

Taxonomy and periodicity of *Chlorococcum* fries, *Coelastrum* Näg. and *Scenedesmus* Meyen in Hooghly, West Bengal, India

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Abstract

Chlorococcum humicola (Näg.) Rabenh., *Coelastrum astroideum* De Notaris, *Scenedesmus bijuga* var. *irregularis* (Wille) G. M. Smith and *Comasiella arcuata* var. *platydisca* (G. M. Smith) E. Hegewald & M. Wolf are very common freshwater Chlorococcalean algal taxa in the geographical occurrence of Hooghly district, West Bengal, India. The members of the order Chlorococcales exhibited wide morphological diversity in shape and size of vegetative cells and, colonies. They reproduced mainly by asexual spores. Besides these, they also propagated by zoospores or aplanospores. During the taxonomic investigation, it was noticed that the above said species were grown better in lentic aquatic bodies as well as most of the taxa showed higher periodicity in hot and humid monsoon (August) and summer (March-April). Except, *Chlorococcum humicola* (Näg.) Rabenh. other three algal taxa are coenobial types. *Scenedesmus* Meyen colony is flat, whereas *Coelastrum* Näg. is spherical in a morphological point of view. It was also observed that the two varieties of the genus *Scenedesmus* Meyen occurred in polluted water bodies, so they are good ecological indicator of water pollution. All these taxa are being reported first time from this area and *Comasiella arcuata* var. *platydisca* (G.M. Smith) E. Hegewald & M. Wolf and, *Coelastrum astroideum* De Notaris for the first time from West Bengal. The study of physicochemical parameters of water bodies showed that they can tolerate the fluctuation of chemical oxygen demand values. Higher temperature (>25°C), moderate alkalinity (<8.5), dissolved oxygen values above 6.0 mg/l

and lower inorganic nutrient contents as well as turbidity accelerated their occurrences, growths and periodicities in aquatic bodies.

Keywords; Taxonomy, Chlorococcales, Hooghly, West Bengal, India.

Introduction

Different water bodies exhibited their own properties in respect of their physicochemical parameters and aquatic life-forms. In each water bodies, the quality and abundance of aquatic flora are determined by the nature and composition of water, its temperature, oxygen content, pH, amount of organic and inorganic matter and, various pollutants [1, 2]. Green algae are aquatic plants and act as the pioneer photosynthetic organism or producer in the world of ecosystem [3]. Till date, a total number of 101 species of Chlorococcales belonging to 18 genera have been reported from various regions of India [4]. The genus *Scenedesmus* Meyen was interpreted in a broad sense that included many species with very different morphological characters [5, 6, 7]. In sewage purification processes, it provides oxygen for the bacterial breakdown of organic matter and thereby, helps to destroy other harmful substances [8]. *Chlorococcum* Fries and *Coelastrum* Näg. and *Scenedesmus* Meyen are microscopic, planktonic, greenish and coccoid algae which are mainly act as primary producer in aquatic ecosystems and also used for experimental work on problems of pollution. Some studies had been made by a few workers on the taxonomy of these genera from India [8, 9, 10, 11, 12]. Taking, ecology of Chlorococcales members into consideration, lower values of nitrates and phosphates (main nutrients) thrive their better growth [13]. Temperature is an important physical factor which affects on other chemical and biological factors of the water [14]. Higher temperature plays a significant role for the occurrence of Chlorococcales member [15, 16] and periodicity of them [17]. pH is another crucial ecological parameter which affects on the survival of aquatic flora [14, 18, 19] and alkaline pH favours for algal growth [20]. The maximum abundance of Chlorococcales algae are found during summer months and spring [13, 21, 22, 23]. The main aim of the present study was the documentation and to report of the Chlorococcalean green algal flora with taxonomy and limnology from Hooghly, West Bengal, India. As, the information on the algal taxonomy and biodiversity in relation to ecological aspects pertaining to the water bodies in West Bengal, India is unavailable hence this study was undertaken from this region.

Materials and Methods

The algae had been collected in glass containers from different places *viz.* Khamargachi (N 23°-05' E 88°-43'), Tribeni (N 22°-99' E 88°-40') and Diara (N22°-79' E 88°-28') of Hooghly district, West Bengal, India. A detailed study was made by examining specimens under Olympus microscope (Model-CH20i) for identification of species. Samples were preserved in 40% formalin. Identifications of these taxa were accomplished followed references [5, 6, 24, 25, 26, 34]. The pH and temperature of the water bodies were determined at the sites immediately after collections with the help of portable pH meter (Model No.

PP9046 Philips, India) and Zeal's mercury thermometers (UK). The other limnological parameters such as nitrate-nitrogen ($\text{NO}_3\text{-N}$), phosphate (PO_4^{3-}), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), turbidity and total alkalinity of waters were estimated by UV-VIS Spectrophotometry (CECIL CE- 7200) following the standard method [27]. All the physicochemical parameters are expressed in mg/l except pH and temperature.

