

Morpho-anatomical characters of few members belonging to Kingdom Protista from Safari Park, Lahore, Punjab, Pakistan

Nadeem-Ullah^{1*}, Mehwish Jaffer¹, Laiba Umer¹, Minahil Urooj¹, Tayaba Arshad¹, Shafiq-ur-Rehman²¹Department of Biotechnology, UCP, Lahore²Department of Basic and applied chemistry, UCPDOI: <https://doi.org/10.36348/sijcms.2024.v07i11.002>

| Received: 08.09.2023 | Accepted: 14.10.2023 | Published: 20.11.2024

*Corresponding author: Nadeem-Ullah

Department of Biotechnology, UCP, Lahore

Abstract

The present study was carried out on Safari Park, Lahore, Punjab, Pakistan. The sampling was carried out randomly in different seasons from different water bodies of the park especially from Lake. Thirty-seven species belonging to six genera i.e., *Pediastrum* (4 species & 11% abundance), *Trachelomonas* (4 species & 11% abundance), *Euglena* (11 species & 30% abundance), *Phacus* (12 species & 32% abundance), *Lepocinlis* (1 species & 3% abundance) and (5 species & 13% abundance). All genera belong to kingdom Protista, two phyla i.e., Volvocophycota and Euglenophycota, two classes i.e., Volvocophyceae & Euglenophyceae, two orders chlorococcales and Euglenales and three families i.e., Hydrodictyceae, Euglenaceae and Naviculaceae.

Keywords: Safari Park, *Euglena*, *Phacus*, *Trachelomonas*, *Pediastrum*, *Lepocinlis*, *Navicula*.

Copyright © 2024 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC 4.0) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited.

INTRODUCTION

Lahore is the capital city of Punjab, Pakistan. Punjab is the largest province of Pakistan and is rich in a variety of water bodies such as rivers, canals, irrigation channels, rice fields, lakes and rain pools (Ali *et al.*, 2010a). It is located at latitude 31°32'59" N and longitude 74°20'37" E. Its elevation is 217 m (712 ft). Climate of Lahore is hot semiarid. Ghose (1924) worked on the algal flora of Punjab province. He described number of blue green algae from Lahore (Ghose, 1924). Later on, Masud-ul-Hasan along with different workers have reported some algae including Cyanophyta from ponds of Lahore and adjoining areas. Nadeem-Ullah & Butt, 2017 on the basis of morphological and cytological characteristics, identified fifty-nine species belonging to Kingdom Monera. Mukhtar *et al.*, 2021 reported 23 algal species belonging to 14 genera from different sites of district Lahore. Ecologically algae play a significant role in the nitrogen fixation, which takes part in increasing fertility of soil (Ali *et al.*, 2010b). Algae are good indicator for pollution (Patrick & Reimer, 1966). They are one of the most important indicators of water quality because of their rapid reaction to environmental changes related to large animals and plants. Algae are the initiators of food chain (Ali *et al.*, 2010b). So, by keeping in mind the necessity of the taxonomic studies of algal

species now a day, we collected algal samples from Safari Park Lahore, to studying morphological and cytological characters of different algal species (Nadeem-Ullah & Butt, 2017).

MATERIAL AND METHODS

Collection site

Algal sample was collected to investigate/identified algal taxa up to species level from selected sites. The area includes Safari Park, Lahore which is located at latitude 31°22'50" N and longitude 74°13'05" E on Raiwind Road, Lahore.

Collection of material

Samples were collected with hands from different habitats of Safari Park. The samples were placed in plastic bottles and labelled with the help of permanent marker according to dates, sampling sites and sample numbers, for analysis of physiochemical variables. The sample bottles were filled as much necessary for investigation. Identification up to species level was done with the help of microscopic study.

Field Observation

Selected sites physical characters i.e., temperature, pH, GPS and EC were measured on spot to

observe the preferred growth conditions of algae in different habitats. Mainly, water appearance, color, flora growing on the sites were also observed during collection (Nadeem-ullah *et al.*, 2018).

Preservation of the material

The samples were divided into two bottles, one of them preserved with 3-4% formalin (Aqueous solution of formaldehyde) by taking the intervals of 15 days while other was placed as such in the air for fresh algal sample. Then, transparent bottles containing preserved algal samples were placed at cool and dry place at room temperature.

