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Taxonomical Studies of Three Species of an Epiphytic Alga *Coleochaete* Bréb. with Ecological Notes in West Bengal, India

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Abstract

During taxonomical study of *Coleochaete* Bréb., an epiphytic alga**,** three species *viz*. *Coleochaete nitellarum* Jost, *Coleochaete pulvinata* A. Br. ex Kütz., *Coleochaete soluta* (Bréb.) Pringsh. belonging to the order Chaetophorales under the class Chlorophyceae were recorded in the winter season from three sites of Hooghly district in West Bengal, India. The thallus of *C. nitellarum* grew diffusely on the submerged angiospermic plants and consists of irregularly branched prostrate filaments. In *C. soluta*, the erect filaments were freely branched while, upper cells of erect filaments were cylindrical and thallus was hemispherical in *C. pulvinata*. The most important finding of the limnological work was the higher concentration of DO in the lentic aquatic ecosystems where they occurred that might be due to higher rate of photosynthetic activities and lower temperature of water. This study also exhibited somewhat, lower nutrient status in respect of NO_3-N: PO_4^{3-}: K ratios. The review of literatures revealed that *C. pulvinata* was the second time report and other two taxa were reported third timely from this state.

Key words**:** Taxonomy, Ecological notes, *Coleochaete* Bréb., West Bengal, India

Introduction

Algae are important biological flora and play significant role in lentic water bodies for sustainable maintenance of aquatic food chains and also help to assess pollution status or organic load. They also mixed up dissolved oxygen content to waters through photosynthesis process.

Coleochaetalean algae showed considerable morphological variations in their structural organization (Mahakham and Theerakulpisut, 2010; Halder, 2015). They are found in clear fresh water lakes and ponds and, considered as key element in evolution of early plant (Cimino *et al.*, 2003). They are found worldwide as epiphytes on submerged aquatic macrophytes and also grow on nonliving substrates like beer cans, plastic bags and pebbles in shallow littoral zone of oligotrohic ponds and lakes (Graham and Wilcox, 2000). The genus *Coleochaete* Bréb. is mucilaginous, colonial and multicellular bright green alga that forms a flat thallus. In most of the species, filaments are radiated from a common point. Cells are haploid and each cell has a single parietal chloroplast with conspicuous pyrenoid. At maturity, multiple (16-32) meiospores are liberated from each zygote. As, the genus is considered to be a key algal taxon in the phylogenic evolution of algae hence, the taxonomic study has a great importance to understand their vegeta-tive and reproductive structures and their micro morphological characteristics.

Few noteworthy contributions were made earlier on the taxonomy of those species by Singh (1941), Randhawa and Venkataraman (1962), Sarma (1962), Saxena (1962), Sinha and Noor (1962), Patel (1966, 1968), Kamat (1975), Prasad and Misra (1984), Dwivedi (1987), Kargupta and Sarma (1991), Habib and Pandey (1992), Sindhu and Panikkar (1995), Srivastava and Misra (2009) and Keshri (2010).

Materials and methods

Algal samples were collected in plastic and glass containers from fresh water habitats at Madhusudanpur (23°.01'N;88°.40'E), Behula (23°.18'N; 88°.42'E) and Seoraphuli (22°.77'N; 88°.32'E) of Hooghly district (20°30'32″-23°1'20″N;87°30'20″-80°30'15″E) (Fig. 1). Detailed taxonomic study was made by examining the specimens under Olympus trinocular microscope with camera attachment (Model-CH20i) and photomicrographs were taken using Canon Power Shot A480 camera. The samples were preserved in 4% formalin. Identifications of the taxa accomplished with the help of authentic literatures (Prescott, 1962; Printz, 1964; Starmach, 1972; Sarma, 1986; Picińska-Fałtynowicz and Semmerling, 2001; Delwiche *et al*., 2002; Srivastava and Misra, 2009; Mahakham and Theerakul-pisut, 2010; Bicudo and Bicudo, 2014). The pH and temperature of the aquatic bodies were determined at the site immediately after collection 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 (NO_3-N), phosphate (PO_4^{3-}), potassium (K), dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS) and sulphate (SO_4^{2-}) of waters were estimated by UV-VIS Spectrophotometry (CECIL CE-7200) following the standard method (APHA, 2005). All the physico-chemical parameters in ecological notes are expressed in mg l^{-1} except pH and temperature.

