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The Study of Phytoplanktons Community of Ajiwa Reservoir in Relation to Water Quality

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Abstract: A preliminary study on the phytoplanktons community in relation to water quality in three selected sampling sites of Ajiwa reservoir was carried out from August to September 2016. The sampling sites were selected for the purpose of the study based on differences in the human activities carried out. Water samples were collected once a week and analyzed using standard methods for identification phytoplanktons and determination of physico-chemical parameters. A total of 17 species belonging to four different families were recovered. Individual cell count of phytoplanktons were highest at Sp3 (109) followed by Sp1 (103) and Sp2 (82) during the study period. Chlorophyceae (81%) dominated the phytoplanktons at both sampling sites of the reservoir followed by Bacillariophyceae (11%), Cyanophyceae (5%) and the least was Euglenophyceae (3%). Values of the physico-chemical parameters recorded showed variations vis-à-vis sampling sites and the weeks. Abundance of Bacillariophyceae and Cyanophyceae indicated a significant positive correlation ($r = 1$; $p<0.01$) with pH and Turbidity respectively. There is no visible form of pollution of the water in the reservoir. The results obtained from the physiochemical parameters analyses were within tolerable limits for aquatic life which could also be responsible for the diversity of the species in the reservoir.

Key words: Phytoplanktons · Chlorophyceae · Cyanophyceae · Bacillariophyceae and Euglenophyceae

INTRODUCTION

Phytoplanktons are unicellular and free floating organisms belonging to the Algae group [1]. There are two major groups of phytoplankton-1 fast-growing diatoms and 2 flagellates and dinoflagellates. Each group exhibits a tremendous variety of cell shapes. Phytoplanktons vary widely in physical and chemical requirements for population growth. All species of dinoflagellates and diatoms share certain basic requirement for growth (Light, carbon dioxide, nutrients, trace element, habitable, temperature and salinity); they can differ considerably in their optimal requirementfor these factors [2]. Phytoplanktons are the easiest food source for most of the aquatic beings like zooplanktons, fishes and thus are the basic food producers in any aquatic ecosystem [1Phytoplanktons are recognized worldwide as bioindicators organisms in the aquatic environment [3].

Human activities around the ponds affect the concentration of physico-chemical parameters, thereby rising the levels sometimes beyond tolerable for some aquatic organisms. The extent to which micro-algal species can tolerate such changes makes them potential indicators [2]. Change in phytoplanton community structure are mainly due to changes in environmental variables such as nutrients and other water quality parameters which influences their distribution and abundance in the environment where they are found [4]. Physicochemical factors like pH, alkalinity, water hardness and macronutrient concentration determine which species or group thrives well in an aquatic ecosystem [5]. Therefore, by improving our understanding of the spatial structure of the different phytoplankton communities, advances in biogeochemical and food-web models can be made, which may enhance our comprehension needed to predict future change [2]. Hence, the present study to determine the phytoplankton population of Ajiwa reservoir, with the view to relate changes in algae taxa with some physico-chemical properties of the environments.

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MATERIALS AND METHODS

Study Area: Ajiwa reservoir was constructed by the federal government in 1972 by President Yakubu Gowon under the 3Rs plan and was completed in 1974. It was constructed along river Tagwai and located in Batagarawa Local Government Area of Katsina State. There is an estimated water of 22.7 million cubic meters with a surface area of 1678m^2, depth of 12m and length of 350m. Ajiwa dam lies between latitude and longitude ($12°54^{I}69^{II}$ – $12°57^{I}68^{II}$ N and $7°42^{I}53^{II}$ – $7°47^{I}50^{II}$ E

Sample Collection: Three sampling points labeled Sp1, Sp2 and Sp3 were selected along the reservoir for the purpose of the study. Samples were collected between 8-10 am for six weeks covering a period of two months (August and September 2016). Water sample was collected in a sterilized dark brown bottle (250ml) at three different stations. At each of the sampling station, each bottle was rinsed several times with the water to be sampled. It was later opened at a depth of 30cm from the surface in the direction of water current. After the bottle was filled, it was removed from the water and was tightly closed. The bottles were then labeled appropriately, placed in the sampling box containing ice and taken to the laboratory for further analysis [5, 6].