Results and Discussion

A total number of four planktonic and coccoid green algal taxa viz. *C. humicola* (Näg.) Rabenh., *C. astroideum* De Notaris, *S. bijuga* var. *irregularis* (Wille) G. M. Smith and *C. arcuata* var. *platydisca* (G. M. Smith) E. Hegewald & M. Wolf of the family Chlorococcaceae belonging to the order Chlorococcales of the class Chlorophyceae was recorded and described for the first time from two types aquatic ecosystems in Hooghly district of West Bengal, India. Each currently accepted name has been provided with its author (s) name. Their descriptions provided below:

Morpho-taxonomic description

KEY TO THE GENERA

- 1(a) Cell solitary or temporary in colonies and normally spherical----- *Chlorococcum* Fries
1(b) Cells always in colonies----- (2)
2(a) Colony spherical to polygonal and hollow; cells not parallel with longitudinal axes and compressed-----*Coelastrum* Näg.
2(b) Colony flat; cells not parallel with longitudinal axis -----*Scenedesmus* Meyen

Order: Chlorococcales

Family: Chlorococcaceae

Genus: *Chlorococcum* Fries

1. *Chlorococcum humicola* (Näg.) Rabenh. (pl. 1, fig. 1)

[28] 3: 58; [24] 73, fig. 3; [26] 75, pl.18, figs. 2a, b. pl. 95, fig. 6, pl. 93, fig. 1.

Description: Cells solitary or in a small clumps, green, spherical; 8.8 to 14.4 μm broad, wall thin, smooth; chloroplast parietal, without notch, completely filling the cell; pyrenoid one; multinucleate; contractile vacuole absent.

Habitat: Canal water at Khamargachi.

Collection No: 567; **dated:** 16.08.2009

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

Order: Chlorococcales

Family: Coelastraceae

Genus: *Coelastrum* Näg.

2. *Coelastrum astroideum* De Notaris (pl. 1, fig. 2)

[29] 80, pl. 9, fig. 93; [6] 725, fig. 202.4

Description: Planktonic and colonial; colony spherical with very minute gelatinous processes leaving and smaller intercellular spaces; coenobium 8 to 16 celled; 38.0 to 46.0 µm in diameter; cells oval with smooth cell wall and enclosed by a delicate gelatinous sheath and also closely interconnected by gelatinous process; chloroplast cup-shaped to diffused with pyrenoids; cells 10.0 to 15.0 µm in diameter.

Habitat: Pond water at Tribeni.

Collection No: 1221; **dated:** 18.04.2012

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

Genus: 2. *Scenedesmus* Meyen

KEY TO THE SPECIES

1(a). Cells lie in a single linear series; cells ellipsoids ----- *S. bijuga* var. *irregularis*

(b). Cells lie in two rows; cells oblong-ovate ----- *C. arcuata* var. *platydisca*

Order: Chlorococcales

Family: Coelastraceae

3. *Scenedesmus bijuga* var. *irregularis* (Wille) G. M. Smith (pl. 1, fig. 3)

[5] 18: 448; [24] 253, figs. 163 i, m as *Scenedesmus bijugatus* var. *irregularis* Wille, 1967
[25] 125, fig. 204; [30] 80, pl. I, fig. 10, pl. II, fig. 27.

Description: Planktonic, colonial, colony flat or slightly curved, consisting of 4 cells and arranged in an irregular or sub-alternating manner; cells are oblong-ellipsoidal to oval; 15.15 µm long and 4.55 µm broad; cell wall smooth i.e. without any spines; chloroplast one and parietal; pyrenoid one.

Habitat: Pond water at Khamargachi.

Collection No: 1220; **dated:** 15.03.2012

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

West Bengal: This is the second time report of that taxon from this state.

4. *Comasiella arcuata* var. *platydisca* (G. M. Smith) E. Hegewald & M. Wolf (pl. 1, fig. 4)

Basionym: *Scenedesmus arcuatus* var. *platydiscus* G.M. Smith, 1916

[5] 18: 451, pl. 30, figs. 101-105. [33] 49: 332, fig. 1 table.

Description: Plant planktonic, colonial, bright green; colony slightly curve and flat, consisting of 8 cells; cells arranged in 2 rows; individual vegetative cell oblong-ovate; cells become angular by compression and kept in contact with lateral walls; cell wall without spines; poles of cells broadly rounded; cells 8.0 to 11.0 µm long and 4.0 to 6.0 µm broad.

Habitat: Pond water at Diara (In association with *Anabaena* species).

Collection No: 1230;**dated:** 29.08.2012

Significance: Primary producer and component of aquatic food chain in freshwater ecosystems.

West Bengal: This taxon is appeared to be the first report from West Bengal, India.