Results and discussion

Three species of *Coleochaete* Bréb. namely *Coleochaete nitellarum* Jost, *Coleochaete soluta* (Bréb.) Pringsh. and *Coleochaete pulvinata* A. Br. ex Kütz. belonging to the family Coleochaetaceae under the order Coleochaetales of class Chlorophyceae were described below with author citation, habitat, date of collection, ecological notes and significances for the first time from Hooghly district, West Bengal, India.

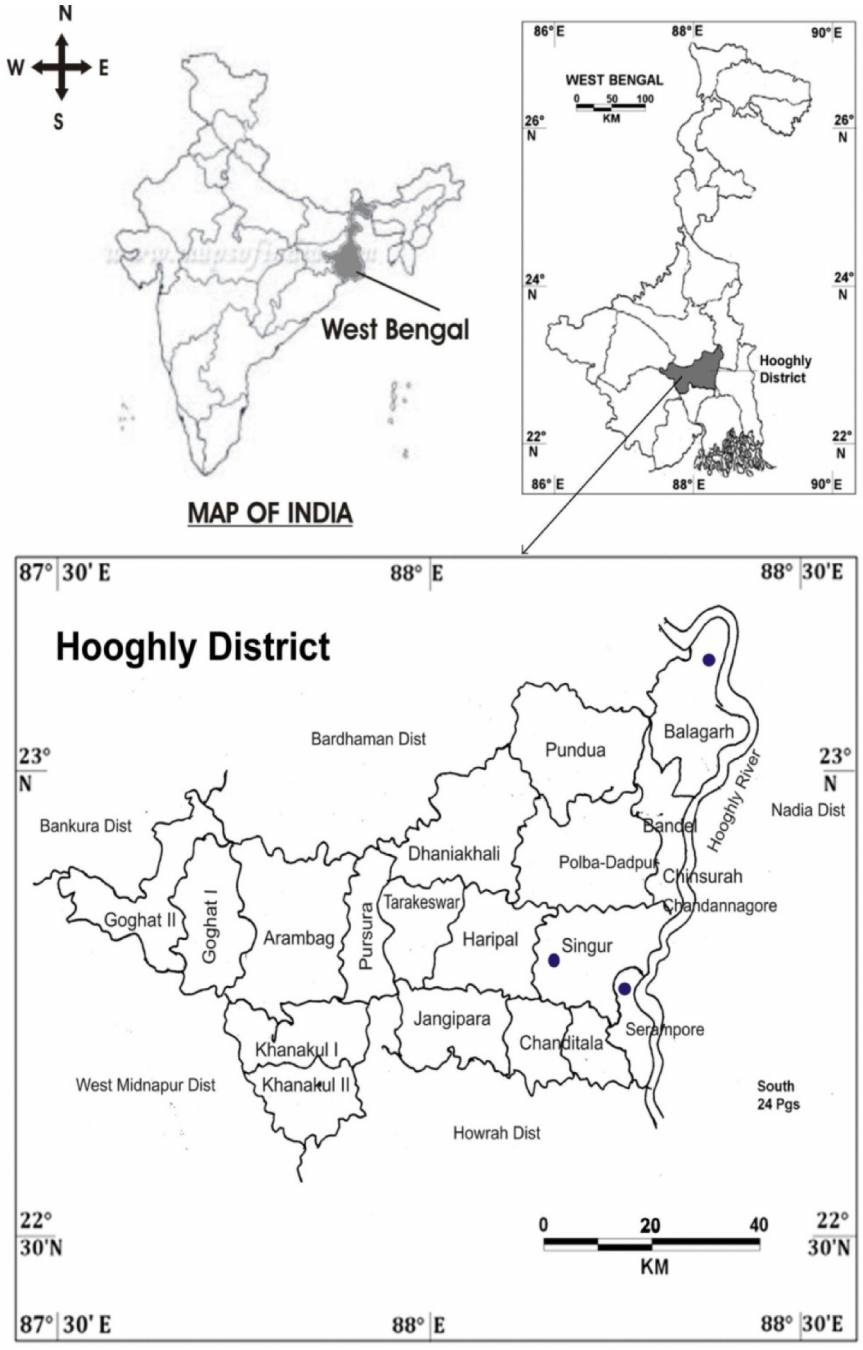
Key to the species

1a. Thallus growing diffusely, consists of irregularly branched prostrate filaments ------*Coleochaete nitellarum*
1b. Thallus not so …… (2)
2a. Erect filaments freely branched---------- *Coleochaete soluta*
2b. Erect filaments not freely branched; upper cells of filaments cylindrical; thallus hemispherical----------*C. pulvinata*

Morpho-taxonomic descriptions

Order: Chaetophorales
Family: Coleochaetaceae
Genus: *Coleochaete* Brébisson

1. *Coleochaete nitellarum* Jost in Ber. Deutsch. Bot. Gesell. 8: 433, 1895; Printz in Hydrobiol. 358, pl. 111, figs.7-9, 1964; Starmach, Flora Slodkowodna Polski. Chlorophyta 3: 532, fig. 547, 1972; Delwiche, Karol, Cimino and Sytsma in J. Phycol. 38: 396, fig.2.C, 2002; Bicudo and Bicudo in Hoehnea 41(3): 419, figs.10-16, 2014 (Fig. 2A)



Map of Hooghly district, W.B

Fig. 1 ● Indicates study sites.

Description**:** Thallus microscopic and filamentous; consists of numerous irregularrly branched prostrate filaments, sometimes adjoining laterally; growing diffusely along with the surface of the host plant; filaments anastomosing and spreading, sometimes coalescent laterally and form an expansion of filaments; cells are subrectangular, square or polygonal; each cell contains a single plate-like chloroplast