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Diversity Of Euglenophyceae In Hussain Sagar Lake Of Hyderabad

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Abstract

The present study reveals the taxonomy and diversity of Euglenophyceae class members in Hussain Sagar Lake, Hyderabad, Telangana. Algae and water samples were collected in four locations for a period of two years, from June 2018 to May 2020.In the present investigation, a total number of 26 euglenoid species belonging to 4 genera were recorded. Among these, *Euglena polymorpha, Euglena oxyuris Euglena acus, Euglena mangini E.viridis, E.proxima, , E.elongata, E.gracillis, Trachelomonas hispida, Phacus acuminatus, Phacus curvicauda, Phacus indicus and Phacus longicauda* were the most abundant species.

Keywords: Euglenophyceae, Taxonomy, Diversity

1.Introduction

The Euglenophyceae diversity is determined by the level of richness of species and their functional importance in the processes they mediate. Euglenoids are unicellular flagellates, with around 40 genera and 1000 species, most of which are found in fresh waters (van den Hoek et al., 1995). The majority of the Euglenophyceae class members have rigid, naked, free-swimming cells with high metabolisms, and they contain carotenoids such as β-carotene, lutein, neoxanthin, astaxanthin, and antheraxanthin, as well as photosynthetic pigments that mimic those of Chlorophyceae since they contain chlorophyll a and b. They have one, two, or three pantonematic-type flagella that emerge from an anterior cell invagination. Paramylum, a polysaccharide, is the reserve product. Puddles, ditches, ponds, streams, lakes, and rivers are habitats for euglenoid flagellates, especially in areas where animal waste or decomposing organic matter has contaminated the water (Buetow, 1968). Euglenoids numbering around 1500 are commonly found in freshwater especially when it is rich in organic materials. (Leander et al.,2017). Several investigators have been studied Euglenoids taxonomy such as Stein (1878), Klebs (1883), Pascher and Lemmermann (1913), Gojdics (1953), Hosmani and Bharati (1975),

Pandey (1985), Barhate and Tarar (1985), Randhawa (1959), Desikachary(1959), Venkataraman (1961), Philipose(1967), and Gonzalves (1981).

The area of study is the Hussain Sagar Lake which is located in the center of Hyderabad, the capital city of Telangana (17.4239° N, 78.4738° E). Hussain Sagar, one of Hyderabad's most popular tourist spots, is just two miles from the city center. The lake, which is bordered to the north, south, and east by Sanjeevaiah Park, Lumbini Park, and Indira Park, provides a setting that is highly unusual to find in the center of any metropolis. Its overall area is 5.7 square kilometers, or 2.2 square miles. Hussain Sagar is 510 meters above sea level, and the lake's lowest point is 32 feet (9.8 meters). At all levels, the average depth is 5.2 meters, the road bund level is 5.18 meters, and the storage volume is 28.6 × 106 meters at spill level (Kora, 2017). The lake's catchment area is 240 square kilometers, or 93 square miles. Twin cities Hyderabad and Secunderabad are united by the Tank Bund, an embankment and dam that spans the Hussain sagar Lake. Situated on a branch of the river Musi, it is an artificial lake. Four main drains, or nalas, serve as feeding systems for the lake and contribute to its water supply in addition to storm water because of the area's rapid rise in residential and industrial development. Domestic sewage and solid garbage at rates of one million liters per day (MLD) are dumped into the lake via Balkapur (13.3MLD), Banjara (6MLD), Kukatpally (70MLD), and Picket nalas (5.7MLD) (Sridhar, 2015). Untreated waste is added to the lake by four inlet streams: Picket nala, Kukatpally nala, Banjara nala, and Bowenpally nala. In order to close this gap, the current study was started to show how diverse the Euglenophyceae species are that inhibit in Hussain Sagar Lake.

