cm	ND	ND	ND
Turbidity, NTU	-0.93412	-0.2165	0.918
Total Chloride, mg/l Cl^-	-0.11395	0.76648	0.776
Chemical Oxygen Demand, mg/l COD	-0.03627	0.814152	0.724
Biochemical Oxygen Demand, mg/l BOD	-0.03627	0.814152	0.724
Mercury, mg/l Hg	-0.09565	-0.88352	-0.627
Nickel, mg/l Ni	0.561666	-0.38125	-0.980
Copper, mg/l Cu	-0.9597	-0.29397	0.883
Phosphate, mg/l PO^{-3}_4	-0.99822	-0.5	0.756
Sulphate, mg/l SO^-_4	ND	0.999991	ND
Nitrate, mg/l NO_3^-	0.554205	0.5	0.184902
Iron, mg/l Fe	0.998221	0.5	-0.75593
Ammonia, mg/l NH_3	0.447478	-0.5	-0.94491
Lead, mg/l Pb	-0.94121	-0.23639	0.909476
Cadmium, mg/ Cd	0.644429	0.993161	0.073038
Arsenic, mg/l As	0.732002	0.971811	-0.04786
Cobalt, mg/l Co	-0.72548	0.174908	0.999898
Silver, mg/l Ag	0.745823	-0.14526	-0.99902
Nitrite, mg/l NO_2^-	0.998221	0.5	-0.75593

DISCUSSION

Physico-chemical parameters

The total dissolved solid was the same across the three points with 6.50mg/l which was significantly lower than the WHO maximum limit of 500mg/l. The mean values are quite lower than the values recorded by Ikuoriah and Oronsaye (2016) in their study of Ossiomo River, Ologbo – a tributary of Benin River.

The pH was highest in downstream and the lowest value at upstream. The mean pH concentration does not exceed the freshwater local and International Standard Limits (of 6.5 – 8.5). The pH range in this study indicates that the water may be acidic. The range recorded in this study is close to 5.54 – 7.31, recorded by Awana (2002) for the River Ossiomo River, Ologbo – a tributary of Benin River, an indication that the water is becoming more acidic due to increased human activity such as occasional oil spill, dredging, local brewing, and lumbering activities which was prominently observed during the period of study. The acidic pH observed in this study agrees with Akubugwo *et al.,* 2013. However, this contradicts the report of Ogueri *et al.,* 2018 over the same lake of study.

The colour detected in this study was 17.00±1.41, 31.00±0.01 and 76.00±1.41 for upstream, midstream and downstream respectively. There was significance difference ($P<0.05$) between the 3 sampling points with upstream and downstream recording the least and highest respectively. The colour detected at each point was more than the WHO Standard of 15PCU. The reason of this high colour may be due to the influx of muddy water into the water body during this raining season (Okorie and Nwosu, 2014).

The turbidity detected in this study was 3.31±0.01, 4.24±0.03 and 6.33±0.01 for upstream, midstream and downstream respectively. Apart from downstream, other points are within the WHO acceptable range. The upstream recorded the least in turbidity which Umunnakwe and Aharanwa, (2014) also reported the upstream of this same lake to be least turbid. However, the mean turbidity at each significantly lower ($P<0.05$) than the report of Umunnakwe and Aharanwa, (2014). In this study, downstream recorded highest turbidity which agrees to its high colour detected (76PCU), this observation contradicts the report of Umunnakwe and Aharanwa, (2014), as they reported midstream to have the highest turbidity with 12.28NTU.

Conductivity is primarily determined in water by the presence and levels of concentration of Sodium and Magnesium ions and to some extent Calcium ions. These ions help buffer the effect of Bicarbonate and Carbonate ions, thus maintaining the pH (Ikuoriah and Oronsaye, 2016). Values of Conductivity recorded are an indication of negligible impact of human activities in the area. There is no significant difference ($P<0.05$) across the stations and seasonal variation of electrical conductivity. The values are far below WHO maximum limit of 1000µS/cm.

The Total Chloride observed during this study was lower than the maximum value given by WHO standard. There was significant difference between points ($P<0.05$) with midstream recording the highest value of 207.94±0.04 and upstream having the least with 161.95±0.10. This is in line with the report of Ebigwe (2014) about Great Kwa River, Calabar.

