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Chlorococcales (Chlorophyta) of Sindh, Pakistan

¹Sultan Mahmood Leghari, ¹S.N. Arbani and ²T.M. Jehangir

¹Department of Fresh Water Biology and Fisheries, University of Sindh Jamshoro 76080, Sindh, Pakistan

²Institute of Chemistry, University of Sindh, Jamshoro, 76080, Sindh, Pakistan

Abstract: The work examines the algal mass present as a source of nutrient in the lakes and ponds for fishes in lower Sindh region. During the study 46 species and 15 varieties of Chlorococcales belonging to *Actinastrum* (1), *Ankistrodesmus* (5), *Botryococcus braunii* (1), *Characium* (4), *Characiopsis* (1), *Chodatella* (1), *Coelastrum* (2), *Crucigenia* (1), *Dicanthos* (1), *Dimorphococcus* (1), *Gloeotaenium* (1), *Golenkinia* (1), *Hydrodictyon* (1), *Kirchneriella* (2), *Nephrochlamys* (1), *Oocystis* (4), *Pediastrum* (9), *Planktosphaeria* (1), *Scenedesmus* (23), *Sorastrum* (1), *Selenastrum* (1), *Tetraedron* (7), *Tetrastrum* (1) are described of these *Hydrodictyon reticulatum*, *Tetraedron pentadricum*, *Sorastrum americanum*, *Dicanthos belenophorus*, *Nephrochlamys subsolitaria* are reported first time from lower part of Sindh, Pakistan.

Key words: Fresh water algae, chlorococcales, chlorophyta, Sindh

Introduction

Chlorococcales are composed of wide variety of species. They are non motile single cell or colonial with definite shapes of green algae. Most of the members are aquatic and microscopic in nature but some may be macroscopic, constitute a major part of the phytoplankton of the fresh water habitats and play an important role in the food chain, are used as food by herbivores fishes and Zooplanktons (Prescott, 1962; Philipose, 1967).

In Pakistan Siddique and Faridi (1964) reported 93 taxa of chlorococcales representing 65 species, 28 varieties are described from Peshawar Valley N.W.F. Province. Aziz and Farooqui (1972) gave the morphological and development of 8 species comprising 4 genera, i.e. *Chlorella*, *Chlorococcum*, *Monoraphidium*, and *Scenedesmus*, from Karachi and its suburbs. Shito and Arbani (1993) reported 35 taxa of chlorococcales representing 8 genera, 16 species and 19 varieties from fish ponds at Chilla District Thatta Sindh.

This project deals with taxonomical identification of 70 taxa represented with 22 genera, 55 species and 15 varieties. The study is based on the collection of data from 1996 to 1999 from lakes, ponds, pools ditches and rice fields of Hyderabad, Sanghar, Dadu, Thatta and Tharparkar districts (Hyderabad and Mirpurkhas Divisions) Lower Part of Sindh, Pakistan.

Materials and Methods

The algal specimen were collected during 1996 to 1999 by plankton net, #25 µm, hand picking and squeezing aquatic plants. From the Kinjhar, Haleji (District Thatta), Bakar (District Sanghar), Sonharo and Mahro (District Badin), Manchar Lake (District Dadu) alongwith rice fields ponds, riverin ponds and village ponds of these area. The specimens were collected into small plastic bottles and identification were made for living as well preserved in 3-4% formaldehyde. The ecological readings were taken on the spot incorporated in the description of species. The water samples were analysed for pH, conductivity, salinity, chloride alkalinity, hardness and Phosphate using standard analytical techniques (Farman, 1981). Chloride, alkalinity, and hardness were determined by titrimetry. The titration were carried out with standard silver nitrate (0.01 M), hydrochloric acid (0.01 M) and E.D.T.A. (0.01 M) respectively. The orthophosphate was determined reduction after reduction of phosphomolybdic acid with ascarbic acid to molybdenium blue by spectrophotometry. All the drawings were made with the help of light microscope (Soft Japan) camera lucida with magnification 8x X 40.0. All specimen were identified primarily by reference to Prescott (1962), Siddique and Faridi (1964), Philipose (1967) and Yamagishi (1992).

Results

Systematic account

Family: *Chlorococcaceae* Blackman

Chlorococcum humicola (Naeg.) Rabenhorst

Cells spherical solitary, 8-15 µm in diameter.

Common occure in Saline Lake Badin.

Planktosphaeria gelatinosa G.M. Smith. Siddiqui and Faridi, 1964:66 (Pl. 1, Fig. 3).

Free floting colony 45-100 µm in diameter, spherical cell compactly grouped with mucilaginous sheath. Cells 6.5 µm in diameter. Planktonic in Bakar Lake.

Family: *Micractiniaceae* G.M. Smith.

