

Pak. J. Bot., 4 (1): 171—181, 1972.

ON THE MORPHOLOGY AND DEVELOPMENT OF SOME CHLOROCOCCALES FROM KARACHI.

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Abstract

The morphology and development of eight species of chlorococcales comprising of 4 genera viz, *Chlorella*, *Chloeoecocum*, *Monoraphidium* and *Scenedesmus* is described. This survey of planktonic algae was made mostly from Karachi and its suburbs during October 1970—March 1972.

Introduction

Chlorococcales Ottmann Brunnthaler (1922) known as “coccoid algae” (Fott, 1966) constitute a big order of fresh water planktonic algae. Chlorococcales are the primary producers and are used as food by herbivores like zooplankton and fishes (Prescott 1962). *Chlorella* and *Scenedesmus* are the principal planktonic algae which are used in the mass-cultivation as these are rich in protein contents and their dry weight production is ten times greater than the higher plants (Malek, 1968). The study of freshwater Algae have so far been neglected from Pakistan except a few recent studies (Faridi 1964, 1970; Islam & Khatoon, 1966; Islam, 1969; Siddiqui & Faridi, 1964).

The present study deals with the taxonomy of some Chlorococcales mostly collected from Karachi and a few of them collected from its suburbs during October 1970—March 1972. This work is a first step towards the survey of fresh-water phytoplankton in the natural lakes, ponds and pools of Karachi area.

Materials and Methods

All the observations were made on living material collected from natural ponds and pools within and around Karachi region. The collection was made weekly and the sampling was done by phytoplankton net.

The slides were prepared from pure living material after centrifugation (on 1000 rev./minute) for 3-4 times. The planktonic samples were observed on the compound Ziess Research microscope employing phase contrast assembly.

Pure culture vessels were kept under fluorescent tube lights (light intensity 1250 lux) at a constant temp. 20-25°C. For the observation of developmental stages and life cycles of the algae, aeration was employed with 4% Carbon-di-oxide mixed with air.

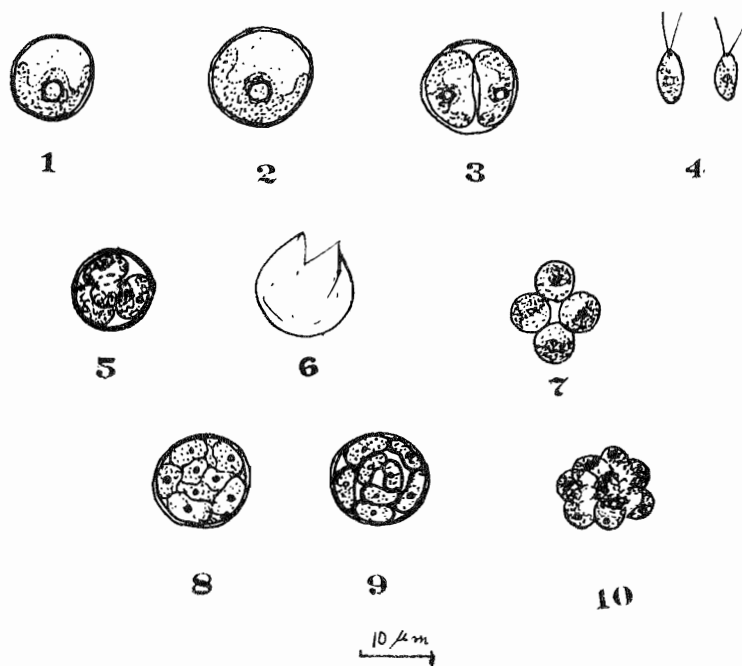


Plate I *CHLOROCOCCUM ARENOSUM* Archibald & Bold (1970)

- Fig. 1-2: Shape of the Cell.
 Fig. 3: Two young Cells inside the mother cell wall.
 Fig. 4: Zoospores.
 Fig. 5: Four young Cells inside the mother cell.
 Fig. 6: Remnant of the mother cell wall.
 Fig. 7: Four young Cells.
 Fig. 8-10: Different Stages of Autospore formation.

FAMILY: Chlorococcaceae

GENUS: *Chlorococcum* Meneghini, 1842
Chlorococcum arenosum Archibald & Bold, 1970.
 Syn. *Chlorococcum humicola* (Naeg.) Robenhorst, 1968.

Strain examined:—AIZAZ 1971/3 Manghopir, Karachi.

Description:—(Plate 1, Fig. 1-10).