Phytoplanktons were collected using plankton net with a collecting bottle of 100ml at the base. The net was immersed just below the water surface to a depth of about 1-2meters and towed through a certain distance. The content of the bottle was poured into a sampling bottle of the same capacity, preserved in Lugol's iodine to prevent any loss of flagella in the flagellates and taken to the laboratory for analysis [1].

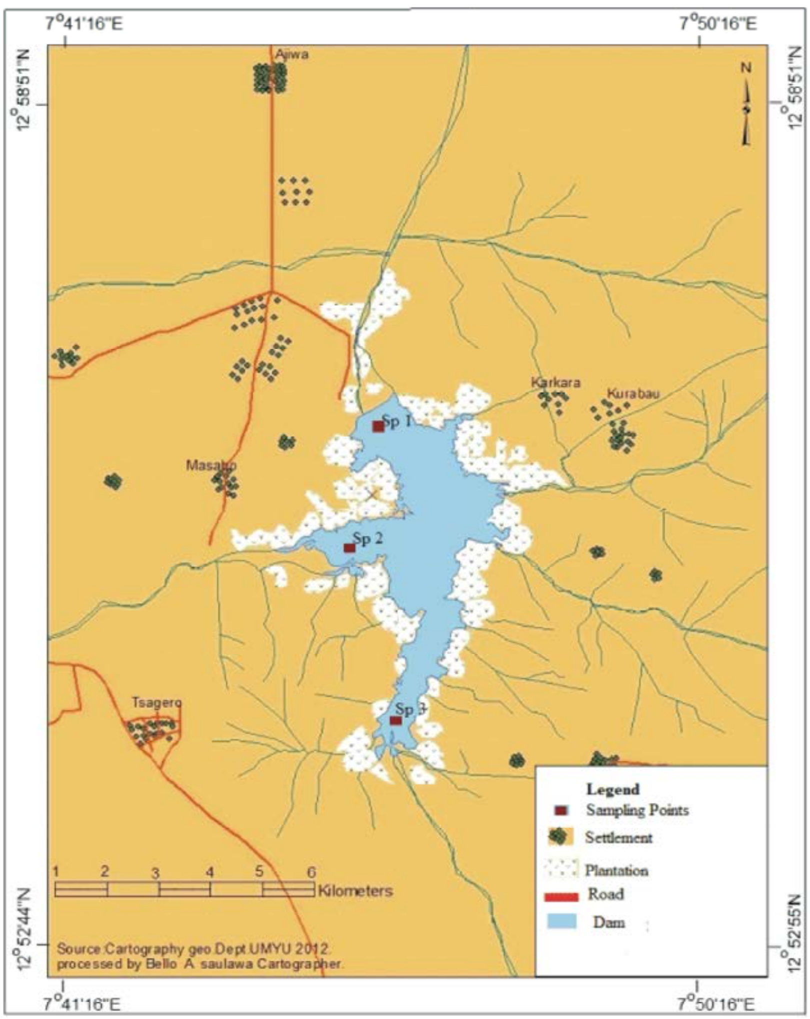

Fig. 1: Map of Ajiwa reservoir showing sampling sites

Analysis of Physico-Chemical Parameters: Water temperature, pHand Dissolved oxygen were measured in situ with thermometer, pocket sized pH meter and Auto-cal Dissolved oxygen analyser respectively. Turbidity and Electric conductivity were measured using turbidity tube and conductivity meter (Hanna Model EC 215) respectively. The BOD was determined by difference between the dissolved oxygen value obtained before and after 5 days of incubation [7, 8].

Identification and Counting of Phytoplanktons: For quantitative determination, 5ml of the 100ml of water collected was examined for phytoplankton. Wet mounts of the sub-sample on glass slide were examined using light and compound microscope. Direct microscopic cell counts using the drop count technique was used to determine the green algal cell density (no of cells per ml). The glass dropper used was calibrated to determine the number of drops that gave one milliliter. A drop of the concentrate was placed on a glass slide and the total numbers of individuals in that drop were counted [2]. Phtoplanktons were identified using charts and illustrations guides of Palmer [9] and Edward and David [10].

