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Evaluation of the Physicochemical Parameters and Phytoplankton Composition of Aiba and Erinle Reservoirs

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Abstract
Physicochemical and biological characteristics of Aiba and Erinle reservoirs were studied to examine the suitability of surface water for drinking purpose. The study aims at comparing physicochemical parameters (such as heavy metals, phosphate, nitrate, pH etc) of the two reservoirs with permissible limits stipulated by World Health Organisation and other Environmental Protection Agencies; and also investigating the presence of pollution indicator phytoplankton species. Water samples were collected from two sampling stations of each reservoir and analysed for physicochemical parameters and phytoplankton composition to know the present status of the water bodies. The two reservoirs are alkaline in nature and some of the physicochemical parameters are above the permissible limits prescribed by World Health Organisation and other national and international bodies. This is supported by the presence *of Nitzschia* sp., *Closterium* sp. and *Oscillatoria limosa* that are regarded as pollution tolerant species. The presence of some toxigenic algae indicates the pollution level of the two water bodies.

Keywords: Water quality, Pollution, Bio-indicators, Algae

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Introduction
A reservoir often refers to an enlarged natural or artificial lake. Reservoirs serve a lot of purposes which include direct water supply, irrigation of farmlands, generation of hydroelectricity, recreational purposes such as kayaking and flood control. They provide raw water feed for water treatment plants which deliver drinking water for human consumption. Water quality can be evaluated on the basis of physicochemical parameters and the aquatic life composition.

Physicochemical parameters describe the physical and chemical properties which determine the quality of water. These parameters determine the suitability of water for human consumption and influence the phytoplankton community of aquatic ecosystems (Moreno *et al*., 2018). Nutrient concentrations, temperature, sunlight and carbon dioxide are important parameters that influence the phytoplankton composition of aquatic ecosystems. However, the growth of certain phytoplankton species can result in harmful algal blooms (HABs) which produce toxic compounds with harmful effects on humans and aquatic organisms. Algal blooms deplete the dissolved oxygen in coastal waters and can lead to suffocation and death of fishes and even humans. There is thus an interrelationship between physicochemical parameters and phytoplankton composition of aquatic ecosystems.

Phytoplankton comes from the Greek words; phyton and planktos which mean plant and drifter respectively. They are microscopic organisms found in the euphoric zone of freshwater and marine ecosystems. Phytoplankton are responsible for approximately half of all photosynthetic activities that takes place on earth. They utilize carbon dioxide and sunlight energy through the process of photosynthesis to produce oxygen and organic compounds. Phytoplankton forms the bases of aquatic food web and they serve as food for zooplankton, fish larvae and other aquatic organisms. There are about 5000 known species of marine phytoplankton (Hallegraeff, 2003). Phytoplankton require nutrients such as nitrates, phosphate, silicate, sulphur and calcium at various levels depending on the species. According to Brettum and Anderson (2005), phytoplankton communities are sensitive to challenges in their environment and therefore phytoplankton total biomass and many phytoplankton species are used as indicators of water quality. According to Rani and Sivakumar (2012), the study of phytoplankton diversity contributes to an understanding of water quality. Phytoplankton have been recognized as bio indicators of pollution in aquatic ecosystems (Yakubu *et al*., 2000).

Relevant studies have revealed that alteration in phytoplankton composition indicates variation in water quality and also changes in physicochemical and biological parameters. Algae appear as essential biological indicators because they respond quickly to alterations in ecosystem situations and thus useful quick assessment of water.

The Aiba and Erinle reservoirs are located in Osun State. These reservoirs provide potable water supply for the surrounding communities. To the knowledge of the authors, there is no research work on the comparative study of water quality parameters in relation to phytoplankton composition of Erinle and Aiba reservoirs. Therefore, the present study aims at studying some physicochemical parameters of the two reservoirs, comparing their values with permissible limits prescribed by World Health Organisation and other Environmental Protection Agencies and also investigating the presence of pollution indicator phytoplankton species in the two reservoirs.