Golenkinia paucispina West at G.S. West. Islam and Begum, 1970:246; (Pl. 4, Fig. 19).

Cells solitary, spherical, setae arising from all sides of the cell wall. Chloroplast cup shaped 19.5-22 µm in diameter with seate. 17-20 µm long. Locality: Hussainabad pond.

Family: *Coelastraceae* (West) Wille.

Coelastrum microporum Naegeli. Philipose, 1967: 228 (Pl. 4, Fig.1).

Colony spherical 8-16-32. Cells ovoid, spherical enclosed with gelatinous sheath. Cells within sheath 7-5 µm in diameter, Colonies 25-45 µm in diameter. Habitat: Planktonic in Bakar lake Sanghar and also in some ponds Hyderabad.

Coelastrum sphaericum Naegeli. Philipose, 1967:229 (Pl. 4, Fig.2).

Colony spherical to ellipsoid 4-8-16 cells. Cells 7.5-8.5 µm in diameter. Habitat: Fresh water and polluted ponds. Locality: Shallow pond at Kotri. Riverin pond Hussainabad.

Family: *Dictyosphaeriaceae* G.S. West.

Dimorphococcus lunatus A. Braun

Phillipose, 1967:205, Islam and Khatun, 1966:25 (Pl.1, Fig.2).

Cells in group arrange in alternate zigzag outer cell is in reniform, Inner cell elongate-ovoid-ellipsoid with parietal plate type of chloroplast. Cells 6-9 µm broad, 17.5-21 µm long. Locality: Planktonic form in Riverin pond Hussainabad and Typha pond near Jamshoro filter plant.

Family: *Characiaceae* (Naegeli) Wille.

Characium anophelesi Iyengar; Philipose, 1967:85 (Pl.4, Fig.9).

Cells pear shaped and rounded at the top narrow gradually attached to the *Copepod* sp, and *Cladocera* sp. Cells 21-24 µm long, 9.6-12 µm broad.

This species commonly found epizooic to the *Copepod* and *Cladocera* sp. in Bakar Lake Distt: Sanghar.

Characium ambiguum Hermann ex-Rabenhorst.

Phillipose, 1967:93 (Pl.4, Fig.10).

Common in the Kinjhar lake epiphytic on the filamentous algae.

Characium apiculatum Rabenhorst.

Cells long, cylindrical, with pointed apex, chloroplast parietal.

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Cells 20µm broad, 60-65µm long, epiphytic on filamentous algae in all lakes of Sindh.

Characium obtusum (A. Braun) Detoni.

Cells solitary epiphytic, oblong to ovoid. Cells 8-12 µm broad, 22-33 µm long with parietal chloroplast one to many pyrenoids occur in Kinjhar lake.

Characium ornithocephalum A. Braun.

Cells elongate fusiform or lanceolate with blunt rounded apex, narrow below the slender strip, disc basal with attaching disc. Cells 8-9 µm broad, 24-26 µm long.

Locality: Riverin Chalagari Pond Halla Road Hyderabad.

Characiopsis longipes (Rab.) Brozi, Prescott, 1962:358 (Pl.4, Fig.11).

Cells fusiform slightly curved apiculate tapering. Cells 39-45 µm long, 12-13.5 µm broad, stalk 17.5 µm long. This species occur epiphytic on *Cladophora* sp. in Thatta Pond.

Family: *Botryococcaceae* Willie

Botryococcus braunii Kuetzing, Prescott, 1962:232.

Cells ellipsoid, in regular shaped, dark coloured masses in mucilage, free floating chloroplast parietal with pyrenoid, cell 4.5-6µm in diameter. Commonly occur in semi hard water majority of the ponds of Badin, Sanghar and Thatta area.

Family: Oocystaceae Bohlin

Oocystis pusilla Hansgirg, Islam and Begum, 1970:239. Shito and Arbani, 1993:49. (Pl.2, Fig.10).

Colony of 4 ovate cells enclosed by mother cell wall, poles broadly rounded. Cells 19.8µm long, 9-13 µm broad, colony 33-40 µm wide, 44-58 µm long. **Locality:** Jamshoro Railway Station pond.

Oocystis macrospora (Turner). Brunthaler (Pl.4, Fig.4).

Colonies of 4 celled, 36-42 µm broad, 42-48µm long. Cells 15-17.5 µm broad, 30-33 µm long.

Locality: Planktonic in Sonahro lake Badin.

Oocystis lacustris Chodat . Philipose, 1967:181 (Pl.4, Fig.3)

Cells ellipsoid with pointed end. Cells 10-15 µm broad, 25-30 µm long.

Locality: Marginal water of Bakar lake and Karo Ghonghro lake.