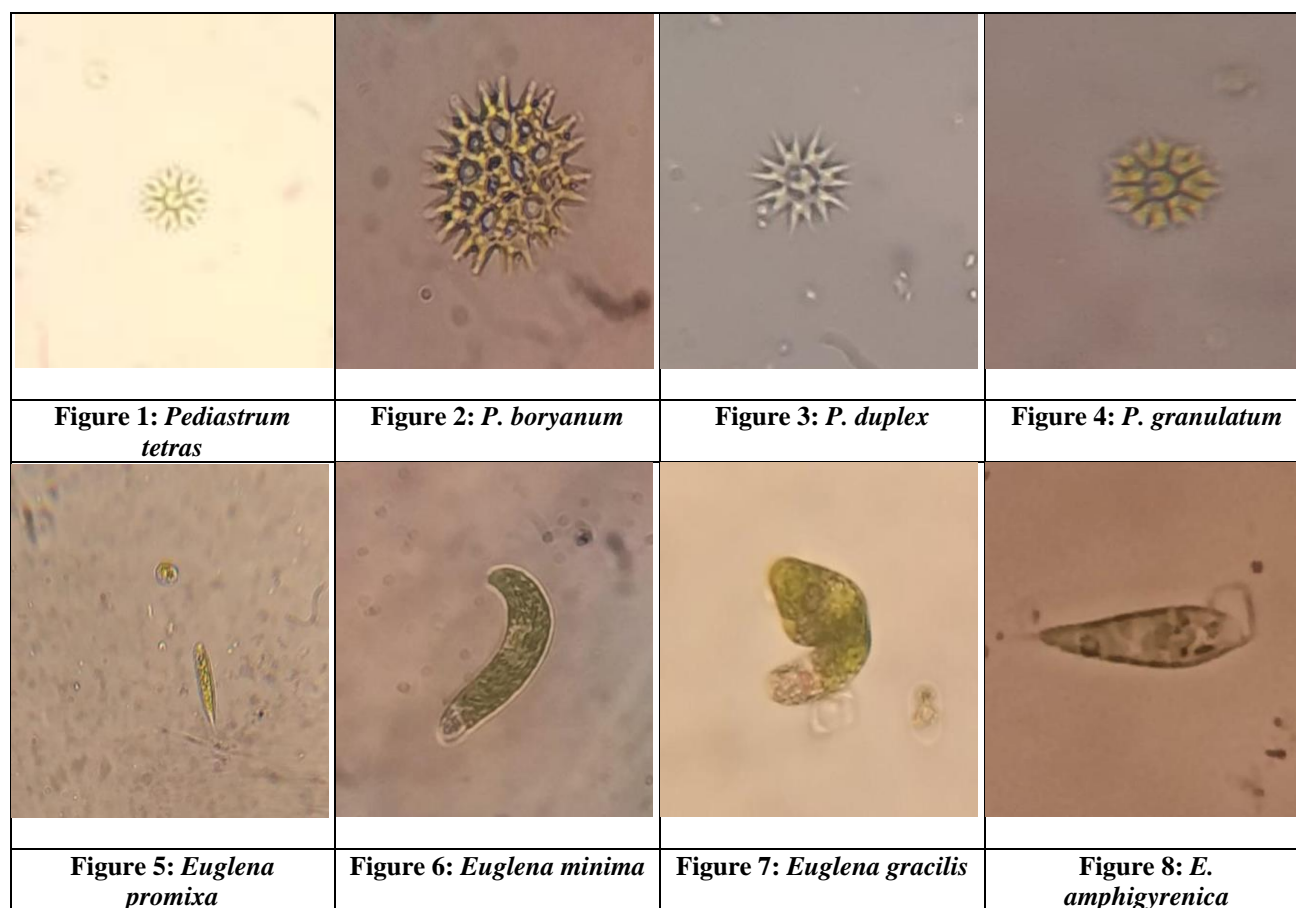
Study of Material in the Laboratory





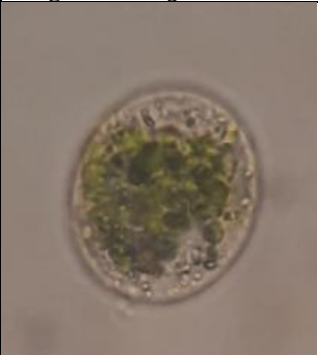











The research on algal taxonomy was carried out in the CBC laboratory at University of Central Punjab, Lahore. Collected samples were studied under microscopes for taxonomic identification. Samples were settled and upper layer is removed by siphoning process.