Materials and Methods

Study Area

Aiba reservoir is one of the oldest reservoirs in the south western part of Nigeria. It lies between longitude $004^0 11$ to $004^0 13^1$ and latitude $07^0 38^1$ to $07^0 39^1$ of the equator. The reservoir experiences two major air masses (North East Trade Wind and South West Trade Wind) which shapes the various seasons of the year. The annual regime of rainfall shows two peaks, one in July and the other in September. The area is characterized by Riparian Forest. Air temperature ranged from 20.00 – 30.50^0C (mean ± S.E. 26.33±0.26^0C). It is 11.38m high and 455.2m long with original storage capacity of approximately 1.91 billion square kilometers. It has a mean depth of 0.75m and a maximum of depth of 7.5m. The bank was mostly covered with tropical vegetation. The reservoir was created for the supply of potable water to surrounding towns. The flora includes sedges, pondweeds, duckweeds and water hyacinths. Human activities around the reservoir include fishing, bathing and swimming.

Erinle reservoir is located in Olorunda Local Government Area, Osun State and lies upstream on the Erinle reservoir (Fig 1). It is owned and operated by the Osun State water corporation. The reservoir is located at longitude $4^0 27$`E and $7^0 46$`N. It has a storage capacity of 94,000,000m^3. It is 330m above sea level, has a crest length of 700m, a maximum height of 27m and a spillway discharge of 800m^3/sec. The dam is used for water supply, flood control and fishing. The surrounding vegetation has a mixture of Savannah, light and thick forest with scattered cultivation due to various human activities. The reservoir has residential, commercial and industrial areas on both sides which release untreated waste into the reservoir.

Sampling and Analysis

Water samples were collected on a monthly basis from the selected reservoirs for a period of eight months (January 2019 – August 2019). Collection of surface water samples were made using plastic containers of 1 litre capacity.

Measurement of temperature and pH were taken on site using a mercury in bulb glass thermometer and pH meter (model H196107) respectively. Chromium, Aluminum, and Zinc were determined using an Atomic Absorption spectrophotometer. Silica content was measured according to APHA (1995) standard procedure using Hach Spectrophotometer (model DR-EL/2). Conductivity was measured using conductivity meter (model AD.33915). Nitrate and phosphate were determined using the corning flame photometer (Model 400). Biological oxygen demand was measured using the procedures of APHA (1995). Turbidity was determined *in-situ* according to Pandey *et al*., (2005). Dissolved Oxygen was determined by Winkler's titrimetric method.

