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Algal Diversity in relation to Physicochemical Parameters of Kalki Cheruvu, Kamareddy District, Telangana

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ABSTRACT

Kalki Cheruvu, a freshwater ecosystem, was investigated to understand the relationship between phytoplankton diversity and physico-chemical parameters. Phytoplankton distribution is closely regulated by hydrochemical and physical variables, which directly influence population dynamics and community composition. Monthly sampling was conducted from 2023 TO 2024, following APHA (2005)[1] protocols, to analyse parameters such as temperature, pH, carbonates, bicarbonates, total hardness, chlorides, phosphates, nitrates, nitrites, silicates, dissolved oxygen, biological oxygen demand, and organic matter. Four algal groups were identified: Chlorophyceae, Cyanophyceae, Bacillariophyceae, and Euglenophyceae. Among these, Chlorophyceae was the most dominant, followed by Cyanophyceae, Bacillariophyceae, and Euglenophyceae, reflecting the ecological status of the lake. The study revealed significant seasonal variation in water quality parameters, though most values remained within permissible limits, indicating good water quality. Overall, the findings suggest that Kalki Cheruvu supports a healthy phytoplankton community and provides water suitable for drinking purposes. This work highlights the importance of continuous monitoring of freshwater ecosystems to ensure ecological balance and sustainable utilisation

Keywords: *kalki Cheruvu ,water analysis, physico chemical parameters, algal diversity.*

I. Introduction

Water is essential for all life on Earth and plays a critical role in maintaining a stable climate. Few chemicals impact the natural world as profoundly as water, whose physicochemical and biological characteristics are key indicators of its quality [1]. Consumption of polluted water leads to water-borne infections, with parameters such as turbidity, nitrate, and phosphate commonly tested to assess contamination levels [2]. Lakes, as vital components of natural landscapes, influence ecological functioning and have garnered significant attention in recent decades due to their diverse genesis, geographical locations, hydrological regimes, and substrate factors.

Water quality encompasses various biotic and abiotic factors that define ecosystem health. The maintenance of a healthy ecosystem depends on the physicochemical properties of water and biological diversity, with ecosystem quality closely linked to biological characteristics [3]. Water quality reflects the interplay of hydrogeological properties and the biotic-abiotic status of the ecosystem [4]. Abiotic and biotic factors are interdependent; fluctuations in abiotic factors often affect biotic components, altering their abundance and biodiversity. Physical properties such as temperature, light intensity, transparency, pressure, and conductivity, along with chemical properties including dissolved oxygen, free carbon dioxide, alkalinity, hardness, phosphate, and nitrate levels, govern aquatic life and determine the trophic status of water bodies.

Abiotic factors typically govern environmental conditions, influencing organism distribution, well-being, and ecosystem functioning. Freshwater bodies like lakes and reservoirs are dynamic systems shaped by multiple environmental factors. Phytoplankton, as primary producers, are essential to aquatic ecosystems; their composition and abundance serve as sensitive indicators of environmental changes and water quality. Variations in phytoplankton communities reflect shifts in physical, chemical, and biological parameters. The productivity of freshwater communities, which supports fish growth, is regulated by the dynamics of their physico-chemical and biotic environments [5]. This study investigates water quality through physicochemical parameters and algal diversity analysis.

II. Materials and Methods

Study Area

Kalki Cheruvu is located in Banswada town of Kamareddy district, Telangana (17° 25 '15.8"N, 78° 5' 16.2"E). It is a key freshwater resource for the local population.

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Fig no 1: Study site of kalki Cheruvu

Water sample collection:
Water samples were collected seasonally during the early morning hours (around 8:30subsurface layers at four fixed locations, across three seasons: summer, rainy, and winter. The sampling period extended over a year from 2023 to 2024..m.) using clean 2-liter polythene containers. The chemical parameters such as pH and temperature were measured in the field using a pH meter and digital thermometer. This analysis was carried out as per APHA method.

Identification and Enumeration
Species identification was carried out using standard taxonomic literature including works by [1,2,3]. Enumeration was performed using Sedgwick-Rafter counting cells, and phytoplankton density was estimated using the drop count method .

III. Results and Discussion

In the present study, four algae groups were shown Chlorophyceae (fig1: 1a,1b,1c,1d) ,cyanophyceae (fig2: 2a,2b,2c,2d), Bacillariophyceae (fig3: 3a,3b,3c,3d), Euglenophyceae (fig4: 4a,4b).the physico chemical parameters such as Temperature, total dissolved solids(TDS), pH,Carbonates, Bicarbonates, biological oxygen demand(BOD), Chemical Oxygen Demand(COD), Total hardness, dissolved oxygen, Magnesium, Phosphates, total suspended solids(TSS), chlorides, sulphates,nitrates of water samples taken from Kalki lake. These parameters were taken at monthly intervals from four stations of the lake.