2.Material And Methods

Sample Collection And Analysis

Samples of water and algae were taken at four different sampling points. The sites listed below are where the samples are collected. The first station is in front of NTR Ghat, the second is next to the boat club, the third is next to Sanjeevaiah Park, and the fourth is next to the rock garden. For a period of two years, from June 2018 to May 2020, water samples were taken monthly at all sampling locations and placed in polythene containers

At Osmania University's Department of Botany, qualitative study on phytoplankton has been carried out. The samples were gathered on a regular basis. Four separate lake stations collected one liter of water samples, which were then stored in the sedimentation column with two to three

ml of a 4% formaldehyde solution added. With the appropriate safety measures taken, water samples were gathered in distinct standard glass bottles (BOD bottles) for the purpose of estimating dissolved oxygen. Each sample was transported in an icebox to the lab. Using standard procedures recommended by APHA, the samples were examined in the laboratory for several physico-chemical characteristics on the same day .The samples were left undisturbed for around a month to allow the organisms to settle completely. 100 ml of the samples were concentrated. Ultimately, frequency measurements and species identification were conducted using the reduced material (Blum, 1957). The purpose of this concentrated material was to identify species and assess frequency. Images were captured with a Cat Scope CSU 2000 L Binocular research microscope fitted with Cat Com digital camera photomicrographic system. Systematic evaluation of Euglenophyceae is done using standard floras and published journals.

3.Results And Discussion

3.1 Physico Chemical Parameters

The average values of the physico-chemical variables (June 2018 - May 2020) of the water body studied along with the standards stipulated by ISI (10500:2012) and BIS [9] quality criteria are given in the Table: 1 2.69 1.6 2.66 6

Table-1

S.No	Parameters	Hussain sagar Lake				ISI 10500:2012		BIS(2003)	
		I	II	III	IV	A	P	**P**	**E**
1.	Temperature	26.5°C	29°C	23.5°C	25°C	-	-	-	-
2.	pH	8.06	8.46	7.57	7.88	6.5-8.5	No relaxation	5	25
3.	$Co3^{-2}$	24.93	33.22	31.96	30.88			-	-
4.	$HCO3^{-}$	237.31	217.17	180.74	219.64			-	-
5.	Cl^{-}	307.36	198.57	292.58	304.12	-	-	250	1000
6.	D.O	2.68	2.4	2.11	2.93	6		6	-
7.	Organic matter	16.8	21.95	28.04	21.19	-		-	-
8.	NO3-	6.545	6.57	4.6	4.56	45	No relaxation	45	45

9.	T.H	346.15	328.67	440.75	418.9	300		300	
10.	Ca^{+2}	85.4	80.74	83.35	80.3	75	200	75	200
11.	Mg^{+2}	62.62	64.13	73.24	73.36	30	100	30	100
12.	T.S	655.1	759.14	737.7	644.2	500		500	1500
13	BOD	93.57	104.3	126.3	136.4			3	
14.	COD	181	139	138	144.3			-	10
15.	TDS	421.13	408.14	412.16	418.14	500		500	
16.	TSS	344.11	321.25	284	304				
17.	SO4-2	41.6	36	33.12	34.31	200	400	200	400
18.	PO4-3	3.92	3.97	3.36	3.41				
19.	SiO2	0.026	0.032	0.024	0.023				

Physico-Chemical Parameters

In the present investigation maximum surface water temperature recorded in summer and minimum in winter. The surface water temperature ranged from 23.5°C to 29°C. Temperature is one of the most important factors in the aquatic environment that plays a crucial role in physico-chemical and biological behavior of an aquatic system (Dwivedi and Pandey ,2002 and Singh and Mathur,2005) . Aquatic organisms depend on certain temperature range for their optimal growth (APHA,2005). The average value of pH varied from 7.57 to 8.46, with the lower range in the station III and the highest in the station II. The monsoon's low pH value was affected by a large inflow of fresh water into the water body. The higher pH in the winter might be attributed to increased photosynthetic activity. Roy (1955), Tiwari and Chauhan (2006), and Aher et. al. (2006) all made similar observations. Low dissolved oxygen levels have been related to the ability of flowing water to purify itself, the photosynthetic efficiency of aquatic plants, and airflow, among other things (Singh and Trivedi 1979). The average values of DO were 2.68 mg/L at station-I, 2.4 mg/L at station-II, 2.11 mg/L at station-III and 2.93mg/L at station IV respectively. In the current research, total alkalinity varied from 350.32 to 530.23 mg/l, with monsoon being the lowest and summer being the highest. The accumulation of a high amount of bicarbonate might be caused by organic decomposition and a reduction in water level. Dilution was clearly responsible for the decrease in alkalinity throughout the monitoring month (Mishra et. al., 1989). Jhingram (1982) indicated that a high productive water body has alkalinity more than 100 mg/l. Total sulphate levels ranged from 34.85 to 41.80 mg/l, with station III having the