Cells spherical of varying size 8-20 μ in diam., solitary or in small clumps. Cell wall very close to the cytoplasm, smooth, thick in old cells. Chloroplast a parietal,

hollow, sphere filling 1/2 to 3/4 of the cell cavity. Pyrenoid one to few, distinct. Nucleus one. Reproduction by zoospores or aplanospores, formed by progressive cleavage. Zoospores, 4-8, are produced in the mother cell wall. Zoospores are bi-flagellated and ellipsoidal in shape, not rounding up when becoming quiescent.

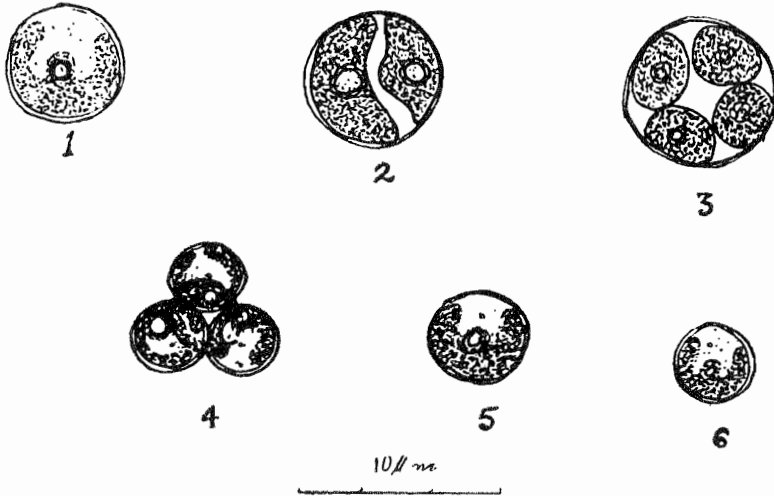


Plate II *CHLORELLA VULGARIS* Beijerincks 1890

Fig. 1: Typical Cell.

Fig. 2-4: Autospore formation inside the mother cell wall.

Fig. 5-6: Young Cells.

FAMILY: Oocystaceae

GENUS: *Chlorella* Beijerincks, 1890.

Chlorella vulgaris Beijerincks, 1890, p. 226, Fig. 175; West & Fritsch, 1927.

Strain examined:—AIZAZ 1971/1, Pond in P.E.C.H. Society, Karachi.

Description:—(Plate II, fig. 1-6).

Cells spherical 4-8 μ in diam., solitary or aggregated in irregular clumps, cell wall thin, chloroplast cup-shaped, filling about 3/4th of the cell cavity, pyrenoid comparatively small. Reproduction by autospore formation, commonly four autospores are produced. Autospores are spherical or ellipsoidal in shape.

Note :- The shape of the cell described by Fott & Novakova (1969) is spherical to ellipsoidal while in our culture the adult cells were commonly spherical (pl. II, fig. 3). The difference lies in the common variability range which can occur due to ecological differentiation.

FAMILY: Oocystaceae

GENUS: *Monoraphidium* Komarkova & Legnerova, 1969.

KEY TO THE SPECIES OF GENUS *MONORAPHIDIUM*

- | | | | | | | | |
|----|-------------------------------------------------------------------------------------------------------|-----|-----|-----|-----|-----------------------|---|
| 1. | Cells with pointed ends | ... | ... | ... | ... | ... | 2 |
| 1. | Cells without pointed ends | ... | ... | ... | ... | ... | 4 |
| 2. | Cells gradually pointed | ... | ... | ... | ... | ... | 3 |
| 2. | Cells not gradually pointed | ... | ... | ... | ... | ... | 4 |
| 3. | Cells widely fusiform, sigmoid or arcuate, rounded ends with advanced age | ... | ... | ... | ... | <i>M. convolutum.</i> | |
| 3. | Cells long, fusiform, twisted into condensed regular spiral | | | | | <i>M. contortum.</i> | |
| 4. | Bluntly pointed to rounded ends, cylindrical to moderately spindle shaped | ... | ... | ... | ... | <i>M. minutum.</i> | |
| 4. | Rounded ends cell cylindrical, sometimes tapering towards apices. Nearly straight to slightly arcuate | ... | ... | ... | ... | <i>M. dybowski.</i> | |