A.Temperature:
The measurement of temperature is one of the most primary factors, which plays an important role in the metabolic activities of the organism .in kalki lake it was observed ,33.4^{0}C which is highest in summer season,22.1^{0}C recorded was the lowest in the winter season .Water temperature influenced aquatic weeds and algal blooms [6].

B.pH:
pH of water is an important environmental factor which affects the biology and the lifecycle of biotic life in aquatic ecosystems. The pH range is crucial in algal development [7] the pH ranges 8.3which was highest in the rainy season 7.2 low in winter season. pH was estimated by using a pocket pH meter at the spot in lake .pH range between 5 and 8.5 is the best for plankton growth.

C.Carbonates:
Carbonate is the prime contributor for maintaining pH of a water body and ends its role is of vital importance [8][9].

The highest amount of carbonates was found to be 22.5 mg/l in summer and the lowest value was recorded as 15 mg/l in rainy.

D. Bicarbonates:
Bicarbonate plays an important role in water biota. Higher value of bicarbonate leads to alkaline pH. The greatest amount of bicarbonate was identified as 45.73 mg/l in summer and the lowest values 30.5mg/l in winter.

E.Dissolved Oxygen:
DO observed in the Dissolved oxygen is an important parameter in water quality assessment as it regulates many metabolic and physiological processes of biotic components. It indicates the pollution in water bodies.The DO values varied from 8.5mg/l to 10.14 mg/l. Highest in rainy- and the lowest was observed in summer. Lower DO indicate organic pollution in lakes as levels in water drop below 5.0 mg/l, many life forms are put under pressure [10].

F.Biological Oxygen demand:
The highest concentration of BOD 8.5mg/L recorded in summer Whereas lowest value 5.9mg/L was recorded in rainy-. High amounts of waste along with rain- water from the surrounding and addition of organic waste in lakes by certain human activities are also responsible for the increase inBOD [11]. High biological oxygen in summer allowed several microbes in the water accelerate their metabolic activities.

G.Chemical Oxygen demand:
The highest value 5.62 mg/l, and the lowest values 4.98 mg /l were recorded-. Highest values were observed in summer and the lowest values were recorded during the rainy season. The Values of COD in conjunction with BOD are useful in knowing the toxic condition and presence of biologically resistant organic substances. [12].The estimation of COD along with BOD is helpful in indicating toxic conditions and the presence of non-biodegradable substances in the water [13].The High COD values indicate that some degree of non-biodegradable oxygen demanding pollutants are present in- the water.

H.Total Hardness:
The maximum values 198.00 mg/Lis recorded during the summer .Lowest values 166.00mg/L were recorded in the rainy season. High range organic components, detergents, chlorides, high temperatures are influenced to decrease in water volume and they increase the hardness. The lowest amount of total hardness was recorded during the winter season due to low concentration sof calcium and magnesium. [14].

I.Magnesium:
The maximum value 35 mg/l was in summer and the lowest value was25 mg /L in winter . Lowering of magnesium levels reduces the phytoplankton population [15].The high values observed in summer could be due to evaporation, increasing the concentration of magnesium [16].

J. Total Dissolved Solids:
Dissolved solids are present in water in natural conditions. The dissolved solids are composed mainly of carbonates, bicarbonates, chlorides, sulphates, calcium, phosphate and iron [17].High TDS value for Kalki-lake was estimated to be 360 mg/l in summer and lower was 320 mg/l in winter.

The contamination of domestic wastewater, garbage and other related wastes in the surface water body can be one among the reasons for increasing TDS measure[18].

K.Total Suspended Solids:
TSS average values in Kalki Cheruvu were recorded -during research, highest value recorded in summer season 52 mg/l ,low values recorded in the winter season 45 mg/l.

L.Chlorides:
It is an inorganic anion in water. The Higher Concentration of chloride 156.25 mg/l. estimated in summer and lower concentration 126.25 mg/l recorded in rainy . The Higher concentration of chloride is considered to be an indicator of higher pollution due to higher organic waste of animal origin[19].The Concentration Of chloride is directly correlated to the pollution level [20].The lowest value of chloride recorded during the -monsoon season due to the dilution of lake water by rain [21].

M. Phosphates:
Phosphates were recorded at very low concentration in Kalki Cheruvu and the concentrations are influenced by domestic sewage and, agricultural waste releases into the aquatic system. The Highest value of phosphate was recorded 67 mg/l in winter and the lowest value of phosphate was recorded 54 mg/l in the rainy season.

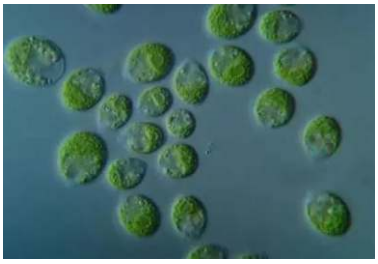
N:Sulphates
The maximum value 36 mg/l was recorded in summer season and Minimum of24 mg/l in rainy season during the period of investigation .Sulphur deficiency can inhibit algal growth indirectly by hindering chlorophyll synthesis[22].