filling the maximum area of the cell; pyrenoid single; nucleus single in each cell; cells 15.0-30.0 µm long and 8.0-22.0 µm broad; sexual reproductive structures like antheridia and oogonia as well as zoospores were not seen in the material; spermocarp thick walled with cortication, produced laterally and clearly visible; 45.0-56.0 µm in diameter; oospore ovate or spherical; 30.0-43.0 µm in diameter.

Habitat**:** In marshy land at Seoraphuli, Hooghly district, West Bengal

Collection No: NH 378; Dated: 28.12.2006

Ecological notes: Seoraphuli, water temperature: 19ºC; pH: 7.2; NO_3-N: 0.2; PO_4^{3-}: 0.26; K: 19.0; DO: 9.0; BOD: 3.2; COD: 100.0; TDS: 120.0; SO_4^{2-}: 6.5

Ecological significance: Acts as a primary producer in aquatic ecosystem.

2. ***Coleochaete soluta*** (Bréb.) Pringsh. in Jahrb. Wiss. Bot 2(1): 34, pl. 1: figs 1-2; pl.4: figs 1-2, 1860; Prescott, Algae of the Western Great Lakes Area 130, pl. 18, figs.6, 10-11, 1962; Starmach, Flora Slodkowodna Polski.Chlorophyta 3: 532, fig. 544, 1972; Picińska-Fałtynowicz and Semmerling in Acta Botanica Cassubica 2: 112, fig. 12, 2001 (Figs. 2B, C)

Description: Thallus epiphytic, homothallic, filamentous; composed of loosely spreading branched filaments, not coalescent laterally and radiated from a common centre and, forming monostromatic expanses; branching is dichotomous; vegetative cells usually elongated, cylindrical or rectangular at the centre, sometimes inflated; peripheral cells exhibited bifurcations; cells 9.0-15 µm broad, 12.0-25.0 µm long; apical cells with rounded tips; chloroplast single, parietal with 1-2 pyrenoids; spermocarp spherical, corticated, 50.0-80.0 µm broad; oospore without cortication and brownish; in this specimen spermocarp was not found.