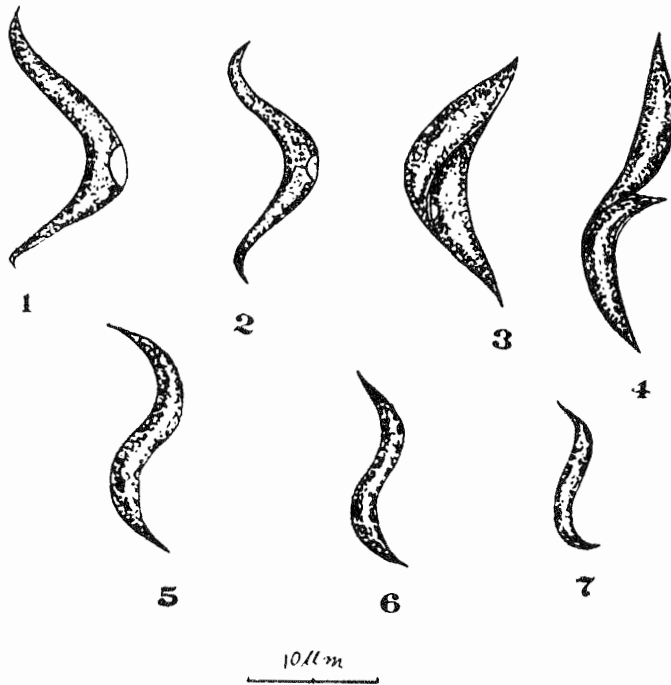


Plate III *MONORAPHIDIUM CONTORTUM* (Thuret in Breb.) Komarkova Legnerovai 1969

Fig. 1-2: Typical Vegetative Cells.

Fig. 3: Young Autospores enclosed in the mother cell wall.

Fig. 4: Formation of two Autospores.

Fig. 5-7: Shapes of young cells.

1. *Monoraphidium contortum* (Thuret in Breb.) Komarkova & Legnerova, 1969, p. 104-106, plate 18, fig. 1-5. in *Studies in Phycology Praha*.

Strain examined:—AIZAZ, 1971/8, pond near Post Office, Liaqatabad, Karachi.

Description:—(Plate III, fig. 1-7).

Cells long fusiform 11-24 μ in length and 1-3 μ in breadth in the middle, pointed gradually towards the ends, curved and with spiral ends. Cell wall thin and very close to the cytoplasm; chloroplast laminate, sometimes seems to be entire, more concentrated towards the ends. Pyrenoid not visible but starch grains are scattered in the chloroplast. Reproduction by autospore formation. Commonly 2 and rarely 4 autospores are seen inside the mother cell wall.

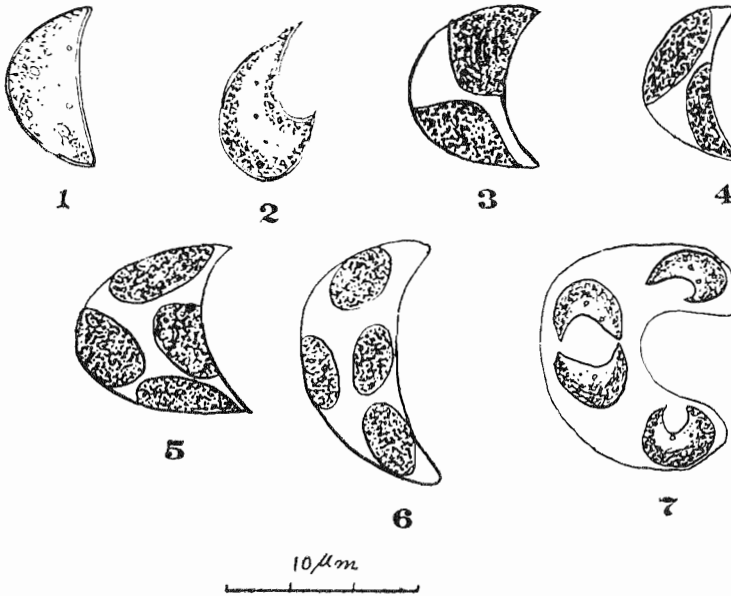


Plate IV *MONORAPHIDIUM CONVOLUTUM* (Corda) Komarkova-Legnerova 1969

Fig. 1-2: Vegetative Cells.

Fig. 3-4: Formation of Autospores

Fig. 5-6: Four Autospores enclosed inside the mother cell wall.

Fig. 7: Autospores ready to liberate.

2. *Monoraphidium convolutum* (Corda) Komarkova & Legnerova, 1969. p. 107-108. plate 20, fig. 1-8. in *Studies in Phycology, Praha*.

Strain examined:—AIZAZ 1971/6, pond near the Post Office at the University Campus, Karachi.

Description:—(Plate IV, fig. 1-7).