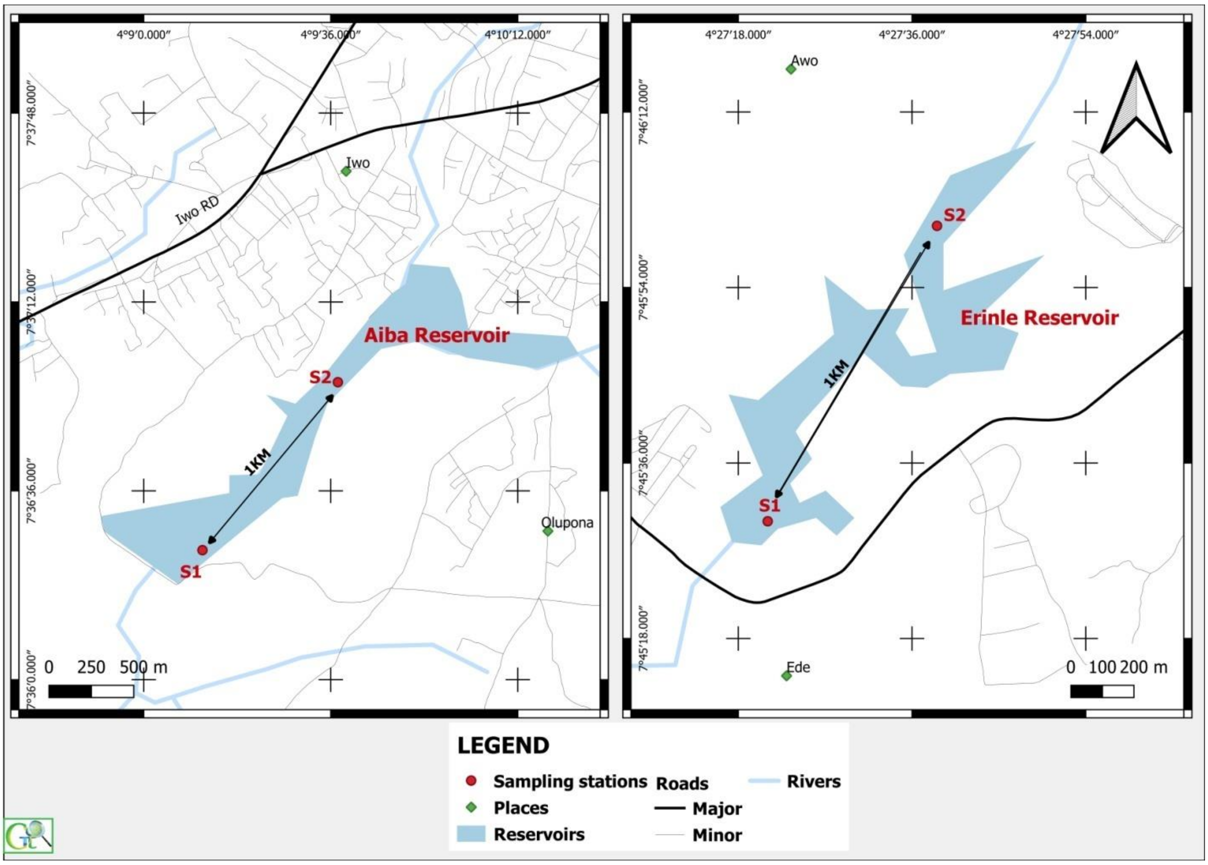

Figure 1: Aiba and Erinle Reservoirs

Calcium hardness and magnesium hardness were determined using titration method described in APHA (1995). Alkalinity was determined by Titration method. Ethylenediamine tetraacetic acid (EDTA) titrimetric method was used in the determination of total hardness. Potassium and chloride content were determined using standard methods (Arnold *et al*., 1985).

Collection and analysis of phytoplankton samples.

Phytoplankton samples were collected from the water surface of two reservoirs using a plankton net (55 µm mesh size) and a plastic container was used to collect 250ml water from each reservoir. The samples were fixed with 4% formalin and stored in the laboratory prior to microscopic analysis. Few drops of concentrated phytoplankton suspension were pipetted onto Sedgewick-Rafter counting chamber. Phytoplankton were identified using internationally accepted taxonomic keys of Edmonton (1959), Prescott (1970) and Sharma (1986). The plankton were counted as number per mL and calculated as number per liter of water.

Statistical analysis

Physico-chemical parameters were analyzed to determine the mean and standard deviation. T-test was used to determine the reservoirs significant differences at $p<0.05$ using Graph-pad Prism 5.0. The raw data was further analyzed using the software Microsoft Excel to determine the relative abundance, Shannon-Weiner Index, Evenness and Simpson Diversity among the different phytoplankton.

Relative abundance

The relative abundance (*pi*) is the proportional representation of a species in a community or sample of a community. The relative abundance (*pi*) of each species is expressed as

$$Pi = \frac{ni}{N} * 100$$

Where *ni* is the number of individuals of the same species and *N* is the total number of individuals for all species.

Shannon index of diversity

The Shannon index of diversity, as detailed by Margalef (1957), is widely used since it considers both species richness and evenness. The Shannon index (*H*1) is computed as

$$H' = -\sum_{i=1}^{s} pi \ln pi$$

Where *pi* is the proportion of total sample belonging to the *i*th species.

Simpson diversity indices

The Simpson diversity index measures community diversity.

$$D = 1 - \frac{\sum n(n-1)}{N(N-1)}$$

Evenness index

Evenness is the degree of equitability in the distribution of individuals among a group of species. Evenness (*J′*) as used by Pielou (1975) is computed as

$$J' = \frac{H'}{InS}$$

Where *H*' is the Shannon–Wiener index of diversity and *S* is the number of species.

Results

The mean values of the physicochemical parameters of Aiba and Erinle Reservoirs are presented in Table 1. There was a statically significant difference at ($p<0.05$) between the parameters (pH, temperature, chloride, aluminum and chromium) of Aiba reservoir and Erinle reservoir. Also, there was a highly significant difference ($p<0.0001$) between parameters (turbidity, dissolved oxygen, alkalinity, biochemical oxygen demand, conductivity, silica, nitrate, total hardness, carbonate, magnesium hardness & potassium) in both reservoirs. There were no significant differences ($p<0.05$) in the values of physicochemical parameters such as phosphate, calcium hardness and zinc in Aiba reservoir and Erinle reservoir, meaning that the values were almost the same in the two water bodies.