With the help of forceps and needles, algal sample were taken from the preserved bottle and then placed onto the clean glass slide. The material was mounted and spread properly on the glass slide with the help of forceps. After that, coverslip was placed on the material and excess water was removed gently pressing the coverslip and was absorbed with the help of blotting paper. The material was observed and studied under the low and high magnification of the light microscope.

Identification of the collected material

The collected samples were identified by using T.V. Desikachary (1959) and Prescott (1962). The taxonomic description of collected species of algae was carried out after survey with the help of standard literature and monographs e.g., Cooke, (1882-1884); Randhawa, (1936); Kützing, (1895); Tiffany and Britton, (1952); Masud-ul-Hassan, (1978); Masud-ul-Hassan and Yunus, (1989), Nadeem-Ullah *et al.*, (2021) etc.



			
Figure 9: <i>Euglena velata</i>	Figure 10: <i>E. polymorpha</i>	Figure 11: <i>E. limnophila</i>	Figure 12:
			
Figure 13: <i>Euglena viridus</i>	Figure 14: <i>E. cantabrica</i>	Figure 15: <i>E. sanguinea</i>	Figure 16: <i>E. texta</i>
			
Figure 17: <i>Trachelomonas volvocina</i>	Figure 18: <i>T. hispida</i>	Figure 19: <i>T. volzii</i>	Figure 20: <i>T. rugulosa</i>
			
Figure 21: <i>Lepocincilis texta</i>	Figure 22: <i>Phacus pyrum</i>	Figure 23: <i>P. caudatus</i>	Figure 24: <i>P. acuminatus</i>

			
Figure 25: <i>P. longicaudata</i>	Figure 26: <i>P. alatus</i>	Figure 27: <i>P. ankylonoton</i>	Figure 28: <i>P. curvicauda</i>
			
Figure 29: <i>P. hamatus</i>	Figure 30: <i>P. minutus</i>	Figure 31: <i>P. sesquitorus</i>	Figure 32: <i>P. acuminatum</i>
			
Figure 33: <i>P. viguier</i>	Figure 34: <i>Navicula salinarum</i>	Figure 35: <i>N. menisculus</i>	Figure 36: <i>N. gregaria</i>
			
Figure 37: <i>N. tripunctata</i>	Figure 38: <i>N. pelliculos</i>		

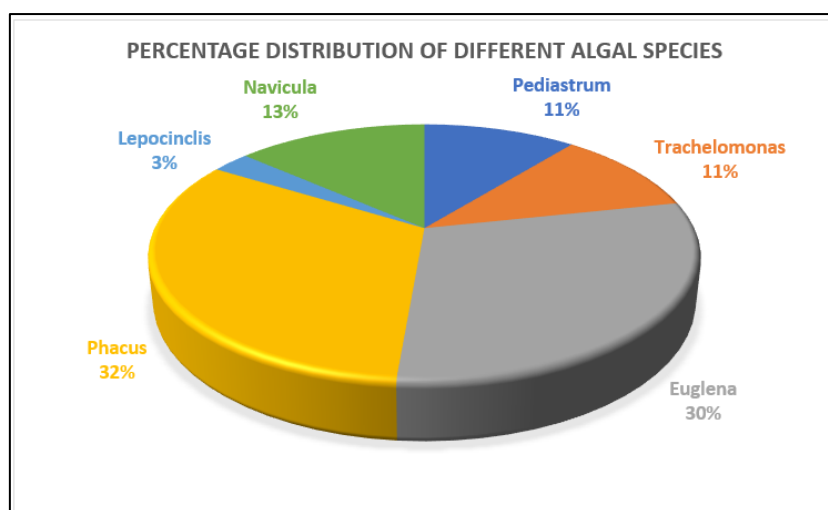


Figure 39: Percentage distribution of different algal species

RESULTS AND DISCUSSION

For the identification and taxonomic study of algae with their physico-chemical properties algal samples were collected from Safari Park, Lahore, Punjab. Identification and taxonomic study were based on morphological and cytological characteristics up to the species level. In this studies, 4 families, 6 genera and 39 species were identified.