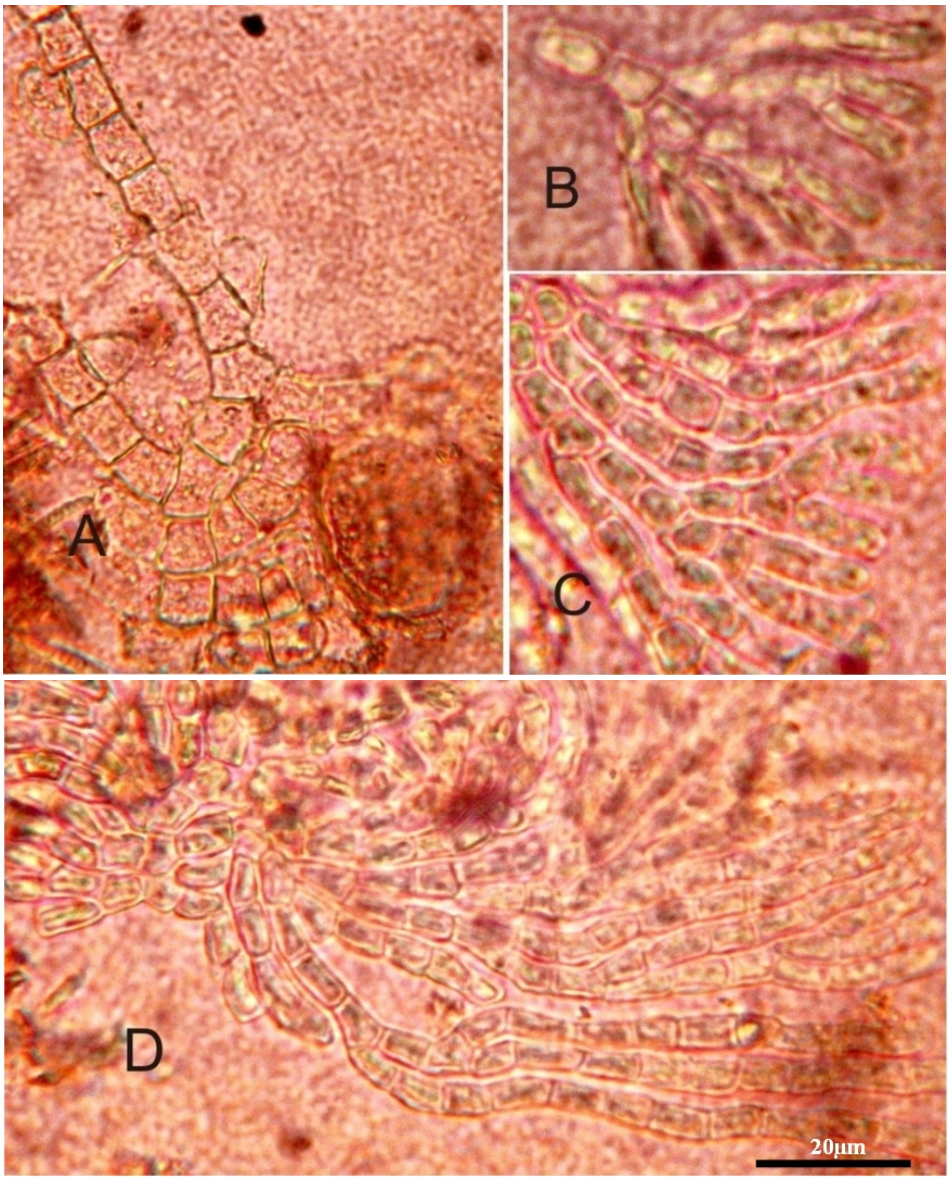
Habitat: In swampy land at Madhusudanpur, Hooghly, West Bengal

Collection No: Vaucher specimen No. NH 350; Dated: 10.12.2006

Ecological notes: Madhusudanpur, water temperature: 20ºC; pH: 7.0; NO_3-N: 0.1; PO_4^{3-}: 0.18; K: 16.0; DO: 10.0; BOD: 3.4; COD: 90.0; TDS: 132.0; SO_4^{2-}: 6.2

Ecological significance: Primary producer in this aquatic body.