Discussion

Physicochemical parameters of the reservoirs

The mean values of pH in both reservoirs ranged between 7.0 – 9.8 i.e. slightly alkaline in nature. The maximum value of pH (9.8) was recorded in Erinle reservoir and the minimum pH value (7.0) was recorded in Aiba reservoir. The two reservoirs have pH values slightly above the permissible range (6.5 to 8.5) given by WHO, USEPA, ISI, CPCB (Table 1). The pH value in Erinle and Aiba reservoirs fall within the range reported by Akinyemi and Nwankwo (2006).

The water temperature ranged between 22^0C to 29^0C. The range in both reservoirs compares well with ranges recorded by Ibrahim *et al.* (2009) in Kontagora reservoir. The water temperature range for Aiba and Erinle reservoirs is within the standard (maximum of 31^0C) required for growth and proliferation of phytoplankton (Afzal *et al.,* 2007).

Turbidity is a measure of suspended minerals, bacterial, plankton and dissolved organic and inorganic substances. Turbidity values ranged between 0.9 to 34.3 NTU. The highest values were reported during the rainy season in Aiba reservoir. The values recorded in reservoir (Aiba) do not conform to the standard set by ICI, ICMR and CPCB (Table 1). Higher turbidity values could be due human activities around the reservoir as well as surface run-offs during the raining season (Kutama *et al*., 2003).

Dissolved oxygen ranged between 1.4 – 5.2 mg/L in the two reservoirs which was slightly lower than the permissible limits as prescribed by WHO for drinking water purposes. The range obtained in both reservoirs does not compare favourably with the reports of Olukosi *et al*., (2016) and Akinyemi and Nwankwo (2006).

Alkalinity is a measure of the capacity of water to neutralize acids. Alkalinity is not considered detrimental to humans but generally is associated with high pH values. Alkalinity values ranged between 36.3 – 111.0 mg/L, which conforms to the standard set by CPCB for drinking water.

Potassium concentrations in the two reservoirs were generally low. Mean values of potassium in both reservoirs ranged between 0.8 – 2.6 mg/L and the range fell within the allowable range set by WHO for drinking water.

Conductivity mean values in both reservoirs ranged between 231.0-305.4 μscm^{-1}. This range (231.0-305.4 μscm^{-1}) fall within the standard set by CPCB (Table 1). Conductivity of the water is dictated by the levels of concentration of sodium, magnesium and calcium ions in water. The conductivity values in Aiba and Erinle reservoirs were typical of most freshwater bodies as pointed out by Chapman and Kimistach (1996).

Table 1: Physico-chemical parameters of Aiba reservoir and Erinle reservoir (Mean±SD)

						AIBA RESERVOIR		ERINLE RESERVOIR		
Parameters	**USEPA**	**WHO**	**ISI**	**ICMR**	**CPCB**	**Mean ± S.D**	**Range**	**Mean ±S.D**	**Range**	**p- value**
pH	6.5-8.5	6.5-8.5	6.5-8.5	6.5-9.2	6.5-8.5	7.76±0.50*	7.0-8.6	8.4±0.76*	7.1-9.8	0.0209
Turbidity (NTU)	-		10	25	10	17.76±7.77***	6.3-34.3	2.2±1.00***	0.9-3.6	< 0.0001
Temperature (^{0}C)		10-50				26.99±1.03*	23.6-28.3	26.0±1.70*	22-29	0.0356
DO (mg/l)	-	6				3.79±0.64***	2.6-5.2	2.60±0.61***	1.4-3.2	< 0.0001
Total Alkalinity (mg/l)	-	200	-	-	-	47.55±5.98***	36.3-53.6	78.0±18.0***	54-111	< 0.0001
BOD (mg/l)	250	-	-	-	-	1.45±0.49***	0.6-2.1	0.76±0.14***	0.56-0.98	< 0.0001
Conductivity (ųs/cm)	-	-	-	-	2000	305.4±37.18***	268.6-396.4	258±23.0***	231-301	0.0001
Silica (mg/l)						1.60±0.36***	0.8-2.0	0.23±0.10***	0.02-0.43	< 0.0001
Nitrate (mg/l)	-	50	45	100	100	0.65±0.41***	0.1-1.3	0.25±0.19***	0.03-0.61	0.0009
Phosphate (mg/l)	0.025	-	-	-	-	0.24±0.25	0.01-0.8	0.31±0.20	0.01-0.63	0.3720
Total hardness (mg/l)	-	500	300	600	600	89.75±9.73***	67.3-106.2	70.0±10.0***	50-86	< 0.0001
Chloride (mg/l)	250	200	250	1000	100	27.02±7.21*	14.6-38.1	22±2.3*	19-26	0.0116
Calcium hardness (mg/l)	-	75	75	200	200	37.51±11.08	23.8-57.1	34.0±4.0	29-41	0.2863
Magnesium hardness (mg/l)	-	50	30	-	100	37.29±7.33***	27.1-49.6	25.0±3.4***	19-29	< 0.0001
Potassium (mg/l)	-	20	-	-	-	0.57±0.53***	0.4-1.9	1.7±0.6***	0.8-2.6	< 0.0001
Aluminum (mg/l)	-	0.2	-	-	-	0.49±0.56*	0.07-2.1	0.16±0.11*	0.01-0.91	0.0123
Chromium (mg/l)	0.1	0.05	0.05	-	-	1.88±1.91*	0.01-4.8	4.2±0.38*	1.4-6.1	0.0147
Zinc (mg/l)	-	5.0	5.0	0.10	15.0	13.6±11.40	1.6-30.6	8.6±5.6	1.4-19	0.1019