lowest levels and station I having the highest. The buildup of a large number of sulphates is a result of organic decomposition and a decrease in water level. Total phosphorus levels varied from 3.36 to 3.97 mg/l, with the lowest values occurring in station III and the highest occurring in station II. In the present investigation the concentration of nitrates, phosphates and were very high confirming eutrophic condition with high organic pollution, surface runoff from the catchment and sewage contamination. The lake water is unfit for domestic consumption due to high sulphate values (Javid and Pandit,2012). Total solids and total dissolved solids were found in higher concentration and exhibited positive correlation with BOD and COD in the lake indicating high degree of pollution. Phosphates, nitrates, organic matter and chlorides were major contributors in the increased concentration of total solids and total dissolved solids.

Algae

3.**2.Phytoplankton**

Table 2: Percentage Of Phytoplankton

Groups	Station-I	Station-II	Station-III	Station IV	Average %
Euglenophyceae	10.75	9.86	9.39	9.56	9.89
Cyanophyceae	80.65	81.63	81.22	81.36	81.21
Chlorophyceae	5.20	4.83	5.92	4.92	5.13
Bacillariophyceae	3.38	3.67	3.45	3.34	3.46

Table 3. Location Wise (Station Wise) Dominant Euglenophyceae Species In Hussain Sagar Lake

Stations	Dominant species
Station – I	*Euglena acus, Euglena mangini , E. gracilis Lepocinclis playfairiana, L.caudata Lepocinclis steinii var. suecica Lemmermann, Trachelomonas hispida, T. armata*
Station – II	*Euglena acus,Euglena mangini, E. longa Lepocinclis ovum Phacus tortus Phacus trimarginata* Allerge and Jahn
Station – III	*Euglena acus, E. longa, E. sociabilis Lepocinclis playfairiana, . L. caudate, Phacus*

	margaritatus Pochmann
Station –IV	*Euglena acus , E. gracilis E. sociabilis,Lepocinclis ovum Phacus tortus, Trachelomonas hispida, T. armata, Lepocinclis ovum var. discifera* Conrad.

The results of our observation are presented below:

Table 4.List Of Taxa Reported From Hussain Sagar Lake

S.No	Name of genera	Name of taxa
1	. *Euglena* Ehrenberg	*Euglena acus*
2		*Euglena mangini*
3		*E. gracilis* Klebs
4		*E. longa*
5		*E. splendens*
6		*E. pusilla var. longa*
7		*E. hiemii*
8		*Euglena acus var.major*
9	*Lepocinclis*	*Lepocinclis playfairiana*
10		*Lepocinclis ovum*
11		*L. globulus Perty*
12.		*L. claviformis Conforti*
13		*L. oxyuris*
14	*Phacus* (Dujardin)	*Phacus tortus(Lemm)*
15		*Phacus pseudobicarinatus*
16		*Phacus indicus*
17		*Phacus orbicularis*
18		*Phacus acuminatus*
19		*P. circulatus*

20		*P. contortus*
21		*P. obolus*
22	*Trachelomonas* Ehrenberg	*Trachelomonas allia*
23		*T. armata*
24		*T. cylindrica*
25		*T. curta*
26		*T. ovata*

Description Of Species:

Plate 1

***1. Lepocinclis playfairiana* Deflandre, 1932 *(*Plate 1, Fig. 1)**

Cell broadly fusiform to elliptical, 47-50 µm long., 20.5-24 µm broad, R l/b = 2.0-2.4; anterior pole asymetric, with a boss reminding beak; posterior pole, colourless, conical caudal process slightly acuminated, straight, 7.5-11 µm long., pellicle smooth; numerous chloroplasts, parietal, discoid, ca. of 3.0 µm diam.; paramylon bodies 2, lateral, ring-shaped; emergent flagellum 1/2 of cell length.

