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Relative abundance and species diversity of algae in Gundutse River Kano, Northern Nigeria

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Abstract
The distribution and abundance of microalgae in the Rivers are controlled by a wide range of physical, chemical and biological factors. The study was aimed to determine the physico-chemical properties as well as the relative abundance and species diversity of Algae in Gundutse River Kano, Northern Nigeria for a period of 3 month (April – June, 2019). Surface water sample for the study were collected from three (3) different sampling (A, B and C) sites based on the depth of the water and analysis of water was conducted either *in situ* or transported to the laboratory for further analysis. The physicochemical properties of the water were determined using standard method while the algal species were determined and identified using microscope. The result of physicochemical properties of the water showed that the temperature, pH, turbidity and electric conductivity ranges from 25.13 to 25.80^{0}C, 7.3 to 7.7, 140 to 155 NTU and 617 to 628µs/cm respectively. The average values of nitrate, phosphate, Dissolve Oxygen and Biochemical Oxygen Demand (BOD) of the water ranges from 1.80 to 2.13 mg/L 1.0 to 1.16 mg/L, 3.73 mg/L to 4.10 mg/L, 1.96 to 2.23 mg/L respectively. From the result a total of twenty (20) different algal species were identified belonging to three (3) different classes namely; Chlorophyceae (40%), Bacillariophyceae (50%) and Cyanophyceae (10%). It is concluded that the occurrence and abundance of green algae species in the river is closely related to the physicochemical characteristics of the water.

Keywords: algae, gundutse, relative abundance, river, species diversity

Introduction
Water is an essential resource for sustainability of life on earth. It is the most vital requirement after oxygen, as its constant supply is needed to replenish the fluids lost through normal physiological activities such as respiration, perspiration and urination [1]. Although the hydrosphere is estimated to contain about 1.36 billion km^3 water, only about 0.3% of this water exists as fresh water in rivers, streams, springs and aquifers available for human use, the remaining 99.7% is locked up in seas and oceans [2]. A River is a body of freshwater flowing from upland source to large lake into sea and fed by sources such as a spring tributary stream [3]. Rivers constitute an ecosystem that supports a wide array of organisms ranging from lower plants to higher plants. In some developing countries like Nigeria they are a contributing source of water for domestic use such as washing of cloths, bathing and sometimes as a source of drinking water. Water bodies are known to support a wide array of aquatic organisms which include phytoplankton/ algae, zooplankton, nektonic and other variety of small species substantially floating on the water [4]. The quantity and types of such organisms depend on the water quality, especially on physical and chemical qualities and the characteristics of the environment [5]. Water quality affects the abundance, species composition, stability, productivity, and physiological condition of indigenous populations of aquatic organisms. Therefore, the nature and health of the aquatic communities is an expression of the quality of the water [6]. The distribution and abundance of microalgae in the River are controlled by a wide range of physical, chemical and biological factors. Environmental factors comprising physical and chemical components have been reported in several studies to have a great influence on the well-being of aquatic species, plankton inclusive [7, 8]. The study was aimed to determine the physico-chemical parameters such as Temperature, pH, Conductivity, Turbidity, Dissolved oxygen, Biochemical oxygen demand and Nitrate ions concentrations as well as the relative abundance and species diversity of Algae in Gundutse River Kano, Northern Nigeria.

Materials and Methods
Study Area
Gundutse town is located in eastern part of Kura. Kura is one of the Local Government areas of Kano State. It is located in the southern part of the state along Kano-Zaria express with a distance of about 35 Kilometer from the state capital. Geographically, it is located at latitude 11^{0}46'N and Longitude 8^{0}25'E. It covers an area of about 206 Km^2 of land. According to 2006 population census, it has a total population of 144,601 and the projected population of 199,002 as of 2016 [9].
Kura Local Government shares common boundaries with Garun-Mallam (West), Dawakin-kudu (East), Bunkure (South) and Madobi Local Government (North). Farming and irrigation remain the major occupations in the area. However many educated indigenes in the area are employed in the formal sector while others engaged in various trading activities.

Collection of Water Samples
Surface water sample for the study were collected from three (3) different sampling (A, B and C) sites based on the depth of the water. Collection of water was done at about 6 am for a period of 3 month (April – June, 2019) and analysis

of water was conducted either *in situ* or transported to the laboratory for further analysis.

Determination of Physico-chemical Properties of the River water

The pH of the river water was determined using pH meter as described by APHA [6]. Surface water Temperature was determined *in situ* with mercury in glass thermometer as described by Offem, *et al.* [10]. The Electrical conductivity of the water was determined using conductivity meter as described by APHA [6]. The turbidity was measured using Nephelometer, Nitrate and Phosphate was determined using DR/2010 Spectrophotometer. Dissolved Oxygen was determined using Dissolved Oxygen Meter as described by APHA [6]. Biological Oxygen Demand was determined after 5 days incubation method as described by APHA [6].