*Significant at P< 0.05 *** Significant at P< 0.001

Table 1 shows the mean and range of physico-chemical parameters of Aiba reservoir and Erinle reservoir. There was a significant difference ($p< 0.05$) between the pH of Aiba reservoir (7.76±0.50) and Erinle reservoir (8.4±0.76). There was a high significant difference at ($p<0.001$) between the turbidity of Aiba reservoir and Erinle reservoir.

WHO – World Health Organization ISI – Indian Standard Institution CPCB – Central Pollution Control Board
USEPA – United States Environmental Protection Agency ICMR – Indian council of Medical Research

Table 2: Abundance and percentage composition of phytoplankton species in Aiba and Erinle Reservoirs

	Group	**Aiba Reservoir**		**Erinle Reservoir**	
S/N	**Bacillariophyta**	Total	% Composition	Total	% Composition
1	*Gomphonema augur*	48	2.00	162	6.91
2	*G. parvulum*	20	0.88	208	8.88
3	*Cymbella Mexicana*	47	1.96	-	-
4	*Synedia ulna*	52	2.16	26	1.1
5	*Gyrosigma acuminatum*	77	3.20	158	6.74
6	*G. attenuatum*	34	1.41	-	-
7	*Pinnularia viridis*	44	1.83	49	2.09
8	*P. major*	24	1.00	-	-
9	*P. dactylus*	30	1.25	14	0.60
10	*Navicula exigua*	112	4.66	-	-
11	*Navicula* sp.	94	3.91	17	0.73
12	*Frustulia* sp.	8	0.33	-	-
13	*Pleurosigma* sp.	20	0.83	-	-
14	*P. elongatum*	25	1.04	-	-
15	*Eunotia pectinalis*	23	0.96	-	-
16	*Amphora* sp.	-	-	23	0.98
17	*Tabellaria* sp.	17	0.71	-	-
18	*Nitzschia gracilis*	12	0.50	-	-
19	*Cyclotella meneghiniana*	34	1.41	-	-
20	*Cyclotella* sp.	-	-	48	2.05
21	*Diploneis ovalis*	9	0.37	-	-
22	*Aulacoseira qranulata*	21	0.87	-	-
23	*Fraqilara* sp.	-	-	9	0.38
		Chlorophyta			
24	*Pleurotaenium trabecular*	69	2.87	-	-
25	*P. minutum*	68	2.83	-	-
26	*P. ovatum*	-	-	77	3.92
27	*Pleurotaenium* sp.	72	3.00	60	2.56
28	*Closterium moniliforme*	81	3.37	175	7.47
29	*C. regularis*	106	4.41	229	9.77
30	*C. kuetzingii*	87	3.62	216	9.22
31	*C. ehrenbergii*	-	-	223	9.52
32	*Chlorella vulgaris*	90	3.74	-	-
33	*Chlorella* sp.	106	4.41	-	-
34	*Spirogyra* sp.	156	6.49	134	5.72
35	*Cosmarium punctulatum*	95	3.95	--	-
36	*C. angulosum*	151	6.28	145	6.19
37	*Micrasterias* sp.	13	0.54	-	-
38	*Pediastrum boryanum*	149	6.20	-	-
39	*Pediastrum* sp.	160	6.66	146	6.23
40	*Oedogonium* sp.	-	-	27	1.15
41	*Gonatozygon* sp.	-	-	17	0.73
		Cyanophyta			
42	*Anabaena circnalis*	32	1.33	66	2.82
43	*Oscillatoria limosa*	78	3.24	92	3.93
44	*Aphanizomenon* sp.	-	-	22	0.94
		Euglenophyta			