Cells widely fusiform, or arcuate, gradually pointed at the ends. Cells 8-12 μ in length and 3-5 μ in breadth. The ends become blunt in the older cells. Cell wall distinct. Chloroplast entire to laminate, pyrenoid absent. Starch and oil globules are scattered in the cytoplasm.

Reproduction by autospore formation. 2-4 autospores are produced inside the mother cell-wall. Autospores resemble the mother cell in the cell structure and shape but are smaller in size.

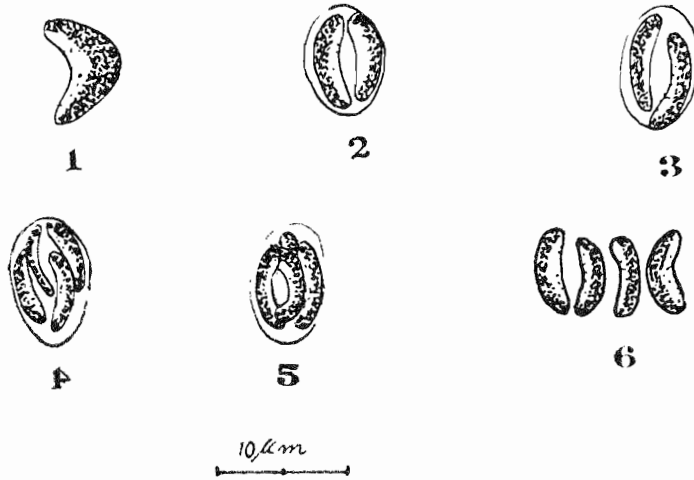


Plate V *MONORAPHIDIUM DYBOWSKII* (Wolosz) Hindak & Komarkova Legnerova 1969

- Fig. 1: Shape of the Adult Cell.
 Fig. 2-3: Two Autospores enclosed inside the mother cell wall.
 Fig. 4-5: Four Autospores enclosed inside the (mother cell wall.
 Fig. 6: Young Cells.

3. *Monoraphidium dybowskii* (Wolosz) Hindak in Komarkova—Legnerova, 1969, p. 108-109, plate 21, fig. 1-4, in *Studies in Phycology*, Praha.

Strain examined: AIZAZ 1971/7, fig. 1-4, collected from a ditch at Gharo, Distt. Thatta, Sind.

Description:—(Plate V, fig. 1-6)

Cells cylindrical, more or less with blunt ends Cells 5-8 μ in length, 2-6 μ in breadth. Young cells straight to slightly arcuate. Old cells curved chloroplast parietal, in the young cell length while in the older cells it withdraws to the sides of the cell and becomes plate like. Pyrenoid not visible. Reproduction by 2-4 autospores produced inside the mother cell wall.

Note:—In Komarkova and Legnerova's species reproduct on proceeds in the way typical of the genus nearly by 2-4 autospores. According to them autospores are fusiform and change into cylindrical cells when they reach to adult stages. In the same way 2-4 autospore formation has been observed in our strain but the cells were not fusiform; they were rather reniform, with rounded ends (Plate VII, fig. 2-5). The autospores are enclosed in the mother cell wall longitudinally and the cells become oval in shape with maturity. The dimensions of cells given by Komarkova & Legnerova (1969) agree well with size of our specimens.