***2.Phacus tortus* (Lemmerman) Skvortsov ,1928 (Plate 1, Fig. 2)**

Cells are commonly orbicular, broadly ovate to broadly elliptic, 54-66µm long,31-37µm wide, thin, moderately to strongly twisted, with a long slender caudus. Two central, centric discs, or a single ring or disc of paramylon can be seen. Cells broad, spindle shaped and single twist involving entire body. The anterior end conically round with apical groove and slightly broad at middle region of the cell. Posterior end narrow and spirally twisted with a long and straight or slightly curved cauda. Pellicle thick longitudinally striated and transversal striae present between the pellicle. Striations arise from the apical groove and end in posterior cauda. Longitudinal striations 15-16 and the transversal striae are uniformly arranged.

3***) Euglena acus (* Ehrenberg, 1830) (Plate 1, Fig. 3)**

Very slightly metabolic. Shape is almost needle like to fusiform, without a true posterior tail piece;periplast stiations faint; chloroplasts numerous and discoid, pyrenoids absent; 7-12 elongated rod shaped paramylon particles present; flagellum ¼ length of body, L 52-200µ; W 7-18µ

4) ***Phacus pseudobicarinatus(* Alves-da-Silva & C.E.M.Bicudo,2009*)*(Plate 1, Fig.4)**

Cell strongly asymmetrical, ovate, 29.6-30.5 × 22.7-24.9 µm, R l/b = 1.1-1.2; sulcus almost as long as the cell, right margin strongly convex, transverse optical section 3-angular, rounded angles, posterior pole suddenly attenuate into a hyaline, conical, curved towards the cell right margin, 2-3 µm long caudus; pellicle hyaline, striae longitudinal and transversal; chloroplasts pariet al, numerous, disc-shaped, ca. 2,8 µm diam.; paramylum granules 2, concentric or not, usually central, small one ca. 6.5 µm diam., large one ca. 12 µm diam., a few other smaller, spherical, dispersed, diameter not measured; lateral view of paramylum granules bobbin-like; nucleus posterior; stigma elongate to 3-angular; flagellum 0.5-1 times the cell length.

Plate 2:

5) ***Euglena acus var.major (*Pringsheim 1956) (Plate 2, Fig. 1)**

Cell fusiform, 92.5-102.6µm long, 7.4-8.3µm broad, Rl/b= 12.4; tail piece 12-17µm long, pellicle rigid to semi-rigid, striae longitudinal; paramylon grains 5 to numerous, rod-shaped The type species (lectotype) of the genus *Euglena* is *Euglena viridis* (O.F.Müller) Ehrenberg

*6)**Euglena mangini* Lefèvre (Dillard 2000) (Plate 2, Fig . 2)**

Cell length 90-110 µm, breadth 18-20 µm, fusiform, posterior end abruptly tapered into a fine, straight, rigid but not sharply pointed tail. Flagellum is of two-thirds cell length. Pellicular striations are delicate but distinct and widely spaced.

7**)** ***Lepocinclis ovum*** (Ehr.) Lemm. (Pascher & Lemmermann f**) (Plate 2, Fig. 3)**

Shape oval , with posterior spine; periplast spirally striate ; flagellum twice length of body. L30-38µ; W 15-18µ. Cell length 17-33 µm, breadth 13-25 µm. Obovoid, anterior margin broadly rounded and ended with short blunt projection; lateral arches slightly arched, chloroplasts small; two large paramylon bodies, ring shape

*8)**Phacus indicus (*Skvortsov 1937) (Plate 2, Fig. 4)**

Nucleus spherical to oblong, located centrally in the cell, 8 to 11.5µm in diameter; endosome one, spherical, 3.5µm across.