Oocystis elliptica W. West. Philipose, 1967:186 (Pl.4, Fig.5)

Colony 4-8 cells with 45 µm in diameter. Cells 12-15 µm broad, 25-30 µm long. **Locality:** Kinjhar, Bakar, Karo Ghonghro lakes and paddy field of Tando Mohammad Khan area.

Chodatella citrififormis Snow . Yamagishi, 1992:91 (Pl.4, Fig.20).

Cells solitary, Ovoid, ellipsoid, with projection on boath Pole, 15-18 µm long, and 9-12 µm wide, seate 3-4 and 24-30 µm long. **Locality:** Kinjhar Haleji lake, Chilia fish hatchery pond.

Dicanthos belenophorus Korsh . Islam and Begum, 1970:24. (Pl.4, Fig. 22).

Cells 8-9 µm broad, 33 µm long with setae. Setae 8-10 µm long.

Locality: Chilia fish pond.

Gloeotaenium loitles bergerianum Hansg. (Pl.4, Fig.18).

Philipose, 1967:178, Islam and Khatun, 1966:20. Colony

2-4 celled, cells spherical to ellipsoidal, in the mother cell wall. Cells separated by a dark layers, small cap liked gelatinous structure occur on external side to each cell. In parent cell wall enclosing 2-4 cells, 4 celled colony, 60-75 µm indiameter, 2 celled colony 36-45 µm broad 70µm long with sheath. Cells, 15-20 µm broad, 20-27 µm long.

Locality: Kinjhar, Bakar, Karo Ghonghro, Lakes and in many ponds of Kotri, Jamshoro area. This is very common species.

Chlorella ellipsoidea (Gerneck) Willie. Cells ellipsoid with foled chloroplast. Cells with 6.8-8 µm in diameter. Common occur in saline ponds of Badin and Thatta district.

Chlorella vulgaris Beijerinck. Cells sphericals with parietal cup shaped chloroplast, 4.5-7 µm in diameter. Sometimes forming a pure layer on the ponds surrounding Hyderabad and near a coal mine colony Lakhra area.

Family Selenastraceae Fritsch.

Selenastrum westii G.M. Smith (Pl.3, Fig.18).

Philipose, 1967:221, Shito and Arbani, 1993:53.

Colonies 2,4, 8 cells. Cells lunate to arcuate shape with

acuminate apices. Cells 2.5-3µm broad, 30-36 µm long.

Locality: Planktonic during winter at Rahoki and Kotri Ponds.

Selenastrum gracile Reinsch.

Commonly occur planktonic form in Chilia fish hatchery Thatta. *Kirchneriella obesa* (W. West) Schmidle. Philipose, 1967:224 (Pl.3, Fig.25).

Colony of 4-8 cells irregularly arranged in mucilage. Cells lunate shape 2.6-5.2 µm broad, 13.5-17 µm long.

Locality: Planktonic in Bakar, Kinjhar lakes and Chilia fish ponds.

Kirchneriella contorta (Schmidle) Bohlin. Philipose, 1967:224 (Pl.4, Fig.12).

Free floating colonies, arcuate, cylindrical. Cells 1.2-2 µm broad, 10-14 µm long. Planktonic in Typha Pond Hyderabad and in Kotri Pond.

Kirchneriella lunaris (Kirch) Moebius

Locality: Karogar spring, Thana Bola Khan area.

Ankistrodesmus convolutus Corda. Philipose, 1967:213. (Pl.4, Fig.13).

Cells solitary or in a group of 2-4. Cells strongly curved or twisted with pointed end. Cells 1.9-3 µm broad and 20-24 µm long.

Locality: Riverin Ponds, Kinjhar, Haleji and Bakar lakes and Rice fields of Jamshoro Road August to October, favourable seasons of the growth.

Ankistrodesmus arcuatus Krosh. (Pl.4, Fig.15).

Commonly occur in Kinjhar, Manchar and Haleji lakes and free floating in Chilia Ponds. Distt:Thatta.

Ankistrodesmus falcatus (Corda) Ralfs. Philipose, 1967:21 (Pl.4, Fig.16).

Cells fusiform with ends tapering to acute apices. Usually in bundles 2-4-8, rarely solitary. Cells 3.5-6 µm broad, 60 µm long.

Locality: Planktonic in Ponds Kotri, Kinjhar, Bakar lakes and Chilia fish hatchery.

Ankistrodesmus falcatus var. *acicularis* (A. Braun) G.S. West.

Philipose, 1967:213 (Pl.2, Fig.11).

Cells single stright or slightly curved with pointed ends. Cells 3.2-4 µm broad, 65-134 µm long. **Locality:** Chilia fish hatchery and Kinjhar lake as a plankton.

Ankistrodesmus spiralis (Turner) Lemm.

Commonly occur in Fresh Water Ponds throughout Sindh during winter season.

Nephrochlamys subsolitaria (G.S. West) Korsh.