O. Nitrates:
The estimated maximum number of nitrates 1.15 mg/l, in the rainy season and the minimum amount 0.64mg/l were recorded in summer. Nitrogen is a component in nitrate, nitrite, ammonia, urea, and dissolved organic compounds in an aquatic environment. The highest amount of nitrate concentration was known to support the formation of blooms [23].

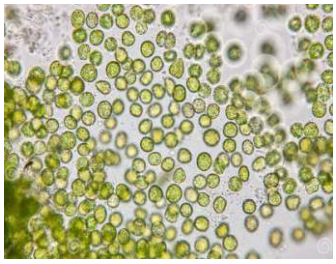
Identified algal list during one-year investigation period as shown below

1. Identified genera and species belonging to Chlorophyceae.

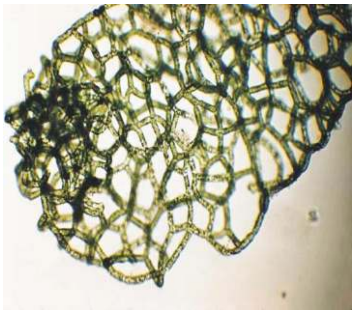
- *Ankistrodesmus spiralis Ralfs, Chara vulgaris*
- *Chlamydomonas globosa J.w. Snow, C. polypyrenoideum Prescott*
- *Chlorella ellipsoida Gerneck,C. vulgarisM.W.Beijerinck*
- *Cladophora oligoclona Kuetz, C. glomerata (L.)Kutz*
- *Closterium acutum (Lyngby) Bb, & Ralf,C. decorum Breb*
- *Coleochaete orbicularis Prindsheium*
- *Cosmarium portianum W.Archer, C. depressum P.Lundell,C. cucumis Corda*
- *Cylindrocystis brebissonii Menegh,*
- *Cylindrocapsa geminelle var. minor Hansgirg*
- *Dactylococcus bicaudatu Abr.West*
- *Eudorina elegans Her,E. illinoinensis Pascher*
- *Golenkinia paucispina West&West*
- *Gonium sociale Warming D.*
- *Hydrodictyon reticulatum L.*
- *Microspora tumidula Hazen*
- *Oedogonium gigantinum Kutzing, O. globosum Nordstedt, O .princeps Wittrock*
- *Oocystis solitaria Wittr*
- *Pediastrum angulosum(Her) Menegh, P. duplex Meyen, P. Simplex Meyen*



1a. Chlamidomonas globosa



1b. Chlorella ellipsoida



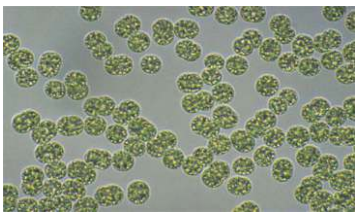
1c. Hydrodictyon reticulatum

1d. Microspora tumidula

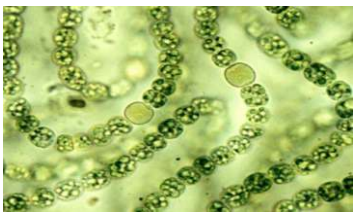
Fig No 1. Some Identified Chlorophyceae -Photoplates

2. Identified Genera and Species belonging to Cyanophyceae

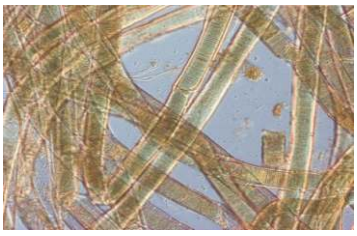
- *Aphanocapsa grevillei Rabenth,*
- *Aphanothece clathrata West &West,A.microscopica Nag.*
- *Chroococcus micrococcus Rabenhorst*
- *Gloecapsa atrata Kutz, G.punctata Nag*
- *Gloeotrichia ghosei Singh,G.natans Ag.*
- *Hydrococcus rivularis Kutzing*
- *Lyngbya majuscula (Dilwyn) Harvey*
- *Microcystis aeruginosa Kutz, M.robusta (Clark) Nygaard*
- *Nostoc sphaericum voucher,N.comminutum Kuetzing, N.punctiforme (Kuetz) Hariot*
- *N.spongiforme C.Agardh*
- *Oscillatoria acuta Bruhl, O.chalybea Mertens,*
- *O.limnosa Ag,O. princeps Vaucher*
- *Phormidium inundatum Kutz*
- *Scytonema subtie .simplex (Kutz)*
- *Spirulina gigantean Schmidle*