The periodicity of those algae had been presented in table-1. In terms of periodicity, *Chlorococcum humicola* was found almost every months except three months. *Coelastrum astroideum* was observed at the onset of winter and summer seasons. *Scenedesmus bijuga* var. *irregularis* was noticed just after the monsoon and prior to monsoon while *Comasiella arcuata* var. *platydisca* dominated in the months on June to October during the years of survey. The data pertaining to various limnological parameters which brought about changes in the ecological set up and there by influenced the growth and periodicity of Chlorococcalean algae in water bodies had been given [table-2]. The temperature data indicated a range of 26°C-31°C in the studied aquatic ecosystems during algal collections time. The author never found temperature below 25°C during the study period. Water had a pH from 7.4-7.8 and alkaline in nature (above 7.0). DO (dissolved oxygen), one of the most important parameter to assess water quality, was observed in the range between 6.2 mg/l and 6.8 mg/l. The BOD and COD values ranged from 4.0-5.0 mg/l and 90.0-140.0 mg/l, respectively. It was noted that BOD and COD were positively correlated in all the sites. NO₃-N (nitrate-nitrogen) and PO₄³⁻(phosphate)-the most essential nutrients for algal growth and development were in lower amounts. Total alkalinity which depends on dissolved bicarbonate, carbonate and hydroxide ions varied from 102.0-134.0 mg/l in the studied water bodies whereas, the range of turbidity was fluctuated between 18.0-26.0 mg/l during the limnological study.

pH range 6.0 - 8.5 is ideal for algal growth [31] and this was found to be true in the present investigation. Abundance of Chlorococcales is higher when temperature is increased [13, 15, 16, 17]. Similar conclusion can be made from this study, although author also observed the Chlorococcalean algal

members in rainy season with high humid climatic condition. Nutrient contents like $\text{NO}_3\text{-N}$ and PO_4^{3-} have a direct relationship with the algal growth [32]. The present results of nutrient status also supported the argument made by author earlier while working on Euglenophycean members from this locality. Overall, higher pH and DO values indicated high rate of photosynthetic activity that might be due to presence of sufficient algal flora or phytoplanktons in the water bodies. So, the present study revealed the importance of floristic works to identify algal species. In addition to that, analysis of physicochemical parameters and their effect on algal biodiversity in selected fresh water ecosystems provided valuable ecological information for further algological study.

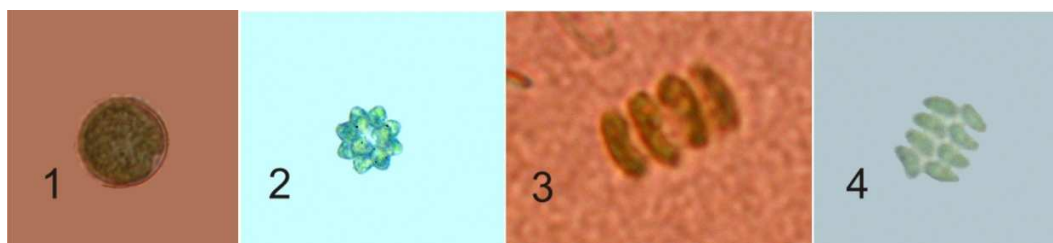


Plate (1): figs.1-4: 1. *Chlorococcum humicola* (Näg.) Rabenh., 2. *Coelastrum astroideum* De Notaris, 3. *Scenedesmus bijuga* var. *irregularis* (Wille) G. M. Smith, 4. *Scenedesmus arcuatus* var. *platydiscus* G.M. Smith. The scale :20µm

Table 1. Periodicity of four algal taxa

Name of the Algal taxa	Periodicity in months											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
<i>Chlorococcum humicola</i>	+	+	+	+	-	-	+	+	+	+	-	+
<i>Coelastrum astroideum</i>	-	-	+	+		-	-	-	-	+	+	-
<i>Scenedesmus bijuga</i> var. <i>irregularis</i>	-	-	+	+	+	-	-	-	+	+	+	+
<i>Scenedesmus arcuatus</i> var. <i>platydiscus</i>	-	-	-	-	-	+	+	+	+	+	-	-

+ indicated presence and – indicated absence of algal taxa

Table 2: Physicochemical characteristics of water bodies at the time of algal collections
(Mean±SE)

Collection sites	Physicochemical parameters of water								
	Temp. (°C)	pH	DO (mg/l)	BOD (mg/l)	COD (mg/l)	NO ₃ ⁻ N(mg/l)	PO ₄ ³⁻ (mg/l)	Total alkalinity (mg/l)	Turbidity (mg/l)
Canal at Khamargachi	26° ±0.2	7.4±0.05	6.8±0.1	4.4±0.2	100.0±5.5	0.3±0.05	0.28±0.05	120±1.1	20±1.0
Pond at Tribeni	30°±0.2	7.8±0.04	6.4±0.2	5.0±0.1	140.0±5.7	0.6±0.1	0.48±0.1	134±1.1	18±1.1
Pond at Khamargachi	26° ±0.5	7.4±0.05	6.4±0.1	4.0±0.08	90.0±2.8	0.37±0.05	0.36±0.05	128±1.1	22±1.1
Pond at Diara	31°±0.2	7.5±0.05	6.2±0.08	4.1±0.1	110.0±5.5	0.4±0.1	0.35±0.04	102±1.0	26±1.0

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