The Chemical Oxygen Demand (COD) is important in determining the organic load of a water sample (Odika and Duru, 2013). COD levels of Oguta lake in this study, are lower than WHO standard. There was no significant difference between means of the 3 points. The observed values in this study are lower than the reported values by Umunnakwe and Aharanwa (2014) about same point of Oguta lake.

The Biological Oxygen Demand (BOD) observed in this study across the 3 points was within the WHO acceptable range. The lowest value observed in this study, is in agreement with the report of Umunnakwe and Aharanwa (2014). The low level of BOD in this study, show that the water of Oguta lake may sustain life (Umunnakwe and Aharanwa, 2014).

The values of Mercury across the 3 points were higher than WHO standards, and show no significant difference across the sampling point ($P<0.05$). This contradicts the report of Umunnakwe and Aharanwa (2014) showing no detectable Mercury in Oguta lake.

The values of Nickel across the 3 sampling points were higher than WHO standard and shown no significant difference across the sampling points ($P<0.05$). The values observed in this study are higher than Umunnakwe and Aharanwa (2014).

The concentration of Phosphate across the 3 sampling points was within the acceptable value of WHO standard. The acceptable level of Phosphate in this study is in line with the report of Umunnakwe and Aharanwa (2014). There was no significant difference ($P<0.05$) across the 3 points. The detectable Phosphate may be caused by the use of agrochemicals in lands near the water body (Adefemi and Awokunmi, 2010). However, there is no detectable Sulphate in this study which is in line with report of Umunnakwe and Aharanwa (2014).

The Nitrate and Ammonia in this study show compliance with WHO standard, there was no significance Nitrate difference across the 3 sampling points ($P<0.05$), with midstream recording the highest value of 920.11mg/l which only exceeded the WHO standard. The highest value of Oguta lake midstream was also reported by Umunnakwe and Aharanwa (2014). Okorondu and Anyadoh (2015) reported high Nitrate concentration of this same water body. There was no significant difference ($P<0.05$) across the 3 sampling points as the value recorded was below maximum acceptable WHO standard.

The Iron, Arsenic and Cobalt observed values were lower than the maximum acceptable WHO standard as they showed no significant difference ($P<0.05$) across the 3 points. Arsenic was not detected by Umunnakwe and aharanwa (2014) reported but reported high Iron content. Arsenic showed significant difference ($P<0.05$) across the 3 points.

Lead, Cadmium and Silver observed values were higher than WHO standard with no significant difference ($P<0.05$) across the 3 points. It is reported that Lead alters learning ability in infant as well as increase blood pressure and Kidney problem in adults (Hoekman, 2015). It was also reported that high Cadmium level in water when consumed may cause nausea, vomiting, diarrhea, muscle cramps, liver injury and renal failure (Hoekman, 2015).

Nitrate was low with no significant difference ($P<0.05$) across the 3 points. This contradicts the report of Okorondu and Anyadoh (2015) on high Nitrate concentration on Oguta lake.

Phytoplankton Assemblages

Phytoplankton assemblages obtained across the three stream points showed only three (3) divisions and 78 species. The identified divisions and species they comprise are Eurkaryta (44), Cyanophyta (25) and Chlorophyta (9). Three

diversity Indices were used to obtain the estimated species diversity in Oguta lake. Eurkaryta recorded 100%abundance in upstream, 51% and 15% abundance in midstream and downstream respectively, while Cyanophyta recorded the highest abundance at downstream with 75%. Chlorophyta only was identified at the midstream and was least abundance with 23%. The Phytoplankton diversity indices done showed that downstream was most diverse having the highest Shannon Weiner Index and Evenness Index of 3.631 and 1.212 respectively. The downstream Richness fell short of midstream which recorded the highest Richness of 39 species. Upstream was the least diverse among the stream points having Shannon Weiner Index and Evenness Index of 0 respectively. The Cyanophyta most abundance at downstream is also reported by Adelakun *et al.,* (2016). In this study, the phytoplankton order was Eurkaryta > Cyanophyta > Chlorophyta, which does not agree with most reported works stating Chlorophyta to be greater than Cyanophyta (Fonge *et al.,* 2012).
Stream Point Similarity in Diversity in Oguta lake done showed that upstream and midstream was closely similar in diversity, midstream and downstream had very little similarity, while upstream and downstream had no similarity.