Philipose, 1967:222 (Pl.1, Fig. 4).

Cells more or less rounded ends, solitary or 2-4 cells enclosed with in the mother cells wall. Cells 3-5 µm broad, 9-12 µm long.

Locality: Kotri and Riverin Pond Hussainabad.

Actinastrum hantzschii Lagerheim.

Philipose, 1967:217 (Pl.4, Fig. 21).

Colonies of 8 cell radily arranged. Cells spindle shaped 3-6 time as long as broad. Cells 3.5-5 µm broad, 20-24.5 µm long with slightly rounded apices. **Locality:** Pond near Khairpur University.

Family: Hydrodictyaceae Cohn.

Hydrodictyon reticulatum (L) Lagerheim. Siddique and Faridi, 1964:53 (Pl.1, Fig.1).

Thallus macroscopic composed of cylindrical cells which are adjoined at their ends to form cylindrical nets 4-5-6 sided meshes, chloroplast parietal plate with single pyrenoids later becoming a reticulate with many pyrenoids and multinucleate. Cells 30-120 µm broad and 180-150 µm long. Net upto 15-20 cm long.

Habitat: This species found in spring water Khuja Khella Swat alongwith *Chara*, *Batercho spermum* sp. 20 sept. 1998. Ponds near Tarbella dam 20 April 1999, also collected from the Rice field near Bhit Shah August 1995. Water tank Geology Department Sindh University (Nov.1995) also collected from pond Sindh University Railway station and Pond on the side of by pass Road Hyderabad.

Distribution: World wide and throughout Pakistan

Pediastrum duplex Meyen (Pl.2, Fig.1).

Philipose, 1967:121; Shito and Arbani, 1993:47.

Colonies 4-8-32-64 cells. With lens shaped and perforation between cells. Inner cell quadrate to angular Inner side, marginal cell concave, outer side produced short truncate process. Cells 3-5 μm broad, 9 μm long. Locality: Planktonic in Kinjhar Lake and Chilia Fish hatchery Thatta.

Pediastrum duplex var. *clathratum* (A.Br.) Legerham. Phillipose, 1967:124 (Pl.2, Fig. 2).

Colony 8-32 (128) celled, with lens shaped, the peripheral cell quadrate. The outer margin extend two stout blunted lipped lobes which has parallel margin. Cell 9-15 μm broad and 21-24 μm long with horn.

Locality: Kotri ponds and Jamshoro Riverin water ponds.

Pediastrum duplex var. *reticulatum* Lagerheim (Pl.2, Fig. 3). Phillipose, 1967:124; Shito and Arbani, 1993:47.

Colony 8-16 celled, with large perforations. Cells 12.5-15.5 μm in diameter. Locality: Euplanktonic in Kinjhar lake, Chilia fish hatchery, Bakar Lake.

Pediastrum integrum Naegeli (Pl.2, Fig. 4).

Siddiqui and Faridi, 1964:61; Phillipose, 1967:112.

Colony entire outer margin cell with two short horn. Cells 6-12 μm in diameter. Locality: Fresh water stream in Golra Sharif Islamabad.

Pediastrum integrum var. *priva* Printz (Pl.4, Fig. 5).

Siddiqui and Faridi, 1964:61

Colony entire cells 5 sided, 19-21.2 μm broad, 21-26.4 μm long.

Locality: Golra Sharif Islamabad, 25 April 1999 planktonic.

Pediastrum muticum var. *longicorne* Racib.

Phillipose, 1967 : 117, (Pl.2, Fig. 6).

Colony more or less rounded with 4-32 celled and without intercellular space, inner cells 5-6 sided, marginal cell with usually broader than long with two long process. Cell wall thick. Cells 19.5-22 μm diameter. Marginal cell 18-24.4 μm broad 18-20 μm long. The two outer process 7-11 μm long. Locality: Kinjhar Lake.

Pediastrum simplex Meyen.

Siddiqui and Faridi, 1964:61; Phillipose, 1967:113-114 (pl.2, fig.7)

Colony composed of 4-64 cells. Cell wall smooth inner cell several sided, peripheral cells extended to form a single horn. Cells 12-20 μm broad 35-60 μm long with horn. Locality: Kotri Pond, Ramsar pond near Karonjhar, Nagarparkar.

Pediastrum simplex Meyen var. *duodenarium* (Bailey) Rabenh. Phillipose, 1967:115

Colonies of 4-8-16-32 cells. Cells 9.5-12.5 μm broad, 25-33 μm long, and having large intercellular space with single central space.

Habitat: Planktonic in Kinjhar, Haleji, Bakar lakes.

Pediastrum ovatum (Ehr.) A.Braun. Phillipose, 1967: 115 (Pl.2, Fig.9)

This species are planktonic, common occur in saline water.