Kingdom protista

Order Chlorococcales

Solitary or colonial; cells spherical, ovate, pyramidal or polygonal; reproduce by autospore formation.

Family Hydrodictyaceae

Coenocytic distinct members, various forms, mostly free floating some tychoplankton; cells cylindrical, triangular or cylindrical, form net or spherical coenobia, 2-64 cells or sometimes hundreds in a colony; chloroplast parietal with on to several pyrenoids; asexual reproduction is by division of parent

colony in daughter colonies; sexual reproduction is by isogamy, gametes are biflagellate.

Pediatrism Meyen

Colony is flat, cushion-like, made up of multinucleate cells, arranged in a regular, geometrical fashion to form a circular plate; the cells being in multiple of two. The peripheral cells may be polyhedral and uni, bi, tri or tetra-lobed and somewhat different in shape from the internal cells. The colony may be continuous or perforate with interstices. There is a parietal, diffused chloroplast, with one pyrenoid and several nuclei. Besides multiplying by auto colonies, isogametes are produced in sexual reproduction.

Key to species:

- Up to 16 cells per colony.....2
More than 16 cells per colony.....3
- Diameter of colony up to 25 μm *P. tetras*
Diameter of colony up to 85 μm *P. granulatum*
- Cells walls sculpture*P.duplex*
Cells walls granular.....*P. boryanum*

Table 1: Morphoanatomical characters of different species of *Pediatrism*

Name of species	Coenobia	No of cells	Diameter of cells	Marginal cells	Inner cells Diameter	Cell wall
<i>P. tetras</i>	Coenobia without holes	4-16	23.9 to 30.9 μm	7.4-8.7 \times 9.8-12.4 μm	6.9-7.4 μm	Smooth
<i>P. boryanum</i>	Coenobia without holes	32	39.5-170 μm	6.2-12.3 \times 10.0-15.0 μm	7.4-34 \times 4.9-22.5 μm	Scarcely granular
<i>P. duplex</i>	Coenobia Circular	32-64	44.5-222.2 μm	7.4-19.8 \times 10.0-24.7 μm	10.0-12.5 μm	Fine Sculpture
<i>P. granulatum</i>	Coenobia circular	16	69.7-84.6 μm	18.9-23.5 \times 17.9-21.0 μm	12.3-18.2 \times 13.6-19.9 μm	Dense regular, granulation

Phylum euglenophycota

Pigmentation: Chlorophylls a & b; flagellation: two basal bodies, one or two, emergent, apical flagella, one with a spiraled row of fibrillar hairs; storage product: paramylon; cell wall constituents 80 % proteins, 11.6% lipid, 8.4% carbohydrates; proteinaceous pellicle in strips under the plasma membrane; mesokaryotic

nucleus, characteristic type of cell-division, no sexual reproduction.

Class Euglenophyceae

Protozoan like protests; freshwater, sedentary or motile by 1-2 stout flagella; gullet and complex

vacuolar system present; chloroplast and pyrenoids present.

Order Euglenales

Possess paramylon a starch like food reserve, reproduction by longitudinal division of the cell.

Family Euglenaceae

Chlorophyll localized in chloroplasts which may be disc shape, ribbon-like stellar; pyrenoids on chloroplasts; food reserve is paramylon; most members uniflagellate few are biflagellate.

Key to Genus:

- The cells covered with a shell/
test..... *Trachelomonas*
The cells are not covered with a shell.....2
- Plastids in the form of parietal discs.....3
Plastids oval, diffuse or ribbon-like.....*Euglena*
- Plastids without pyrenoids.....*Phacus*
Plastids with pyrenoids.....*Lepocincils*

Trachelomonas Ehrenberg

In this genus euglenoid cells are enclosed in a firm gelatinous shell which has an opening for the

flagellum. The shell or test has an almost endless variety of shapes and forms of decoration, and since these features are specific the taxonomy of the genus is based upon characteristics of the test rather than on those of the protoplast. The test is brown, often opaque, or tan to nearly colorless, according to the amount of iron compounds deposited in it. The test may be smooth or decorated with spines, warts, reticulations, punctations or combinations of these. The protoplast inside is highly metabolic and has the general features of the euglenoids. There is 1 flagellum, a red pigment-spot, and numerous ovoids, disc-like chloroplasts which may have pyrenoids. Reproduction is by cell division, which takes place within the test, one of the new cells escaping through the aperture and secreting its own shell.