Phytoplankton Abundance – Physicochemical Relationship

This finding agrees with that of most authors who reported that the phytoplankton community in fresh water is mostly Chlorophyta, Cyanophyta and Diatoms (Sorayya *et al.,* 2011). Wackstrom *et al.,* (1997) and Ajuonu *et al.,* (2011) reported that the qualitative and quantitative dominance of diatoms in an aquatic ecosystem is a major indicator of water quality and environmental condition as they are adapted to a wide range of physico-chemical parameters. The presence of blue-green algae, as the most abundant genera, indicates that the water is not potable except after treatment. The blue-green algal blooms gave a dark green paint-like appearance in water, which is indicative of eutrophication (Fonge *et al.,* 2012). According to Palleyi *et al.,* (2011), phytoplanktons need a variety of chemical elements but the two critical ones are Nitrogen and Phosphorus. The finding in this study is contradictory to Fonge *et al.,* (2012) report of positive correlation of phytoplankton with phosphate and Nitrate. In this study, there was negative correlation of Phosphate with Eurkaryta and Chlorophyta, except for Cyanophyta that showed strong correlation. Nitrate showed positive correlation with phytoplankton but not very significant. This poor positive correlation of Nitrate agrees with the report of Palleyi *et al.,* (2011). Palleyi *et al.,* (2011) suggested this may be due to the low level of Nitrate and low Nitrate level was detected in this level. These low levels of Phosphate and Nitrate may be the cause of low phytoplankton levels (Williams and Tonnessen, 2000).

Bacteriological Results

The results obtained in this study agree with similar studies by other researchers who reported that heterotrophic bacteria are found in water and could be from human/animal wastes, runoffs, pastures, natural soil or plant bacteria, sewage and other unsanitary practices (Ibe and Okplonye, 2005). The high total bacteria count recorded could be as a result of increased surface area which exposes the water to contaminant as well as human activities like swimming, washing, dipping of dirty legs, hands and cans inside the stream while fetching water as also reported by (Welch *et al.,* 2000). The high coliform values obtained maybe an indication that the water samples were faecal contaminated as also reported in a similar study by (Ajayi and Akonal, 2005). The upstream was more contaminated than others as there was significant difference across the three sampling points ($P<0.05$). The presence of *E. coli,* not only make water unsuitable for human consumption and usage but also pose serious health concerns. In this study, *E. coli* was only detected at the upstream while faecal coliforms was detected in all sampling point with no significant difference ($P>0.05$). These imply that water from Oguta lake is microbiologically unfit for both drinking and recreational purposes.

CONCLUSION

It has been revealed that currently, the microbiological and physic-chemical quality of water from the Oguta lake makes it unfit for drinking and recreational activities. Yet many unassuming people are found using the water body for both activities. The contaminants seem to have seeped into the water body via human activities and agricultural runoff. There is therefore serious need to control activities around the lake to prevent microbial as well as harmful chemical contaminants which have public implications. Following the low number of phytoplankton as result of low level of Phosphate and absence of Sulphate, the pollution of Oguta lake maybe due to biological contaminants.

RECOMMENDATION

It is recommended that safe disposal of domestic sewage and industrial effluents should be practiced by operators and relevant legislations for protection of our water bodies enforced.

REFERENCES

Adefemi, S. O. and Awokunmi, E. E. 2010. Determination of physic-chemical parameters and heavy metals in water samples from Itaogbolu area of Ondo State, Nigeria. *African Journal of Environmental Sciences and Technology,* 4(3), 145-148.

Ajayi, A.O. and Akonal, K. A. 2005. Distribution pattern of Enteric organisms in Lagos Lagoon, *African Journal of Biological Research,* 8 (3): 163-168.

Ajuonu, N. Ukaonu, S. U., Oluwajoba, E. O., Mbawuike, B. E., Williams, A.B. and Myade, E. F. 2011. The abundance and distribution of plankton species in the Bonny Estuary, Nigeria. *Agriculture and Biology Journal of North America*, 2: 1023-1037.

Akubugwo, E., Nwachukwu, M., Odika, P. C. and Duru, M. K. C. 2013. Water Quality Assessment of Njaba River, Nigeria. *Journal of Environmental Science, Toxicology and Food Technology,* 4(6): 33-37.

Awana, B. B. 2002. The Crustacean zooplankton of Ossiomo River, Ologbo. A B. Sc. Thesis, University of Benin, Benin City. pp49.