Statistical Analysis: Physico-chemical parameters were analyzed statistically using Analysis of Variance (ANOVA) for significant differences within the stations. The data was also subjected to Pearson's correlation to determine association between phytoplanktons abundance and water quality parameters.

RESULTS

A total of 17 species belonging to four different familiess namely Chlorophyceae, Cyanophyceae, Bacllariophyceae and Euglenophyceae were recorded. Out of the 17 species, 10 species belong to Chlorophyceae, one specie belongs to Eugleniphyceae and three species each of Bacillariophyceae and Cyanophyceae. Individual cell count of phytoplanktons were highest at Sp1 (109) followed by Sp2 (103) and Sp3 (82) during the study period (Table 1). Chlorophyceae (81%) dominated the phytoplanktons at both stations of the reservoir followed by Bacillariophyceae (11%), Cyanophyceae (5%) and the least was Euglenophyceae (3%) (Figure 2).

The mean variations recorded for physico-chemical parameters of Ajiwa reservoir in the three sampling stations are shown on Table 2. The highest mean water temperature was recorded in station C (28.9±2.3°C) and lowest water temperature of 28±1.1°C (Sp1) while mean pH ranged between 7.6±0.2 (Sp1) and 7.7±0.6 (Sp3). Mean turbidity ranged from 328.3±26.4 (Sp1) and 331.7±37.6 (Sp2) whereas mean electric conductivity values of 67.8±10.9 (Sp2) and 72.84±6.2 (Sp1). Mean DO was between 6.0±1.6ppm (Sp3) and 7.3±1.5ppm (Sp2), while mean BOD values ranged from 2.3±0.6ppm (Sp1) and 2.4±0.6ppm (Sp3).

The water temperature showed a weak positive correlation with the abundance of chlorophyceae and a positive correlation with Bacillariophyceae. It however showed a negative correlation with Cynophyceae and

Table 1: Species Composition and Percentage Relative Abundance of Phytoplankton Species of each Sampling station in Ajiwa Reservoir

	Sp1			Sp2			Sp3		
Taxa	N.S	N.I	RA	N.S	N.I	RA	N.S	N.I	RA
Chlorophyceae	9	83	80.58	8	65	79.27	10	89	81.65
Bacillariophyceae	3	11	10.68	3	10	12.20	3	12	11.01
Cyanophyceae	2	5	4.85	3	6	7.32	2	5	4.59
Euglenophyceae	1	4	3.88	1	1	1.22	1	3	2.75
Total	15	103	35.03	15	82	28.23	16	109	37.07

N.S = Number of species; N.I = Number of individuals; RA = Relative abundance %

Table 2: Mean±SD of Physico-chemical Parameters Recorded during the Study Period in Ajiwa Reservoir

Parameters	Sp1	Sp2	Sp3	Range
Temperature (°C)	28±1.1	28.4±1.6	28.9±2.3	25.3-31.3
pH	7.6±0.2	7.5±0.2	7.7±0.6	7.25-7.81
Turbidity (ntu)	328.3±26.4	331.7±37.6	328.3±37.1	300-400
Conductivity (µS/cm)	72.8±8.2	67.8±10.9	68.7±12.8	54.2-89.4
DO (mg/l)	7.1±1.8	7.3±1.5	6±1.6	3.20-9.50
BOD (mg/l)	2.3±0.6	2.4±0.9	2.4±0.6	1.22-3.63

DO: Dissolved Oxygen; BOD: Biological Oxygen Demand

Table 3: Pearson Correlation Matrix between Phytoplanktons abundance and Physico-chemical Parameters in Ajiwa Reservoir.

Parameters	Chlorophyceae	Bacillariophyceae	Cyanophyceae	Euglenophyceae
T (°C)	0.30	0.55	-0.66	-0.27
pH	0.96	1.0**	-0.87	0.61
Turbidity	-0.99	-0.87	1.0**	-0.95
Conductivity	0.44	0.17	-0.64	0.86
DO	-0.79	-0.93	0.62	-0.33
BOD	-0.28	0.00	0.50	-0.76

T: Temperature; DO: Dissolved Oxygen; BOD: Biological Oxygen Demand; **Correlation is significant at the 0.01 level (2-tailed)