Key to species:

- Lorica are round.....2
Lorica is long.....3
- Apical pore without collar.....*T. volvocina*
Apical pore with annular thickening.....*T. rugulosa*
- Length is 27.0-39.5.....*T. hispida*
Length is 16.5-21.0.....*T. volzii*

Table 2: Morphoanatomical characters of different species of *Trachelomonas*

Name of species	Lorica shape	Apical pore	Ph	Season Of collection
<i>T. volvocina</i>	round to slightly oval	Apical pore without collar	7.80	Spring
<i>T. hispida</i>	Long	Apical pore without collar	7.57	Spring
<i>T. volzii</i>	long, elliptical	Apical pore with collar	7.80	Spring
<i>T. rugulosa</i>	Round	Apical pore with annular thickening	7.35	Spring

Euglena Ehrenberg

Cells elongated, fusiform or nearly cylindrical; round or somewhat flattened; chloroplast oval plates or rarely diffuse or ribbon like; paramylum in the form of one or two large or several small rods or sticks; tail piece present, formed by the gradual narrowing of the cell.

Key to species:

- Cell are metabolic.....2
Cell are non-metabolic.....6
- Cells are ovoid to suborbicular.....3
Cells are not ovoid to subcylindrical.....5
- Chloroplast are disc-like.....*E. polymorpha*
Chloroplast are not disc-like.....4
- Cell diameter 28-33 μm*E. sanguinea*
Cell diameter 14.5-19 μm*E. proxima*
- Paramylon grains are not present.....*E. gracilis*
Paramylon grains are present.....*E. texta*
- Cell are spindle.....7
Cell are non-spindle.....9
- Flagella.. is withdrawn.....*E. minima*
Flagella are present.....8
- Chromatophores are ribbon like.....*E. viridius*
Chromatophores are flat or stellate.....*E. velata*
- Cells are not cylindrical.....*E. limnophilia*
Cells are cylindrical.....10
- Cell length 100-210 μm*E. amphigyrenica*
Cell length 36-84 μm*E. cantabrica*

Table 3: Morphoanatomical characters of different species of *Euglena*

Name of species	Shape of cell	Paramylon bodies	Length	pH	Pyrenoid
<i>E. proxima</i>	Metabolic	Numerous	50-95 μm	7.80	----
<i>E. minima</i>	Spindle	Distinct	12-14 μm	7.35	Present
<i>E. gracilis</i>	Metabolic	Not observed	37-50 μm	7.35	Present
<i>E. amphigyrenica</i>	Cylindrical	----	100-210 μm	7.80	----
<i>E. velata</i>	Spindle	Varying number	98-100 μm	7.80	Present
<i>E. polymorpha</i>	Metabolic	Small ovoid grains	80-90 μm	7.80	Present
<i>E. limnophilia</i>	Fusiform	Dimorphic	84-97 μm	7.80	Absent

Name of species	Shape of cell	Paramylon bodies	Length	pH	Pyrenoid
<i>E. viridius</i>	Spindle to cylindrical	Numerous	78-80 μm	7.80	Present
<i>E. cantabrica</i>	Fusiform	Cluster	36-84 μm	7.35	Present
<i>E. sanguinea</i>	Metabolic	Several	55-120 μm	7.35	----
<i>E. texta</i>	Metabolic	Numerous	33-48 μm	7.35	Absent

Phacus Dujardin

Cells more or less flattened with a rigid pellicle, cup shaped or twisted. Periplast striations are always present and are quite distinct. Cells have a posterior spine or tail which is curved and pointed or may be straight and long. The plastids are in the form of small discs without pyrenoids. One long flagellum emerges out through the canal, other one small and emergent.