Ebigwe, J. 2014. Physic chemical Parameters and Phytoplankton Assemblages along Spatial and Temporal Gradients in Great Kwa River, Calabar, Nigeria. *International Journal of Biology and Chemistry,* 8(1): 1-20.

Fonge, B. A., Tening, A. S., Egbe, E. A., Yinda, G. S., Fongod, A. N. and Achu, R. M. 2012. Phytoplankton diversity and abundance in Ndop wetland plain, Cameroon. *African Journal of Environmental Science and Technology,* 6(6): 247-257.

Hoekman, T. B. 2015. Heavy metal toxicology. http://www.heavy.metals.html. October, 2000. Accessed 20th Sept., 2019.

Hulyal, S. B. and Kaliwal, B. B. 2009. Dynamics of phytoplankton in relation to physic-chemical factors of Almatti reservoir of Bijapur district, Karnataka State. *Environ. Monit. Assess.* 153, 45-59.

Ibe, S. W. and Okplonye, J. 2005. Bacteria Analysis of Borehole Water in Uli Nigeria. *African Journal of Applied Environmental Biology*, 7: 116-119.

Ikhuoriah, S. O. and Oronsaye, C. G. 2016. Assessment of Physicochemical Characteristics and some Heavy Metals of Ossiomo River, Ologbo – A Tributary of Benin River, Southern Nigeria. *Journal of Applied Science and Environmental management,* 20 (2) 472-481.

Odika, P. and Duru, M. 2013. Seasonal Water Quality study of Nche stream, A water body in Imo State, Nigeria. *An International Research Journal of Environmental Science.* Doi: http://dx.doi.org/10.12944./CWE.14.3.11. ISSN:0973-4929, online ISSN: 2320-8031.

Ogueri, C., Adebayo, E. T. and Nwaiwu, V. N. C. 2018. Assessment of heavy metals in fish species and some physic-chemical parameters of Oguta lake, Imo State, Nigeria. *International Journal of Hydrology.* 2(2): 112-115.

Okorie, D. O. and Nwosu, D.O. 2014. Seasonal variations in Physicochemical properties of Imo River. *Journal of Pharmacy and Biological Sciences*. 9(5), pp. 7-9.

Okorondu, S. I. and Anyadoh-Nwadike, S. O. 2015. Bacteriological and physiochemical Analysis of Oguta lake water, Imo State, Nigeria. *Science Journal of Public Health,* pp: 14-19.

Palleyi, S., Kar, R. N. and Panda, C. R. 2011. Influence of Water quality on the biodiversity of phytoplankton in Dhamra River Estuary of Odisha Coast, Bay of Bengal. *Journal of Applied Science and Environmental Management,* 15 (1) 69-74.

Saifullah, A. S. M., Hena, M. K. A., Idris, M. H., Halimah, A. R., Johan, I. 2014. Diversity of Phytoplankton from Mangrove Estuaries of Soarawak, Malaysia. *World Applied Science Journal.* 31, 915-924.

Sorayya, M., Aishah, S., Mohd, B., sapiyan, S. and Mumtazah, S.A. 2011. A self organizing map (SOM) guided rule based system for freshwater tropical algal analysis and prediction. *Scientific research and Essays,* 6(25); 5279-5284.

Tiwari, A. and Chauhan, S. V. S. 2006. Seasonal phytoplanktonic diversity of Kithan Lake. *Agra. Journal of Environmental Biology,* 27, 35-38.

Umunnakwe, J. E. and Aharanwa, B. C. 2014. Assessment of Water Quality and Heavy Metal levels of Fish Species in Oguta Lake, Imo State, Nigeria. *Journal of Natural Sciences,* 4(8): 201.

Wackstrom, J., Korhola, A. and Blom, T. 1997. Diatoms as quantitative indicators of pH water temperature in subartic fennoscandian lakes. *Hydrobiology*, 347:171-184.

Welch, P., David, J., Clarke, T. B., Dougaltia, M. C. and Adesiyin, A. A. 2000. Microbial sanitation of Water in Rural Communities of Trinidad. *Pan American Journal of Public Health,* 8(3): 72-180.

Williams, M. W. and Tonnessen, K. A. 2000. Critical loads for Inorganic Nitrogen Deposition in the Colorado Front Range, USA. *Ecological Application*, 10:1648-1665.