3. ***Coleochaete pulvinata*** A. Br. ex Kütz. in Spec. Alg.: 424, 1849; Prescott, Algae of the Western Great Lakes Area 129, pl. 18,



Figures 2 A. *Coleochaete nitellarum* Jost, B-C. *Coleochaete soluta* (Bréb.) Pringsh. D. *Coleochaete pulvinata* A. Br. ex Kütz.

figs. 7-8, 1962; Sarma in Nova Hedwigia 58: 72, pl. 22, figs. 138-140, pl. 23, figs.141-142, 1986; Picińska-Fałtynowicz & Semmerling in Acta Botanica Cassubica 2: 112, fig. 10, 2001; Delwiche, Karol, Cimino and Sytsma in J. Phycol., 38: 396, fig.2.D, 2002 (Fig. 2D)

Description: Thallus homothallic, epiphytic, heterotrichous, mucilaginous, cushion like in appearance and up to 1 mm in diameter;

prostrate system composed of barrel-shaped or sub spherical cells to polygonal cells; 11.0-16.5 µm broad and 15.4-25.5 µm long; chloroplast single, parietal with 1-3 pyrenoids; erect system produced from prostrate system; erect filaments multicellular, mostly unilaterally branched; cells cylindrical; 12.0-18.5 µm broad and 22.5- 50.5 µm long; chloroplast single, parietal with 1-5 pyrenoids; first degree of branches lied behind some distance from apical branches; apical cells with rounded tips; antheridia single or in groups and flask-shaped; 4.0-8.0 µm broad and 8.0-11.6 µm long; oogonium more or less spherical; 18.5-30.0 µm in diameter; spermocarp globose, intercalary and 65.0-98.0 µm in diameter; zygotes are corticated, developed closer to the center of the thallus and divide to yield at least eight meiospores; in this specimen antheridium, oogonium and spermocarp were not observed.

Habitat: Swampy land at Behula, Hooghly, West Bengal.

Collection No: Vaucher specimen No. NH 317; Dated: 01.12.2006

Ecological notes: Behula, water temperature: 18ºC; pH: 7.2; NO_3-N: 0.12; PO_4^{3-}: 0.20; K: 18.0; DO: 9.4; BOD: 3.8; COD: 100.0; TDS: 138.0; SO_4^{2-}: 6.8

Ecological significance: Primary producer in aquatic ecosystem.

Szymańska (2003) while working on the taxonomy of *Coleochaete spalikii* Szymańska found that the genus *Coleochaete* Bréb. grew as ephiphytic condition and it was filamentous. These arguments were supported by Keshri (2010) and Halder (2015). Similar types of observations were also made in this work. Srivastava and Misra (2009) during their taxonomic study of *Coleochaete* Bréb. and *Bulbochaete* Agardh from North-Eastern Uttar Pradesh, India found that *Coleochaete* Bréb. possessed well developed prostrate system. Similar type of thallus structure was observed in the present study.

In respect of ecological study, Mahakham and Theerakulpisut (2010) reported Coleochaetalean algae from aquatic bodies which were rich in higher total phosphorus (13.0-42.5 $\mu g/L^{-1}$) and waters were acidic (pH 5.8-6.0) in Northeast Thailand. But in this study, quite lower level of phosphate (PO_4^{3-}) content was measured and water was found to be weakly alkaline (pH 7.0-7.2). Most interestingly, it was noticed that all these species occurred in freshwater ecosystems where DO levels were higher - (6.0 mg/l^{-1}), it might be due to they also preferred to grow in less polluted waters or waters with high level of dissolved oxygen contents.

Conclusions

Analysis of water is necessary to depict a clear picture of water bodies where algae flourished whereas, taxonomic study is prerequisite to know the present available stock of algal flora and their diversity of a particular region. The present study recorded three species of *Coleochaete* Bréb. from this area and assessment of physico-chemical characteristics exhibited that water was less polluted in these studied ecosystems and, NO_3-N, PO_4^{3-}, K, BOD, COD, TDS and SO_4^{2-} values were lower but DO value was quite higher.

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