45	*Euglena viridis*	82	3.41	-	-
46	*Phacus* sp.	24	1.00	-	-
		Dinophyta			
47	*Perdinium bipes*	34	1.41	-	-

Chloride levels in the two reservoirs fluctuated between 14.6-38.1 mg/L. The highest was found in Aiba reservoir during the rainy season. The chloride level in the two reservoirs agrees with the standard set by USEPA, WHO, ISI, ICMR & CPCB.

Biological Oxygen Demand (BOD) mean values ranged between 0.56 to 2.1mg/L in the two reservoirs. Water bodies having less than 4mg/L are regarded as clean and unpolluted whereas waters having more than 10mg/L are regarded as polluted indicating they contain large amount of degradable material.

Silica mean values in both reservoirs ranged between 0.02 – 2.0mg/L. The report disagrees with the findings of Moshood (2008) who reported high silica content in Oyun reservoir, Nigeria. According to Little (2004) the presence of high rate of rock weathering and soil weathering are responsible for high amount of silica in water bodies.

Nitrate mean value ranged between 0.03 to 0.65mg/L is much lower than the permissible limit (50, 45, 100 and 100) prescribed by WHO, ISI, ICMR and CPCB respectively. Phosphate values ranged between 0.01 to 0.8mg/L is above the permissible limit prescribed by USEPA (0.025mg/L).

Total hardness is a measurement of calcium and magnesium and is expressed as calcium carbonate; our body needs both calcium and magnesium to remain healthy. According to Canadian Drinking Water Quality, hardness levels between 80 and 100mg/L as $CaCO_3$ are considered acceptable. In both reservoirs, total hardness values ranged between 50.0-106.2mg/L. Minimum value (50.0mg/L) was recorded in Erinle reservoir while the maximum value (89.75mg/L) was recorded in Aiba Reservoir. The range is much lower than the permissible limits (500, 300, 600, 600) as prescribed by WHO, ISI, ICMR & CPCB respectively.

The mean value of magnesium hardness was found in the range of 19 to 49.6mg/L. This is within the permissible limit as prescribed by WHO but well above the permissible limit prescribed by ISI. Maximum concentration of magnesium (49.6mg/L) was found in Aiba Reservoir while the minimum value was found in Erinle Reservoir.

The value of calcium hardness was found in the range of 23.8 to 57.1mg/L. Its value is within the permissible limit as prescribed by WHO, ISI, ICMR & CPCB. The lowest and highest values of calcium hardness were recorded in Aiba reservoir.

Phytoplankton Community of Aiba and Erinle Reservoirs

The abundance of phytoplankton and their percentage composition is presented in Table 2. The distribution of species indicates that Aiba reservoir had the highest number of phytoplankton, 2404 organisms/ml while Erinle reservoir had 2343 organisms/ml. The phytoplankton were expressed as organisms per ml for the purpose of calculating diversity indices. A total of 47 algal species belonging to five (5) groups namely Chlorophyceae, Bacillariophyceae, Cyanophyceae, Euglenophyceae and Dinophyceae were recorded.

The most dominating, Chlorophyceae group in both reservoirs consisted of species like *Closterium regulais*, *Pediastrum* sp., *Cosmarium* sp., *Pleurotaenium* sp., *Spirogyra* sp. and *Chlorella* sp. The observation of more chlorophytes than the other forms of phytoplankton in both reservoirs follows the typical trend in tropical water bodies (Moshood, 2008). The same observation has been reported in Owalla reservoir and Kanji reservoir by Mishra *et al.*, (2008). The appearance of chlorophyceae in higher number than other groups of phytoplankton was also reported by Hameed *et al*., (2019) in Ifewara Reservoir.