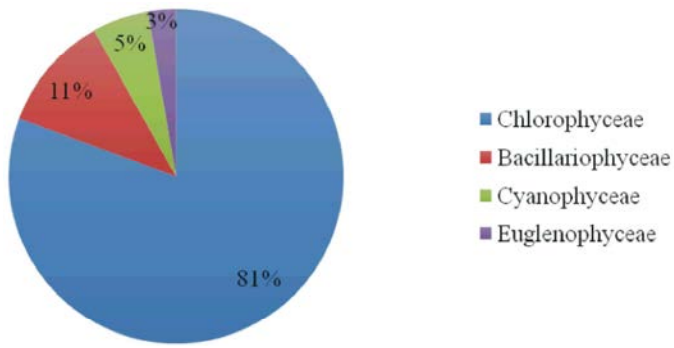

Fig. 2: Relative abundance of each family recovered during the study

a weak negative correlation with Euglenophyceae. Water pH and Turbidity showed there is highly strong and significant positive correlation with the abundance of Bacillariophyceae and Cynophyceae respectively. Electric conductivity showed a slightly weak positive correlation with Bacillariophyceae and a strong positive correlation with Euglenophyceae. Dissolved oxygen showed a strong negative correlation with the abundance of Chlorophyceae and Bacillariophyceae; whereas Biological oxygen demand indicated no correlation with the abundance of Bacillariophyceae in the reservoir (Table 3).

DISCUSSION

The result of phytoplanktons obtained compared favorably with some Nigerian reservoirs. Findings from this research showed that phytoplanktons abundance is in the following decreasing order:

Chlorophyceae>Bacillariophyceae>Cyanophyceae >Euglenophyceae. This order of phytoplankton abundance observed was similar to the findings of Mohammad and Saminu 2012 who worked on Salanta River, Kano, Nigeria. It however varied considerably with the work of Ojutiku *et al*. [4] who worked in Agaie-Lapai Dam in Niger State, Nigeria and reported 14 different species belonging to five taxonomic groups of which Bacillariophyceae was the most abundant group. Similarly, Ahmad and Indabawa [11] who worked in Kano River, Tamburawa, Kano State, Nigeria and recovered 56 algal species among which 37 species belong to the family Bacillariophyceae.

The range in water temperature recorded during the study compares well with values reported in Asaba Lake [12]. The relatively low water temperature observed in study could be due to low evaporation, low solar radiation and rainfall and the time of the day sampling was conducted [3]. Water transparency varied directly with rainfall. High turbidity observed in this study may be due to the presence of flow velocity, flood, surface runoff, settling effect of suspended particles, non-tidal waves and non- organic/detrital transport, increased food abundance, high photosynthetic activity and vise-versa [12]. Variations in Electric Conductivity in the reservoirs are common to other lenthic water bodies found in northern Nigeria. These changes may be linked to climatic conditions and human activities around the catchment which range from surface runoff of fertilizers from neighboring farms and other substances from the catchment area [5]. The pH obtained was near neutral throughout the study and it was within the range for inland waters (6.5-8.5) for most biological activities. The shift from neutral to slightly alkaline observed in this study could be attributed to run off from the neighboring farm land as well as discharge into the water bodies [3, 5]. The high value of Dissolved Oxygen (DO) obtained in this work might be due to aeration with continues disturbances of the water from wind storms [8]. High biological oxygen demand obtained in this work may be attributed to organic, inorganic and oxygen demanding pollutants present in the water sources. The dissolved oxygen and biological oxygen demand range recorded in this work compares well with the findings of Sulaiman and Audu [8], Abdullahi and Indabawa [13] and Mohammad and Saminu [14].

Even though no sufficient data in hand to support these results, but the values of correlation coefficient (Which could either be positive or negative) obtained between abundance of phytoplanktons families and physico-chemical parameters in this study could be supported by the work of Ahmad and Indabawa [13]. Therefore, further studies would be required to understand the pattern of phytoplankton distribution with respect to water quality parameters.

CONCLUSION

The results obtained from the physiochemical parameters analyses were within tolerable limits for aquatic life which could also be responsible for the diversity of the species recorded in the reservoir. Changes in green algal populations observed in this reservoir maybe as a result of their interactions with their physical, chemical and biological environment.

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