Key to species:

- Cells less than 50 μm long.....3
Cells above than 50 μm long.....2
- Width of cells above than 40 μm*P. caudatus*
Width of cells upto 38 μm*P. longicauda*
- Cells oval in shape.....4
Cells ovoid in shape.....5
- Cell more than 35 μm in width.....8
Cell less than 35 μm in width.....9
- Tale piece tapering.....*P. pyrum*
Tale piece of any other shape.....6
- Cells upto 25 μm in width.....7
Cells more than 25 μm in width.....*P. minutus*
- Tale piece short.....*P. viguier*
Tale piece curved.....*P. alatus*
- Chloroplast numerous per cell.....10
Chloroplast few per cell.....11
- Cells upto 60 μm long.....*P. hamatus*
Cells above than 60 μm long.....*P. sesquartortus*
- Cell oval shape.....*P. acuminatus*
Cell broadly ovoid to sub-orbicular...*P. curvicauda*
- Cell length upto 30 μm*P. acuminatum*
Cell length upto 50 μm*P. ankylocnoton*

Table 4: Morphoanatomical characters of different species of *Phacus*

Name of Species	Cell Shape	Length	Periplast	pH
<i>P. pyrum</i>	Ovoid	28-30 μm	Spirally striated	7.57
<i>P. caudatus</i>	Oval	90-96 μm	Longitudinally striated	7.57
<i>P. acuminatus</i>	Oval	25-30 μm	Longitudinally striated	7.80
<i>P. longicauda</i>	Oval	70-85 μm	Longitudinally striated	7.80
<i>P. alatus</i>	Ovoid	19-24 μm	Longitudinally striated	7.80
<i>P. ankylonoton</i>	Oval	20-30 μm	----	7.80
<i>P. curvicauda</i>	Ovoid to suborbicular	25-30 μm	Longitudinally striated	7.80
<i>P. hamatus</i>	Ovoid to ellipsoidal	50-60 μm	----	7.80
<i>P. minutus</i>	Ovoid	20-28 μm	Longitudinally striated	7.80
<i>P. sesquartortus</i>	----	75-85 μm	Longitudinally or spirally striated	7.80
<i>P. acuminatum</i>	Oval	25-30 μm	Longitudinally striated	7.45
<i>P. viguier</i>	Ovoid	28-32 μm	----	

Lepocinclis Perty

Cells ovoid, ovate, elliptical or fusiform, sometimes nearly spherical, with a firm and usually spirally striated periplast, round in cross section; posteriorly extended into an abruptly pointed tail-piece (rarely gradually tapering); a gullet in the anterior end where there arises a single flagellum that is once or twice the cell in length; chloroplasts numerous parietal discs; pigment-spot laterally placed in the anterior region; reserve food in the form of 2 large, lateral paramylon rings, the 2 together sometimes nearly encircling the cell.

L. texta (Dujardin) Lemmermann emend. Conrad

Reference: Salla, (2018).

General Character

Obovoid to ovoid cells are 43-65 x 32, 2-40,7 μm in size. The apex is asymmetrical, with lateral depression, while the posterior end is enlarged, with or without a caudal appendage. The taxon is cosmopolitan. In Africa, it has been identified in the following

countries: Burkina Faso and Burundi. It is sampled at the Abou station.

Locality: Safari (site 2)

Remarks: The algal species were collected from safari stagnant water with temperature 33.2°C and pH 7.35 was observed.

Family Naviculaceae

Frustules of valves are symmetrical at both axes. Valve may be elliptical, lanceolate or boat shaped in outline. The sagittal axis is usually linear; it may be sigmoid. Each valve has a raphe with distinct central and polar nodules. Valves have transverse or striae. There were two laminate chromatophores in each specimen.

Navicula Bory de Saint-Vincent

Frustules free-floating, solitary or in colonies; girdle straight, rectangular, valve linear, lanceolate or fusiform; ends capitate, rounded or rostrate, raphe

straight with central and polar nodules; striae or costae transverse, parallel or radiate, axial area narrow, linear; chromatophores two, laminate, lie on both sides of the valve with a bridge like connection in the middle, sometimes they are split up into numerous small, rounded granules.