Identification of Algae

Samples collected from three sampling sites were collected at about 30 cm depth and one meter away from the shore at each sampling station [6]. Glass jars (100 mL) were used to collect samples for algal analysis. The water was fixed immediately with Lugol solution to preserve green algal cells [6]. Treatment and analysis of algal samples were done according to the procedures of APHA [6]. A portion of each of the sample was examined with the aid of microscope. References on identification of species of algae were made to that of Patrick and Reimer [11] and Kadiri [12].

Result

Physico-Chemical Properties of the River Water

Table 1 represents the average values of temperature, pH, turbidity, and electric conductivity of the water of River Gundutse from April to June. The results showed the average temperature for the month are 25.80, 25.57 and 25.13^{0}C. The pH of the river ranges from 7.3 to 7.7. The highest pH was recorded in site A for the month of April (7.7) while least pH was recorded in site B for the month of June. Highest turbidity for the river was recorded in June with site A having the highest value (155 NTU). The turbidity recorded for April (140 NTU) in both sites is lower when compared to May (152 NTU) and June (155 NTU) respectively. The results for electric conductivity indicated that the average result recorded were 617, 628 and 628µs/cm for the month of April, May and June respectively.

Table 1: Results of Temperature, pH, Turbidity and Electric conductivity of River Gundutse from April to May 2019.

Parameters	Month	Site A	Site B	Site C	Average
	April	26.10	25.50	26.10	25.80
Temperature (^{0}C)	May	25.70	25.30	25.70	25.57
	June	25.20	25.10	25.10	25.13
	April	7.7	7.5	7.6	7.60
Ph	May	7.6	7.4	7.4	7.47
	June	7.4	7.3	7.5	7.40
	April	139	136	129	135
Turbidity (NTU)	May	142	138	140	140
	June	155	146	151	152
	April	612	621	619	617
Electric Cond (µs/cm)	May	621	627	625	624
	June	625	630	628	628

Table 2 represents the average values of nitrate, phosphate, Dissolve Oxygen and Biological Oxygen Demand (BOD) of the water of River Gundutse from April to June. The results showed the average nitrate for the month of April, May and June are 1.80, 1.86 and 2.13 mg/L respectively. The phosphate level of the river ranges from 1.0 to 1.16 mg/L. The highest phosphate level was recorded in site C for the month of May and June (1.2 mg/L) while least phosphate level (1.0 mg/L) was recorded in site A for the month of April, May and June. Highest dissolve oxygen level for the river was recorded in June with site C having the highest value (4.1 mg/L). The dissolve oxygen level recorded for April (3.56 mg/L) in both sites is lower when compared to May (3.73 mg/L) and June (4.10 mg/L) respectively. The results for Biological Oxygen Demand (BOD) indicated that the average result recorded were 2.23, 2.13 and 1.96mg/L for the month of April, May and June respectively.

Table 2: Average Nitrate, Phosphate, Dissolve Oxygen and Biological oxygen demand (BOD) of River Gundutse from April to May 2019.

Parameters	Month	Site A	Site B	Site C	Average
	April	1.8	1.8	1.8	1.80
Nitrate (mg/L)	May	1.8	1.9	1.9	1.86
	June	2.1	2.2	2.1	2.13
	April	1.0	1.0	1.0	1.00
Phosphate (mg/L)	May	1.1	1.1	1.2	1.13
	June	1.1	1.2	1.2	1.16
	April	3.5	3.6	3.6	3.56
Dissolve Oxygen (mg/L)	May	3.7	3.7	3.8	3.73
	June	4.0	4.2	4.1	4.1
	April	2.2	2.3	2.2	2.23
BOD (mg/L)	May	2.1	2.1	2.2	2.13
	June	1.9	2.0	2.0	1.96

Identification of Algae species

The number of Algae species identified from 3 different sites is presented in Table 3. The result showed that a total of twenty (20) different algal species were identified belonging to three (3) different classes namely; Chlorophyceae, Bacillariophyceae and Cyanophyceae. Members of class Bacillariophyceae has the highest frequency 10 which accounted for 50% of the identified species, followed by members of class Chlorophyceae with 8 members (40%) and least frequency is members of Cyanophyceae with 2 members (10%)

Table 3

S/N	Algal species	Class
1	*Spirogyra* spp	Chlorophyceae
2	*Cosmarium* spp	Chlorophyceae
3	*Haematococcus* sp	Chlorophyceae
4	*Closterium* sp	Chlorophyceae
5	*Oedogonium* spp	Chlorophyceae
6	*Chlorococcum* sp	Chlorophyceae
7	*Penium* sp	Chlorophyceae
8	*Zygnema* sp	Chlorophyceae
9	*Coscinodiscus* sp	Bacillariophyceae
10	*Caloneis* sp	Bacillariophyceae
11	*Diatoma* spp	Bacillariophyceae
12	*Frustulia* sp	Bacillariophyceae
13	*Fragilaria* sp	Bacillariophyceae
14	*Ulothrix* sp	Bacillariophyceae
15	*Encyonema* sp	Bacillariophyceae
16	*Eunotia arcus*	Bacillariophyceae
17	*Craticula* sp	Bacillariophyceae
18	*Gomphonema* spp	Bacillariophyceae
19	*Chroococus* sp	Cyanophyceae
20	*Oscillatoria* sp	Cyanophyceae