Similarly, the most dominating Bacillariophyceae groups in the reservoirs are *G. parvulum, Cymbella mexicana, Gomphonema augur, Gyrosigma* *acuminatum, Pinnularia viridis*, *Navicula exiqua*, *Navicula* sp., *Cyclotella meneghiniana* and among Cyanophyceae, the most dominating specie is *Oscillatoria limosa*. Akin-Oriola (2003) pointed out that neurotoxic alkaloids (anatoxin-a) produced by *Anabaena* sp. and *Oscillatoria* sp. can damage the nervous system. In the present study, Chlorophyceae was the most dominating group in Aiba reservoir with 1403 organisms/ml with percentage composition of 58 while in Erinle reservoir it was 1449 organisms/ml with a percentage composition of 62. In Aiba reservoir, Euglenophyceae and Dinophyceae consisted of about 4% and 2% respectively, while in Erinle reservoir Euglenophyceae and Dinophyceae were absent.

In Aiba reservoir among 39 species of phytoplankton, 14 belonged to Chlorophyceae, 20 belonged to Bacillariophyceae, two (2) belonged to Cyanophyceae, two (2) belonged to Euglenophyceae and 1 belonged to Dinophyceae. In Aiba reservoir, the percentage abundance of phytoplankton was Chlorophyceae (58%), Bacillariophyceae (31%), Cyanophyceae (5%), Euglenophyceae (4%) and Dinophyceae (2%) (Figure 2). In Erinle reservoir, out of 24 species of phytoplankton, 11 belonged to Chlorophyceae, 10 belonged to Bacillariophyceae and 3 belonged to Cyanophyceae. During the present study the percentage abundance of phytoplankton was Chlorophyceae (62%), Bacillariophyceae (30%) and Cyanophyceae (8%) (Figure 3).

Dominance index (D) is a measure of the numerical importance of the most abundant species. The Dominance index in the present study indicates that Aiba reservoir has the highest dominance (0.96) of phytoplankton species and Erinle reservoir (0.93) has the least. The evenness in Aiba reservoir (0.93) was greater than that of Erinle reservoir (0.90) (Figure 4).

According to Wilham and Dorris (1968), Shannon and Weiner value greater than 3 indicate clean water, values in the range of 1 to 3 are characterized by moderate pollution and values less than 1 characterized as heavily polluted. According to this index, Aiba reservoir water is clean while Erinle reservoir is on the verge of pollution.