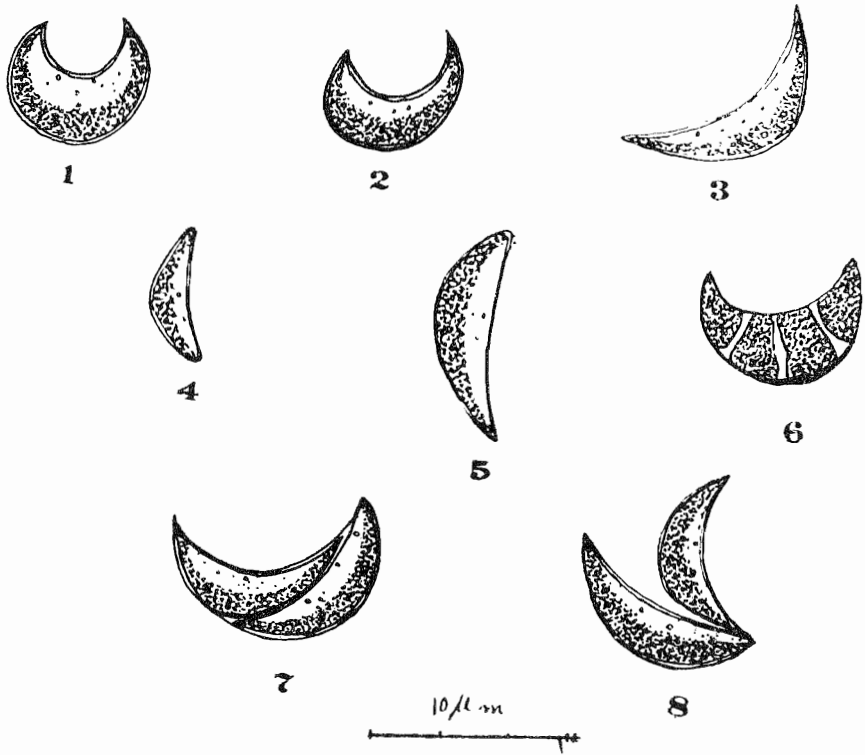


Plate VI *MONORAPHIDIUM MINUTUM* (Nag.) Komarkova X Legnerova 1969.

Fig. 1-5: Shapes of Adult Cell.

Fig. 6: Autospores enclosed inside the mother cell wall.

Fig. 7-8: Formation of Autospores.

4. *Monoraphidium minutum* (Nag.) Komarkova & Legnerova, 1969 p. 109-110, plate 22 fig. 1, in *Studies in Phycology*, Praha.

Strain examined:—AIZAZ 1971/5, Pond in University Campus, near Bio-chemistry Department, Karachi.

Description:—(Plate VI, fig. 1-8)

Cells cylindrical but a little curved, bluntly pointed at the ends, arcuate cell wall thin Cells 6-10 μ in length and 3-6 μ in breadth. Chloroplast laminate at the basal portion and becomes entire in the older cells. Pyrenoid absent. Reproduction

by 2-4 autospores produced by the transverse or longitudinal division of the mother cell contents.

Note:—Our specimen closely resembled the one described by Komarkova & Legnerova (1969) except that the former was bluntly pointed at its ends.

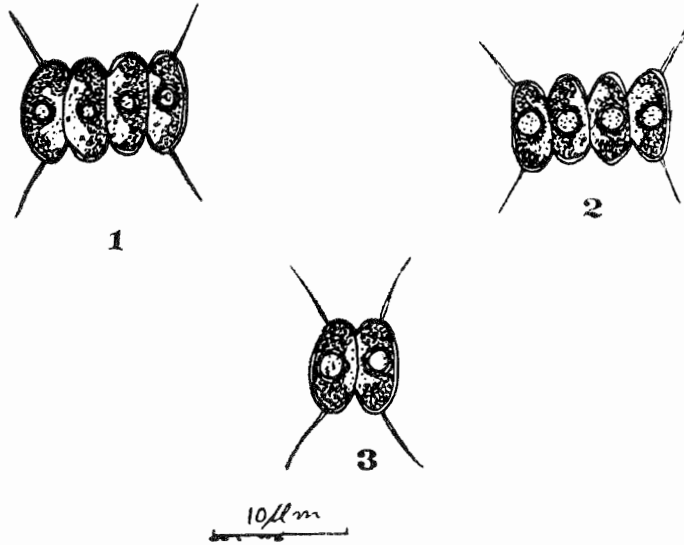


Plate VII *SCENEDESMUS QUADRICAUDA* (Turp) de Breb in tde Breb & Godey 1835.

Fig. 1-2: Four celled Coenobia.

Fig. 3: Two celled Coenobium.

FAMILY: Scenedesmaceae

GENUS: *Scenedesmus* Meyen, 1829

Scenedesmus quadricauda (Turp.) de Brebisson in de Brebisson & Godey 1835, in Prescott 1962, p: 280, plate 64, fig. 4.

Strain examined: AIZAZ 1971/12, pond in University Campus, near Zoology Department, Karachi.

Description:—(Plate VII, fig. 1-3).

Colony 2-4 celled in a single series 4 celled colony 7-8 μ in length and 12 μ in breadth. Breadth of a single cell is 3 μ . cells oblong, cylindrical; outer cells with 2 spines at the poles, inner cells without spines. The poles at the cells are rounded, chloroplast parietal enclosing a large pyrenoid. Reproduction not observed.

Note:—The cells in our culture differed from those described by Prescott (1962) and Fritsch (1961) in nature of spine and cells which could be attributed to different ecological conditions.

Acknowledgement

We are thankful to Dr. M.A.F. Faridi, who provided us valuable suggestions during the preparation of this paper.

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