Discussion

The physico-chemical properties defined the physical and chemical state of substances. The Measurement and determination of physico-chemical parameter is very important because it enable one to determine the quality of water for public consumption as well as the distribution of aquatic organisms in the water especially algae and phytoplankton. The mean physico-chemical properties of River Gundutse are recorded in Table 1 and 2. The average surface temperature of the water greatly influences other physico-chemical properties of the water. According to the result of this study, temperature is higher in April and dropped in June. This is in conformity with the finding of Ahmad and Indabawa [13]. The high values of temperature recorded in the month of April could be associated with high solar radiation, high evaporation and absent of rainfall. The pH of the water slightly neutral with higher pH in April compared to May and June. The values of pH recorded in this study fall within the WHO [14] standard and correlates positively significantly with temperature. The highest value of pH recorded could be attributed to run off from the neighbouring farm land as well as discharge into the water bodies.

On the other hand, the value of electric conductivity decreases in the month of April but increase in June. The result of electric conductivity of this study correlates with that of Ahmad and Indabawa [13]. The electric conductivity of water gives a good indication of total salt content. The turbidity value across the river ranges from 135 – 152 NTU from the month of April to June. This showed that the turbidity of water is increasing. Turbidity depends on the clarity of water, the clearer the water the lower the turbidity and the darker the water the higher the turbidity which affects the distribution of aquatic organism [15]. Turbidity usually occurs in most surface water as a result of suspended clay, silts, organic and inorganic matter, planktons and other micro-organisms.

Nitrate and phosphates are the two most important factors contributing to eutrophication in water. The highest mean nitrate value recorded is 2.1 mg/L while the least value recorded was 1.8 mg/L. The nitrate values recorded in this study fall within WHO [14] limit. From the result, the nitrate amount was higher in June than April and May. This could be attributed to the runoff from neighbouring farm land fed with inorganic fertilizers by farmers, discharged in to the water bodies due to rainfall. Similar observation was made by Watanabe *et al.* [16], who reported that nutrients are potential determinant of ultimate productivity, as evidenced by many limnological studies correlating high nitrate and phosphate values to abundant phytoplankton flora.

The highest value of dissolve oxygen recorded was found to be 4.1mg/l due to the decrease in temperature and the lowest was found to be 3.6mg/L due to increase in temperature. This result was in conformity with the finding of Shawai *et al.* [17] who recorded high dissolve oxygen with decrease in temperature and vice versa. The dissolve oxygen is one of the best indicators of the health of the water in aquatic ecosystem. Also the distribution of oxygen in water varies accordingly to the type of water body i.e. for past flowing water bodies the oxygen concentration is uniform or nearly uniform from top to the button due to the mixing of water while in standing or stagnant water there is variation from top to the bottom, high concentration of oxygen was found at the surface but lower concentration at the button. The highest biological oxygen demand (BOD) was found to be 2.23 mg/L and the lowest BOD value was found to be 1.96 mg/L. this correspond with the work of Shawai *et al.* [17] and Ezra [18] which ranges between 1.3mg/L - 3.9mg/L reported in the study of planktonic algae in relation to physico-chemical parameters, properties of some fresh water ponds in Kano and Bauchi Nigeria respectively. In general the higher the BOD, the decrease in dissolve oxygen concentration in the water is due to the decomposition of organic matter found in the water that consumes the dissolve oxygen [19].

A total of twenty (20) different algal species from three (3) different classes (Chlorophyceae, Bacillariophyceae and Cyanophyceae) were identified and recorded during the study period. Bacillariophyceae has 10 species (50%), Chlorophyceae has 8 species (40%) and Cyanophyceae has 2 species (10%). Several studies conducted for identification of algal species in fresh water body [13, 17, 20]. This result was conformity with that of Shawai *et al.* [17] but contradict that of Abdullahi *et al.* [21] who found over 56 different algal species in Kanye dam, Kano. The relative low number of algae recorded in the study could be due to poor content of nutrient in the river as the water is continuously flowing.

Conclusion

The algal analysis of River Gundutse revealed the presence of a number of algal species that represent the major class of algae consisting of Chlorophyceae, Bacillariophyceae and Cyanophyceae. Bacillariophyceae were found to be the dominant species with 10 total numbers of algal species. Physico-chemical data shows slight variation in the physical and chemical properties of the river water during the study period

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