Plate 3:

9) ***Euglena acus (*** **Ehrenberg, 1830) (Plate 3, Fig. 1)**

Cells sub-cylindrical to elongated or fusiform; 175.5-177.3 µm long and 10.9-12.8 µm broad; posterior end tapering and pointed with a short tail; pellicle firm, colorless without flexibility, no change of shape on stimulation; flagella one; chloroplast pale green, many, discoid; paramylon

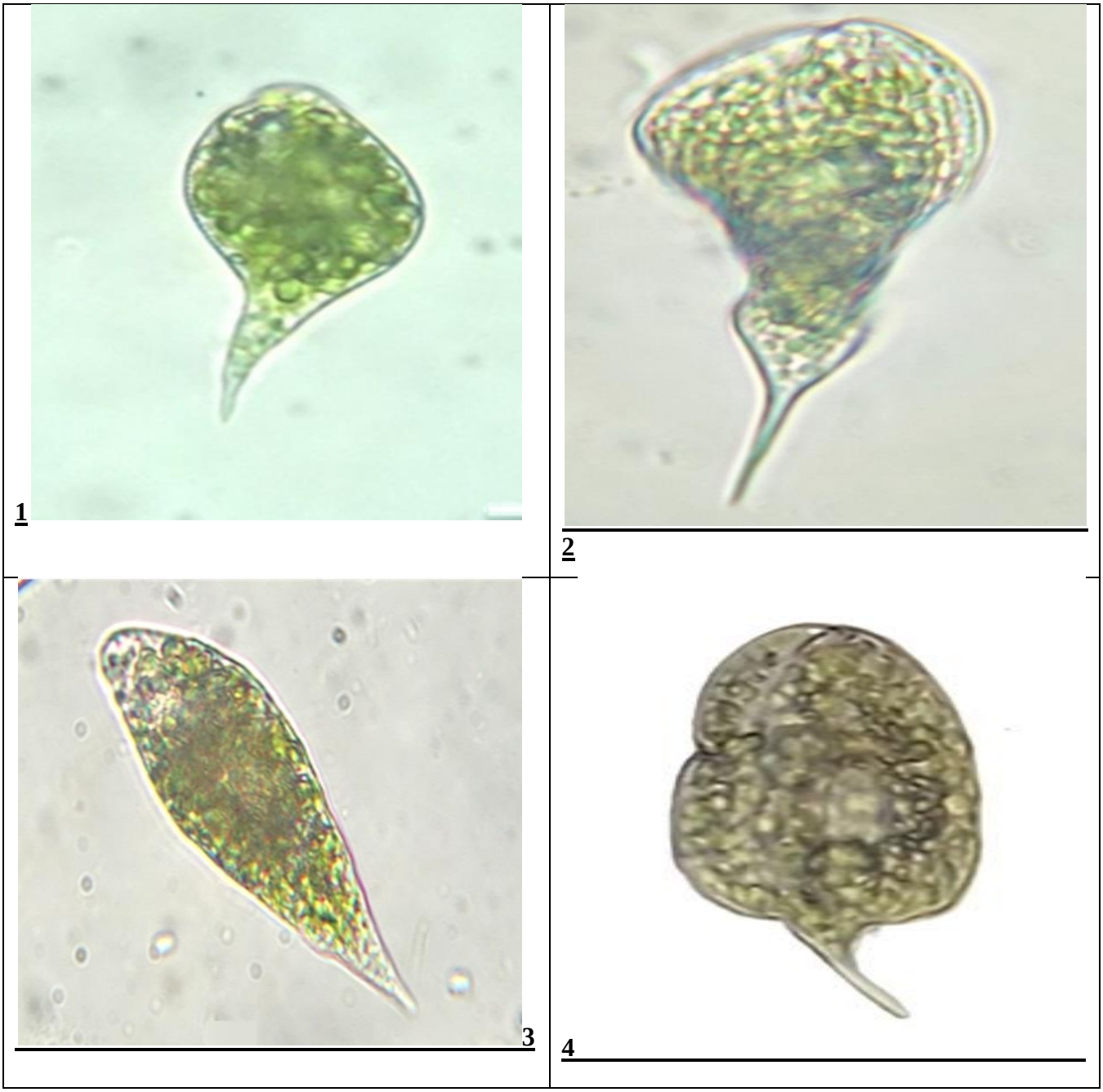
bodies 7-10, rod shaped; 4.87-7.31 µm long and 2.1-3.5 µm broad; nucleus one in each cell, eye spot red and ovoid.