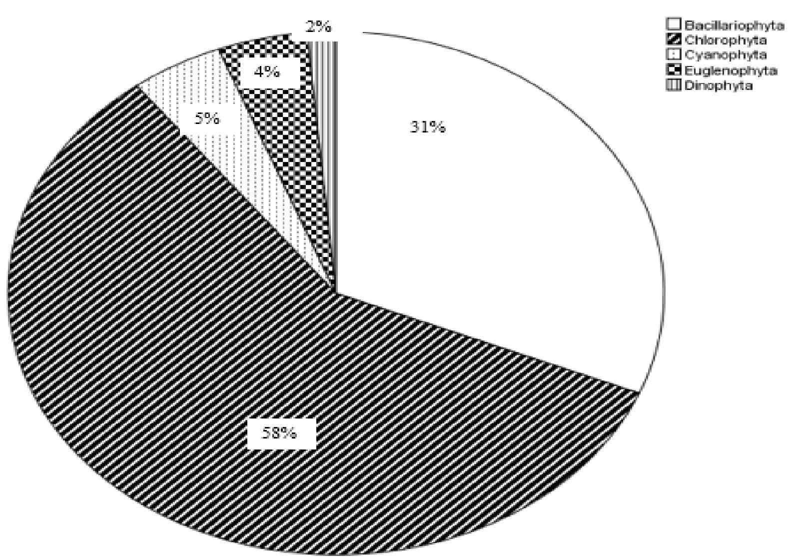

Figure 2: Percentage composition of phytoplankton division at Aiba reservoir

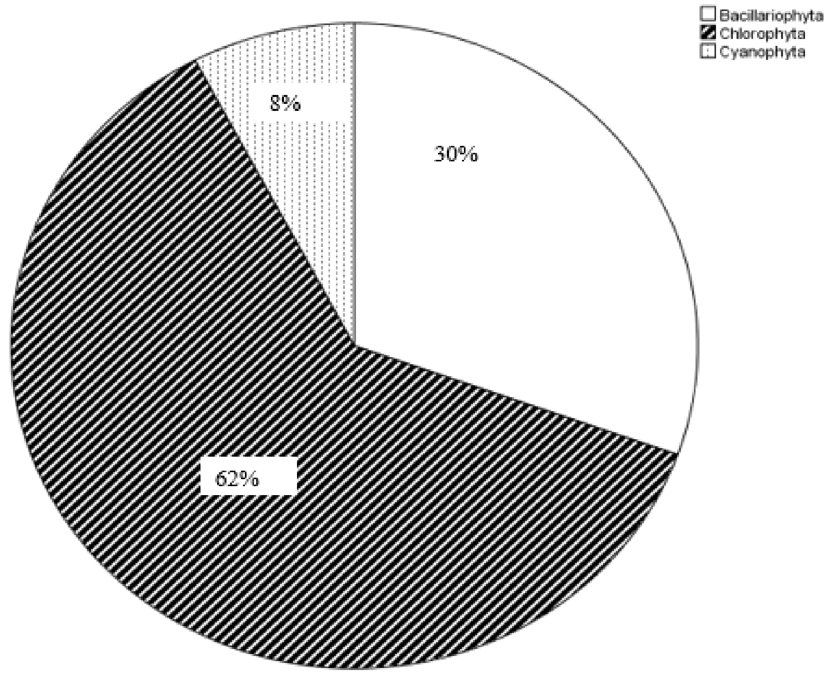

Figure 3: Percentage composition of phytoplankton division at Erinle reservoir

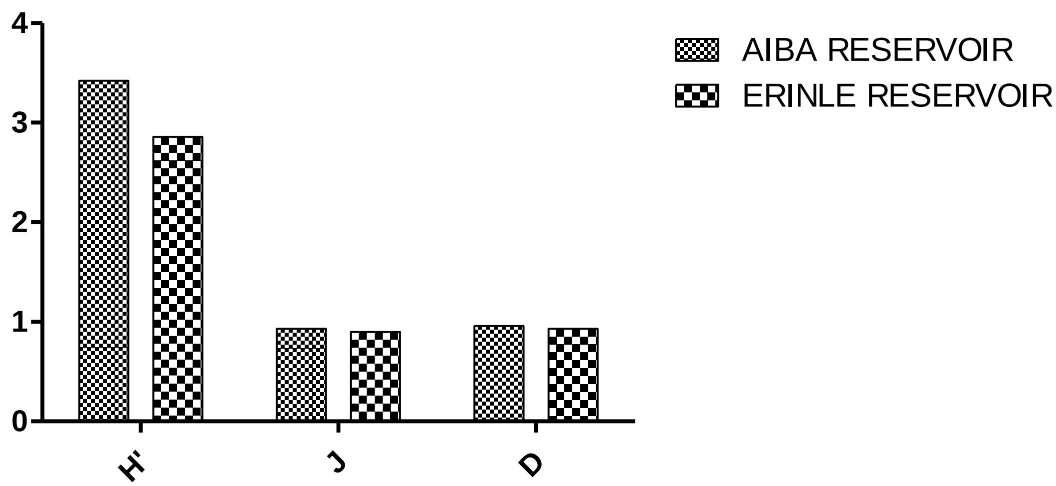

Figure 4: H' (Shannon Weiner Index), J (Evenness) and D (Simpson Index) of Aiba and Erinle reservoirs

Conclusion

In Conclusion, heavy metals concentrations are well above standard prescribed by WHO and other International Agencies. The two reservoirs are polluted to some level based on values of phosphate, nitrate and biological oxygen demand recorded. Total hardness, calcium hardness, magnesium hardness, temperature, conductivity, alkalinity, chloride, potassium and nitrate were found to be within the permissible limit as prescribed by WHO and other International Agencies. Presence of *Anabaena* sp and *Oscillatoria* sp indicate the trend of the water bodies towards possible pollution because they are known to be toxin-producing algae. To maintain the water quality of the two reservoirs, the continuous monitoring of physicochemical parameters and phytoplankton species composition should be done and the water can be used for cooking and drinking only after prior treatment.

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