Locality: Saline pond Mahmood Mir Jat village near Shah bander (6-7-1999).

Pediastrum tetras (Ehr.) Ralfs. Phillipose 1967:128 (Pl.2, Fig.8).

Colonies 4-8-16 cells, with out intercellular space marginal cell divided into tow lobes by a deep linear incision on the outer side. Inner cell 4-6 sided with single incession. Cell 6.8-18 μm in diameter.

This species is very common in Kinjhar, Ponds Sonda, Bakar Lake, Haleji Lake.

Sorastrum americanum (Bohlin) Schmidle

Prescott, 1962:228; Patel and Isabella, 1977:177 (Pl.3, Fig. 17).

Cells 5-7.1 μm broad, 21-28.2 μm long with spine, spine 7.5-9.4 μm long. This species collected from Riverin Pond Hussainabad.

Tetraedron minimum (A. Braun) Hansgirg (Pl.1, Fig.5).

Prescott, 1962:267; Siddiqui and Faridi, : 1964:74 .

Cells 6-12 μm in diameter. Locality: Fish pond Chilia and Bakar lake.

Tetraedron minimum f. *tetralobulatum* (Reinsch) De Toni.

Phillipose 1967:139 (Pl.4, Fig.10).

Cells 11-13.5 μm diameter. Spine 1.5-2 μm long. Planktonic in Fish Pond Chilia District Thatta.

Tetraedron muticum (A. Braun) Hansg. (Pl.1, Fig. 6).

Phillipose, 1967:137; Shito and Arbani, 1993:54; Siddiqui and Faridi, 1964:3.

Cells flat triangular with concave rounded angles without spine.

Cells 7.5-9 μm broad, 24.26.4 μm long Locality: Kinjhar Lake, Manchar Lake also occur in rice fields of Thatta.

Tetraedron pentadricum W. et G.S. West. (Pl.1, Fig. 8)

Phillipose, 1967:151, Siddiqui and Faridi, 1964:73.

Cells small five lobed, corner acute with spine. Cells 12-13:5 μm long. Locality: Planktonic in Manchar lake.

Tetraedron proteiforme G.M. Smith.

Phillipose, 1967:141 (Pl.1, Fig.7).

Cells 2-3 corners, with angle ending long spine.

Two angled 12-15 μm in diameter. Three angled 30-33 μm in diameter. Common occurs Planktonic in ponds Jamshoro, Kotri and Sanghar.

Tetraedron cruciatum (Wallich) W et.G.S. West, Phillipose, 1967:155; Patel and Isabella, 1978:34 (Pl.5, Fig.1).

Cells cruciatly 4 lobed, lobes bifurcated cells sides deeply concave between the lobes, lobes end 2-3 small, spines. Cells 24.5-40.5 μm in diamter occur in fresh water Ramsir pond Nagarparkar.

Tetraedron hastatum (Reinsch) Hansgirg.

Commonly occurs in Ponds of Hyderabad.

Tetraedron regulare Kuetzing. Common occurs in Bakar lake.

Tetraedron trigonum (Naegeli) Hansgirg. Common occurs in Chilia Fish form Thatta.

Family: Scenedesmaceae Oltmanns

Tetrastrum staurogeniaeforme (Sch.) Lemm. Islam, 1970:250. (Pl.3, Fig. 23).

Colony with 4 triangular cells. Cells 3-3.5 μm in diameters.

Setae 3-3.5 μm long. Locality: Kinjhar lake and riverin water ponds Hussainabad.

Scenedesmus quadricauda var. *longispina* (Chodat) G.M. Smith. Phillipose, 1967:235. (Pl.3, Fig. 24).

Colonies 2-4-8 celled. Cells ovoid. Cells 4.5-5 μm broad, 17.5-19 μm long. Spines 12-15.5 μm long. Locality: Fish Pond, Chilia District Thatta.

Scenedesmus quadricauda (Trup) Breb . var. *setosus* Kirchn.

Phillipose 1967:273 (Pl.3, Fig.15)

Locality: Chilia fish Hatchery Thatta.

Scenedesmus acutiformis, Schroeder.

Phillipose, 1967:260 (Pl.3, Fig.26).

Cells 4.5-5 μm broad, 13.5-17.5 μm long. Locality: Planktonic in Manchar lake.

Scenedesmus abundans (Kirchner) Chodat.

Phillipose, 1967:278 (Pl.3, Fig.1).

Colony 2-4-8 cells. Cells 3.5-5 μm broad, 6.7-5 μm long, spines 3-3.5 μm long. Locality: Fresh water pond near Jamshoro Railway Station along with Fungal spores.

Scenedesmus acuminatus (Lager.) Chodat. Phillipose, 1967:251, (Pl.3. Fig. 2).