*10)**Phacus orbicularis*** **Hübner 1886 (Plate 3, Fig. 2)**

Cells circular to broadly oval with a short ,bent posterior tail piece ; periplast longitudinally striate; one large annular paramylum granule;flagellum length of body. L 50-100µ; W 30-60µ.

Photomicrographs Of Euglenophyceae

Plate 1:



1

2

3

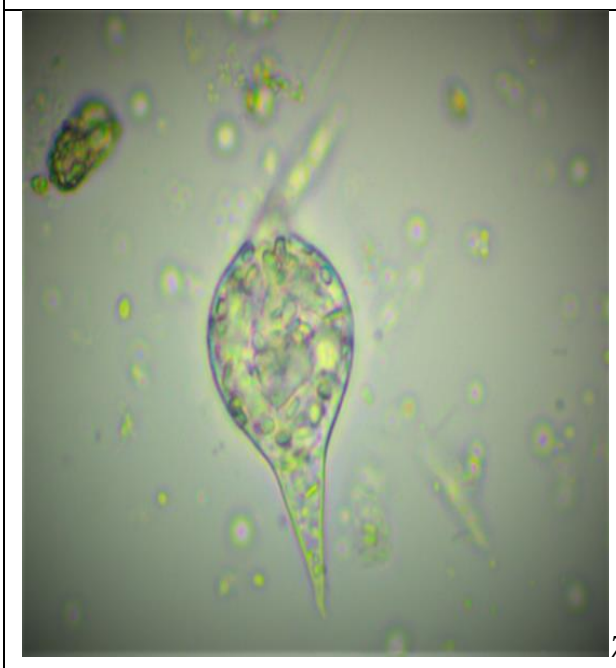
4

1. *Lepocinclis playfairiana*
2. *Phacus tortus*
3. *Euglena acus*
4. *Phacus pseudobicarinatus*

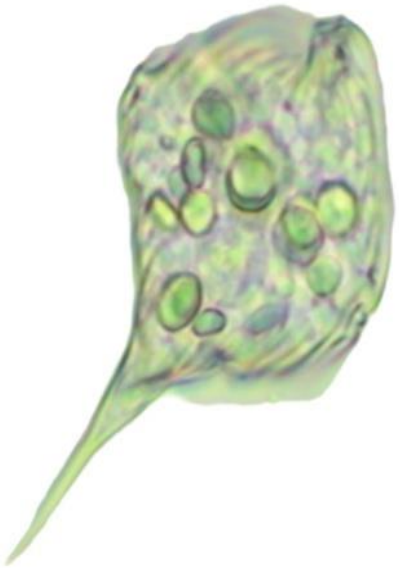
Plate 2:

5

6



7



8

5. Euglena acus var.major

6. Euglena mangini

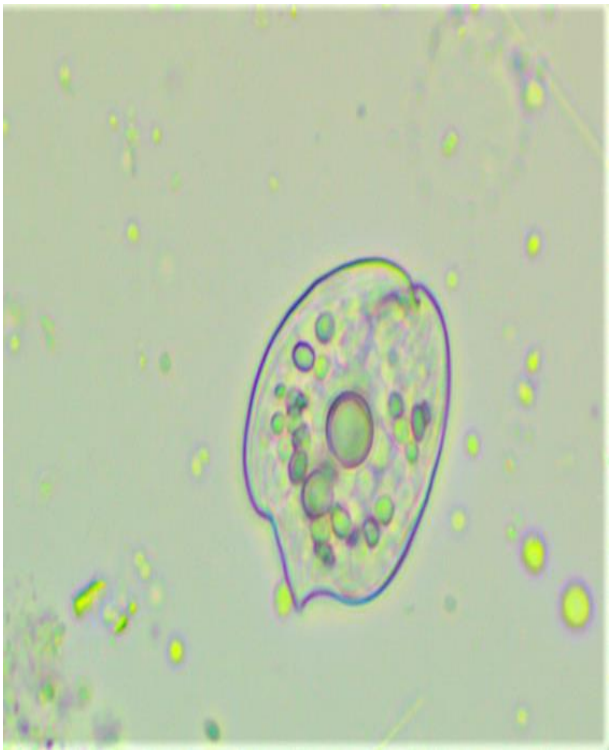
7. Lepocinclis ovum

8. Phacus indicus

Plate 3:

9

10



9. Euglena acus

10. Phacus orbicularis

Euglenophyceae are generally abundant in waters rich in organic matters. A total of 26 species of euglenophyceae under 4 genera were recorded during the present study. Camera Lucida diagrams of the euglenoids recorded during the study are represented in the above figures. *Euglena i*s represented by 7 species. *Phacus* is considered to be dominant genera of polluted water . The genus Phacus in the present investigation is represented by species which indicates the presence of higher pollution load. The genus Tracheolomonas is represented by five species (Table 4)). Thalli of Euglena exhibit many shapes formed by twisting of their body during their

movement. Morphology of euglenoids has been studied in detail by Leander and his associates (Leander et al., 2017). Most common shapes such as fusiform, cylindrical and spindle shape occur in the cells of *Euglena, Euglenaria, Euglenaformis* and *Lepocinclis*. In *Monomorphina*, cells are pear-shaped with a prominent tail. In *Phacus* cells are flattened, leaf-like and sometimes twisted. Oval, elliptical and fusiform are the shapes in which cells of *Strombomonas* exist. The shape of *Trachelomonas* is globose, compressed globose and subglobose to ellipsoid, ovoid, cylindrical and hexangulate. The size of euglenoids is varying even within species due to activities associated with their movement. Extensive studies of Euglenophycean members were made by Fritch (1937), Zafer (1959) and Rao (1972) found that higher concentration of chlorides, ammonical nitrogen and lower concentration of phosphates favor the growth of Euglenophyceae members. Euglenophyceae members contributed a major fraction of phytoplankton of the present habitat. They were represented by the species of *Phacus, Euglena* and *Trachelomona*s and showed high species diversity in inland water bodies. Euglenophyceae were observed to be characteristic features of habitats with organic pollution in studies by Kumar et al. (1974) and Pandit (1999) while euglenoid maxima was found in summer and associated with high temperatures and high phosphate concentration (Munawar, 1974; Pandit, 1980) Euglenophyceae is represented by blooms of *Euglena polymorpha, Euglena acus, E. viridis, Euglena proxima, Euglena oxyuris, E. elongata, E. gracillis, Trachelomonas hispida, Phacus acuminatus, Phacus curvicauda* and *Phacus longicauda*. We observed a total of 10 taxa of Euglenophytes belonging to 3 genera from middle-lower part of the Hussain sagar lake. *Lepocinclis , Phacus longicauda, P. ranula, P. orbicularis , P. tortus ,P. helikoidis ,P. circumflexus ,P.brachykentron , P.pleuronectes , P.acuminatus , P.curvicauda, P. ephippion , P.arbiculavis , P anomalous ,P.denisii , Euglena proxima , E. paramylum, E. repulsans ,E. polymorpha, E. caudata var , Euglena oxyuris ,E. acus ,E. tripteris ,Trachelomonaswoycickii ,T. pulcherrima ,T. varians ,T. robusta, T. hispida , Lepocincils fusiformis* were also identified in the present study. During the period of study the phytoplankton of lake was dominated by Euglenophyceae in the summer season. None of the species reached a strong quantitative predominance. Special species richness was observed in the genus *Euglena.*

4. Conclusion

The water was alkaline in Hussain Sagar Lake. Carbonates and dissolved oxygen were recorded in low concentration while organic matter, COD, phosphates and nitrates were recorded in high

concentration. Cyanophyceae, Chlorophyceae, Euglenophyceae and Bacillariophyceae were recorded in the lake. Among the four groups of algae, Euglenophyceae constituted the dominant group. Bacillariophyceae were recorded in very low numbers. Ph, dissolved oxygen, organic matter, phosphates and nitrates influenced the growth of Euglenophyceae. Temperature, organic matter, phosphates and nitrates influenced the growth of Euglenophyceae. Bacillariophyceae are influenced by silica and dissolved oxygen. *Euglena, Phacus,Trachelomona*s and *Lepocinclis* were dominant in the lake; they can be used as good indicators of pollution. On the basis of both physico-chemical and biological characteristics, the lake water is polluted and eutrophic.

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