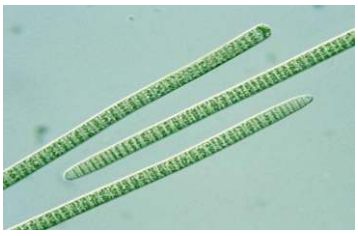
2a. Microcystis aeruginosa



2b. Nostoc sphaericum



2c. Lyngbya majuscula

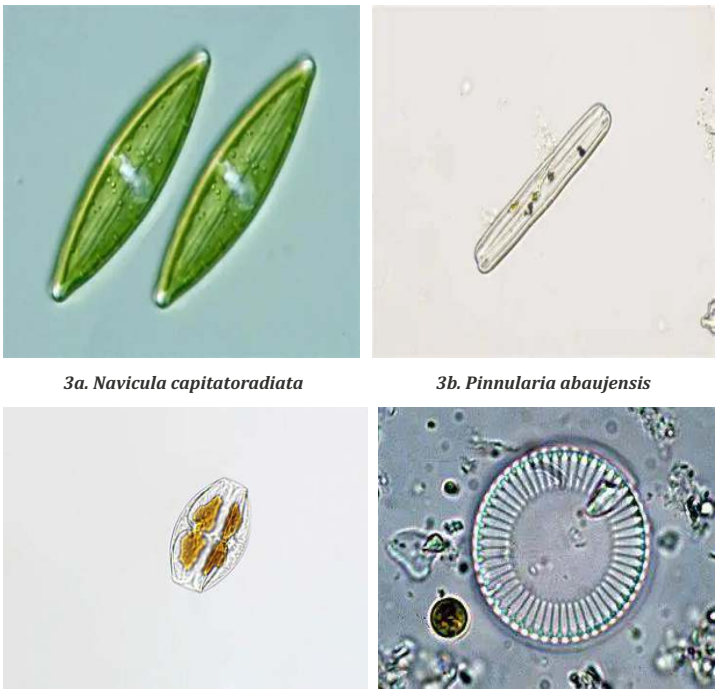


2d. Oscillatoria acuta

Fig No 2. Some Identified Cyanophyceae -Photoplates

3.Identified genera and species belonging to Bacillariophyceae.

- *Acanthes exigua Grun*
- *Amphora coffoeformis (Ag)Kustz*
- *Cyclotella meneghiniana Kutz*
- *Cymbella affinis Kutz,C.microcephala Grun*
- *Fragillaria crotonensis Kitton,F.ramboidis Ehrenb*
- *Gomphonema constructum Her,G.lanceolatum Ehr*
- *Melosera verians Ag.*
- *Navicula capitatoradiata Germain,.N.cuspidata Kutz,N.cryptocephala Kuetz*
- *N.radiosa Kutz*
- *Pinnularia abaujensis(Pant) Ross,P.biceps Greg.var.amphcephala*
- *Rhopalodia gibba (Ehrenb) O.Muller*
- *Synedra acus Kutzing*



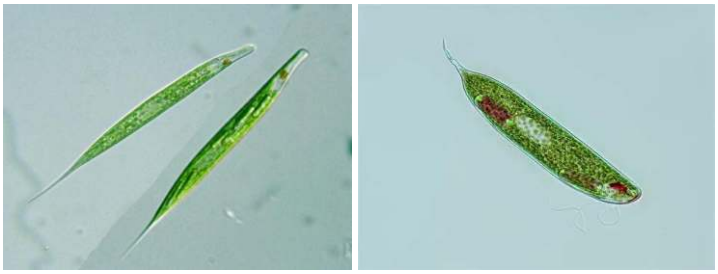
3a. Navicula capitatoradiata *3b. Pinnularia abaujensis*

3c. Amphora coffeaeformis *3d. Cyclotella meneghiniana*

Fig No 3. Some Identified Bacillariophyceae -Photoplates

4. Identified Species belonging to Euglenophyceae

- *Euglena acus Ehrenberg*
- *E. polymorpha Dangeard*



4a. Euglena acus *4b. Euglena polymorpha*

Fig No 4. Some Identified Euglenophyceae -Phtotplates

IV. Conclusion

This study underscores the significant seasonal variation in phytoplankton communities of Kalki Cheruvu. Chlorophyceae emerged as the most dominant class, followed by Cyanophyceae and Bacillariophyceae, while Euglenophyceae were found in lesser numbers.

The presence of pollution-sensitive taxa indicates that the lake remains relatively unpolluted and can be considered suitable for domestic, agricultural, and aquaculture purposes. And- the result of the analysis of physico-chemical parameters had indicated that human activity and influx of domestic waste into the lake led to eutrophication-.Seasonal variations in parameters such as temperature, pH, dissolved oxygen, and nutrient levels play a vital role in shaping the composition and abundance of phytoplankton communities.

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