Key to species:

1. Striae are lineate.....*N.salinarum*
Striae are radiate.....2
2. Raphe system on both valves.....*N. pelliculos*
Raphe is straight or lateral.....3
3. Central area is about one half.....*N.meniculos*
Central area is elliptical.....4
4. Areolae is 25-32 in 10 μm*N.gregaria*
Areolae in 30-32 in 10 μm*N.tripunctata*

Table 5: Morphoanatomical characters of different species of *Navicula*

Name of species	Shape of Valve	length	Width	Striae in 10 μm	pH
<i>N.salinarum</i>	Elliptical to lanceolate	23-35 μm	8-9 μm	13-17	7.57
<i>N. menisculus</i>	Lanceolate	11-25 μm	6-7.5 μm	10.5-15	7.57
<i>N. gregaria</i>	Lanceolate	16-35 μm	4.1-7.0 μm	14-18	7.35
<i>N.tripunctata</i>	Linear-lanceolate	32-60 μm	6-10 μm	9-12	7.35
<i>N. pelliculos</i>	Elliptical	9-12 μm	4-6 μm	70-80	7.35

DISCUSSION

From the above study it was concluded that most of the species of *Euglena* and *Phacus* remain dispersed through out the year in different environmental and climatic conditions with 30 and 32% abundance respectively. Summer and rainy seasons are the most favorable for the growth of these genera. Similar kinds of results were discussed by Nadeem-ullah *et al.*, 2021. Nadeem-ullah *et al.*, 2021 postulated that most of the members of family Euglenaceae are the indication of polluted water and was water quality tests prove that lake water of Safari Park, Lahore is slightly Eutrophic water. proved that *Lepocinclis* was found with least growth having only one species with just 3% abundance and it was observed in slightly alkaline pH and moderate temperature.

REFERENCES

- Ali, S.T., Zarina, A., & Shameel, M. (2010a). Seasonal Variation and Distribution of Euglenophycota in the Punjab. *Pakistan Journal of Botany*, 42(6), 4371-4378.
- Ali, A., Shinwari, Z.K., & Sarim, F.M. (2010b). Contribution to the algal flora (Chlorophyta) of freshwaters of district Swat. NWFP, Pakistan. *Pakistan Journal of Botany*, 42(5), 3457-3462.
- Cooke, M.C. (1882-84). British freshwater algae, exclusive of Desmidiaceae and Diatomaceae. Williams and Norgate, London. Pp. 329.
- Desikachary, T.V. (1959). Cyanophyta. ICAR New Delhi. Pp. 686.
- Ghose, S. L. (1924). A systematic and ecological account of the collection of blue-green Algae from Lahore and Shimla. *Journal of Linnean Society, Botany*, 46, 333-346.
- Kützing, F.T. (1895). Species Algarum VI (1), Brockhaus, Leipzig. Pp. 922.
- Masud-ul-Hasan. (1978). A contribution to the freshwater algae of the Punjab I. *Biologia*, 24(1), 25-30.
- Masud-ul-Hasan, and Yunus, A. (1989). An addition to the algal flora of Lahore. *Biologia*, 35(1), 99-131.
- Nadeem-Ullah, & Butt, G. Y. (2017). Ecotaxonomic Studies of some filamentous Members of Cyanophycota in four districts of Punjab, Pakistan. *Biodiversity & Environmental Sciences*, 11(4), 152-156.
- Nadeem-Ullah, & Butt, G. Y. (2018). Ecotaxonomic distribution of some colonial cyanophycota from North-east Punjab, Pakistan. *Pak. J. Bot.*, 50(6), 2325-2330.
- Nadeem-Ullah, G., Butt, Y., Jaffer, M., and Qurat-ul-Ain. (2021). Morphoanatomical characterization of some members of euglenophycota (algae) of North-East Punjab, Pakistan based on light microscopy (LM) & Scanning electron Microscopy (SEM). *Micro. Res. & Tech.* 1-7.
- Patrick, R.M., and Reimer, C.W. (1966) The Diatoms of the United States exclusive of Alaska and Hawaii, V. 1 *Monographs of the Academy of Natural Sciences of Philadelphia* 13.
- Prescott, G. W. (1962). Algae of the Western Great Lakes Area. William C. Brown, Du buque, Iowa. 977 pp.
- Randhawa, M.S. (1936). Occurrence and distribution of freshwater algae of North India. *Proceedings: Pl Science.*, 4(1), 36-44.
- Salla, M., Traore, K., Grogga, N., Kassi, K.F.J., & Soro, D. (2018). Taxonomy of some Euglenophyta rivers Boubo and Mé in the coastal Southern of Côte d'Ivoire. *International Journal of Scientific and Engineering Research*, 9(7), 1508-1509.
- Tiffany, L.H., and M.E. Britton. (1952). The algae of Illinois. Hafner Publishing Company, New York.