Colonies 4-8 cells fusiform with pointed end. Cells 5-6 μm broad, 30-35 μm long. Locality: Hussainabad Pond.

Scenedesmus arcuatus Lemm. Phillipose 1967:257 (Pl.3, Fig.3).

Colonies 4-16 celled with small space. Cells 5-9 μm broad 16.5-18 μm long. Locality: Chalgari pond.

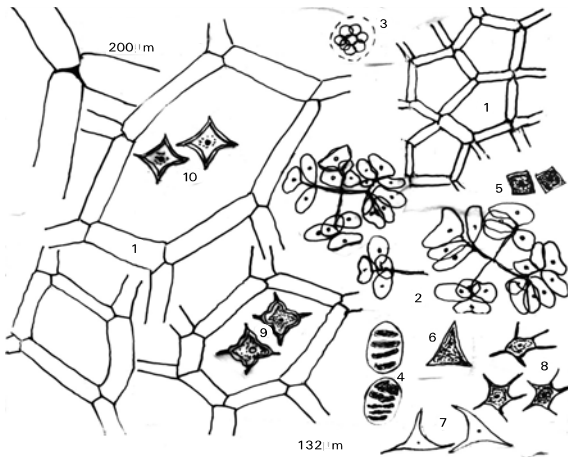


Plate No. 1

- Fig.1 *Hydrodictyon reticulatum* (L) Lagerheim
 Fig.2 *Dimorphococcus lunatus* A Braun
 Fig.3 *Planktosphaeria gelatinosa* G.M. Smith
 Fig.4 *Nephrochlamys subsolitaria* (G.West) Korsh.
 Fig.5 *Tetraedron minimum* (A. Braun) Hansgirg
 Fig.6 *T. muticum* (A. Br.) Hansgirg
 Fig.7 *T. proteiforme* (Tur.) Brunnth.
 Fig.8 *T. pentadricum* w.et G.S. West
 Fig.9 *T. minimum* fa. *tetralobulatum* (Reinsch) DeToni
 Fig.10 *T. ragulare* Kuetzing var. *torsum* (Turner) Brunthaler.

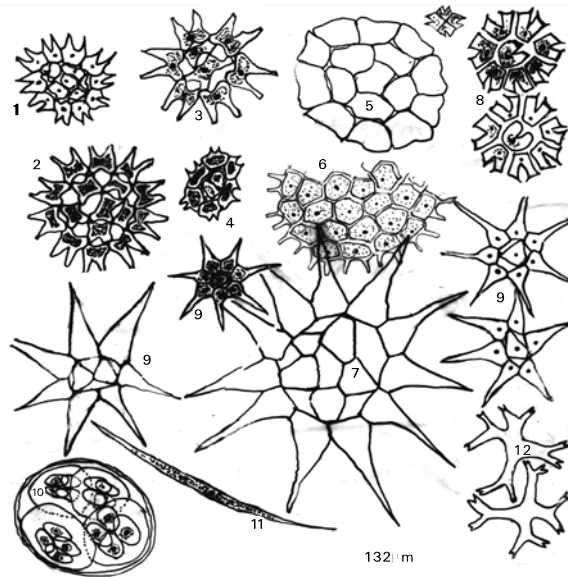


Plate No. 2

- Fig.1 *Pediastrum duplex* Meyen.
 Fig.2 *P. duplex* var. *clathratum* (A. Br.) Lagerheim.
 Fig.3 *P. duplex* var. *reticulatum* Lagerheim.
 Fig.4 *P. integrum* Naegeli.
 Fig.5 *P. integrum* var. *priva* Printz.
 Fig.6 *P. muticum* var. *longicorne* Racib.
 Fig.7 *P. simplex* Meyen.
 Fig.8 *P. tetras* (Ehr.) Ralfs.
 Fig.9 *P. ovatum* (Ehr.) A. Br.
 Fig.10 *Oocystis pusilla* Hansgirg.
 Fig.11 *Ankistrodesmus falcatus* var. *acicularis* G.S. West.
 Fig.12 *Tetraedron cruciatum* (Wallich) West and G.S. West.

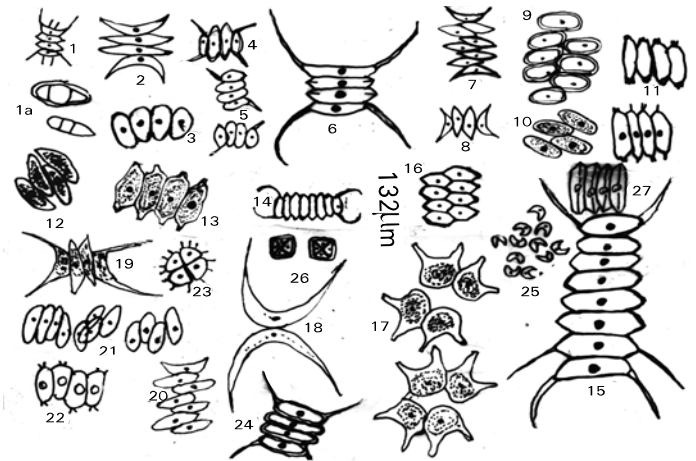


Plate No. 3

- Fig.1 *Scenedesmus abundans* (Krichner) Chodat and Fungal Spore..
 Fig.2 *Scenedesmus acuminatus* (lager.) Chodat.
 Fig.3 *S. arcuatus* Lemm.
 Fig.4 *S. armatus* G.M. Smith.
 Fig.5 *S. armatus* var. *bicaudatus* (Gugli) Chodat.
 Fig.6 *S. armatus* var. *major* G.M. Smith.
 Fig.7 *S. bijugatus* (Turp) Kuetz.Fig.
 Fig.8 *S. acuminatus* (larger.) Chodat.
 Fig.9 *S. bijugatus* f. *irregularis* Wille.
 Fig.10 *S. bijugatus* var. *alternans* (Reinsch) Hansg.
 Fig.11 *S. denticulatus* var. *australis* Playfair.
 Fig.12 *S. incrassatus* Bohlin.
 Fig.13 *S. obliquus* (Turp.) Kuetzing.
 Fig.14 *S. opoliensis* Richter.
 Fig.15 *S. Quadricauda* (Trap.) Breb. var. *setosus* Hansg.
 Fig.16 *Scenedesmus platydiscus* (G.M. Smith) Chodat.
 Fig.17 *Sorastrum americanum* (Bohlin) Sch
 Fig.18 *Selenastrum westii* G.M. Smith.
 Fig.19 *Scenedesmus acuminatus* var. *acuminatus*.
 Fig.20 *S. baculiformis* Chod.
 Fig.21 *S. acutus* Meyon.
 Fig.22 *S. denticulatus* Lagerh.
 Fig.23 *Tetrastrum staurogeniaeforme* (Sch.) Lemm.
 Fig.24 *Scenedesmus quadricauda*.
 Fig.25 *Kirchneriella obesa* (W.West) Schmidle.
 Fig.26 *Crucigenia tetrapedia* (Kirch.) W. and West.
 Fig.27 *Scenedesmus acutiformis* Sch.

This species occur planktonic and also found associated with *Riccia* sp. growing on the bank of river Indus at Jamshoro. *Scenedesmus armatus*. (Chodat) G.M. Smith. Philipose, 1967:261, Siddiqui and Faridi, 1964:76 (Pl.3, Fig.4). Colony 12-24 μm in diameter. Cells 4-5.5 μm broad, 15-17.5 μm long, spine 9-12 μm long. Locality: Free floating in Ponds and Rice fields of Jamshoro. *Scenedesmus armatus* var. *bicaudatus* Chodat. Philipose, 1967:262 (Pl..3, Fig. 5). Cells 3.5-4.5 μm broad , 12-14 μm long. Spine 6-9μm long. Occurance: Free floating in Rice field Jamshoro. *Scenedesmus armatus* var. *major* G.M. Smith. Philipose 1967:266 (Pl.3, Fig.6). Cells 7.9 μm broad, 24-26-4 μm long spines 17-27 μm long.

Locality: Mahmood Jat Village near Shah Bundar, Kinjhar lake and Haleji lake.

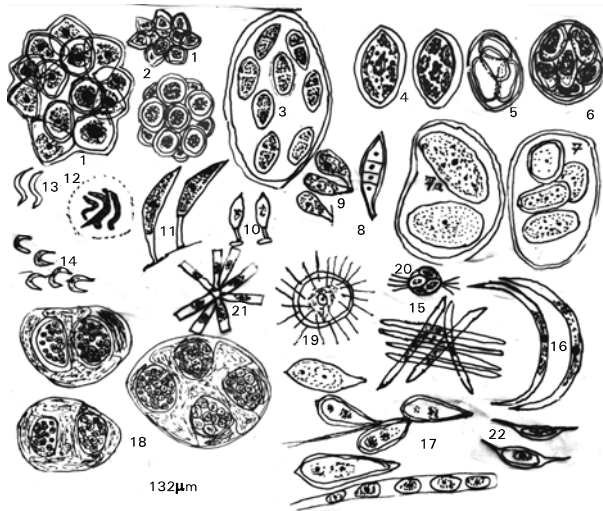


Plate No.4

- Fig.1 *Coelastrum microporum* Naegeli
- Fig.2 *Coelastrum sphaericum* Naegeli
- Fig.3 *Oocystis lacustris* Chodat.
- Fig.4 *Oocystis macrospora* (Turner) Brunnthalar.
- Fig.5 *Oocystis elliptica*. W. West
- Fig.6 *Oocystis elliptica* W. West
- Fig.7 *Nephrocystium obesum* West G.S. West.
- Fig.8 *Characium angustum* A. Braun.
- Fig.9 *Characium anophelesii* Iyenger
- Fig.10 *Characium ambiguum* Hermann
- Fig.11 *Characiopsis longipes* (Rab.) Borzii.
- Fig.12 *Kirchneriella contorta* (Schmidle) Bohlin
- Fig.13 *Ankistrodesmus convolutus* Corda
- Fig.14 *A. falcatus* var. *mirabilis*.
- Fig.15 *A. arcuatus* Korsh
- Fig.16 *A. falcatus* (Corda) Ralfs.
- Fig.17 *Characium orissicum* Philipose.
- Fig.18 *Gloeotaenium loitles bergerianum* Hansg.
- Fig.19 *Golenkinia paucispina* West and G.S. West.
- Fig.20 *Chodatella citrififormis* Snow.
- Fig.21 *Actinastrum hantzschii* Lagerheim.
- Fig.22 *Dicanthos belenophorus* Korsh.

Scenedesmus biJugatus (Tur.) Kuetz. Philipose, 1967:261, Siddiqui and Faridi 1964:76 (Pl.4, Fig. 7). Colony 20-24 µm in diameter. Cells 4-5.5 µm broad, 15-17.5 µm long, spine 9-12 µm long. Locality: Occurrence: Free floating in Ponds and Rice fields of Thatta.

Scenedesmus biJuga F. *irregularis* G.M.Smith. Philipose, 1967: 235 (Pl.3, Fig. 9). Cells arrange in an irregularly, subalternating or in double series. Cells 6.7-10 µm broad, 15-17 µm long. Locality Ponds, Hyderabad, Kinjhar, Bakar and Haleji Lakes.

Scenedesmus biJugatus var. *alternans* (Reinsch) Hansg. Prescott, 1962: 277 (Pl.3, Fig.10). Cells regularly arranged in alternate series, cells 7-9 µm broad, 16-22 µm long. Locality: Widely distributed in Kinjhar, Manchar and Bakar Lakes.

Scenedesmus denticulatus Lagerheim var. *australis* Playfair. Philipose, 1967:271. (Pl.3, Fig.11). Colonies of 4 celled, arranged in a single series with 1-3 and teeth on the each poles of the cell. Cells 4-5.5 µm broad, 21-25.5 µm long.

Locality: Pond near K.B. Fedar Canal Kotri.
Scenedesmus incrassatulus Bohlin. Philipose, 1967:252 (Pl.3, Fig.12).

Colony of 4 fusiform, sub acute cells. Cells 6.7-9 µm broad, 27-29.7 µm long. Locality: Planktonic in Karogar spring Thanu Bola Khan area.

Scenedesmus obliquus (Turp.) Kuetzing. Philipose, 1967:248-249 (Pl.3, Fig.13)

Colony 2-4-8, cells arranged in a linear series. Cells fusiform 9-10.5 µm broad, 30-36 µm long. This species is slightly longer as described by the Philipose 1967. Locality: Free floating in Pond Hussainabad, District Hyderabad.

Scenedesmus opoliensis Richter. Philipose, 1967:275 (Pl.3, Fig.14).

Colonies 2-4-8 celled, cylindrical to subfusiform, cells arranged in series. Terminal cells with a long curved spine. Cell 4.5-7 µm broad, 21-24.5 µm long cell. Spine 17.5 µm long. Locality: Rice fields and ponds Tando Mohammad Khan. Fish hatcheries Chilla, Bakar and Kinjhar lakes of Sindh.

Crucigenia tetrapedia (Kirch) West and West. Islam and Begum, 1970:250 (Pl.3, Fig.26).

Colony triangular of 4 cells. Cells 3-4.4 µm broad, 6 µm long.

Locality: Chilia fish hatchery and lake Manjosa Kashmir.

Crucigenia quadrata. Morren.

Planktonic in Badin lakes.

Crucigenia irregularis. Willie.

Planktonic in riverin Ponds, Hyderabad.

Discussion

The results of chemical analysis indicated the pH of the water bodies. Kinjhar, Bakar and Karoghangro lakes and ponds of Badin, Hyderabad and Sanghar, Dadu and Thatta districts from where water samples are collected was slightly alkaline in nature and varied in the pH range of 7.4 to 8.4. The observed conductivity with in 415-617 µs/cm and indicate that water bodies are mostly fresh water in reveriane range suitable for agriculture and fisheries purpose. The presence of algal species in lakes and ponds belongs to chlorococals of chlorophyta and indicate that these lakes and ponds may be classified oligo to Beta-mesosaprobic. (Sladeczek, 1973) are mostly fresh water and suitable for fish culture.

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