New record of Cyanoprokaryotes from India in Maldah District, West Bengal

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Abstract

Systematic survey and collection of Cyanoprokaryotes was carried out from different water bodies of Maldah District, West Bengal. During the study, altogether 22 genera and 105 species (comprising 93 species, 09 variety and 03 forms) were identified from different types of water bodies of Maldah District. Out of 105 species, 09 species viz. Microcystis ichthyoblabe Kütz., Microcystis novacekii (Komárek) Compère, Microcystis panniformis Komárek, Microcystis wesenbergii (Komárek) Komárek, Coelosphaerium collinsii FE Drouet and WA Daily, Oscillatoria redekei Goor, Phormidium rimosum (Komárek) Anagn. and Komárek, Pseudanabaena crassa Vozžhenn. and Pseudanabaena dicyothalla (Skuja) Anagn. have been explored for the first time from India and described along with their details including nomenclature and distribution.

Keywords: Cyanoprokaryotes; India; Maldah District; New Record; West Bengal

Introduction

Maldah District is one of important district among 19 districts of West Bengal. The major river Ganges flows along south-western boundary of the district followed by another major rivers like Mahananda, Fulhar and Kalindri. All above rivers originated basically from Himalayan or sub-Himalayan region and flows Southerly direction whereas some seasonal rivers like Tangoan, Punarbhaha, Pagla and Bhagirathi are also flowing through district territory. Thus, in terms of duration and frequency of flood and its recurrences is concerned, Maldah District is defined as a chronically flood-affected area. Swamps (bils) are extending along right bank of Mahananda from Kalindri. The practice of aqua culture, cultivation of rice and Makhana (Eurayle ferox Salisb.) are other aspects on which socio-economic condition and livelihood of the district depends. To meet the requirements, huge number of big and small size ‘dighi’ and ‘ponds’ depending upon land area available to individuals are made by them. Such water bodies often get eutrophicated by micro and macrophytes as a result of contaminants from various non-point and point sources like runoff of agriculture fields in which huge quantity of fertilizers and pesticides is used and civic as well as industrial pollutants respectively.

Among the aquatic flora, diversity and distribution of microscopic flora is much greater having both beneficial and harmful properties.
Therefore, exploration of all forms of different community is warranted which is not possible to be studied by any individual. Thus, during the study, particularly concentrated on cyanoprokaryota for proper exploration of the unexplored area i.e. Maldah District of the State of West Bengal. The ancient cyanobacteria produced much of oxygen in the Earth's atmosphere, as they dominantly metabolise and fix carbon in the form of sugars by using carbon dioxide. Increase in concentration of oxygen on the earth crust, recorded during 2.4 billion years ago considered as an architect of earth's atmosphere as they are “nature’s first and foundational mother and father for causing photosynthesis”, entail to form pure ecological niche on our planet and precisely stands as founder of the aquatic food-chain. As per findings, they have been distributed all over land and water system often in such an environment where there is no other vegetation possibly due to their adaptive capability to extreme adverse environmental conditions with respect to different environmental factors. Quantum of work has been done by the Indian workers which is very much scattered.

Cyanoprokaryotes studied in diverse habitats, it is evident that enormous work on quantitative and qualitative along with taxonomic studies, indicator of water pollution / environmental assessments and R & D studies using selected species have been carried out in different parts of India. So far, out of 19 districts of West Bengal such studies have been carried out only in some of the Districts and surrounding area comprising Bankura (Sinha and Mukherjee, 1984) and (Mukherjee, 1986), Burdwan (Gupta and Sen, 1978; Chatterjee and Choudhury, 1980; Chatterjee and Chatterjee, 1983), Hooghly (Gupta and Sen, 1987; Banerjee, 1998; Sikdar and Keshri 2014), Howrah (Mukhopadhhyay and Chatterjee, 1981; Sabata and Nayer, 1992; Sen and Gupta, 1993), Kolkata (Santra, 1987; Mitra and Gupta, 1994; Banerjee, 1997; Sen, 2006), Midnapur (Pal and Santra, 1985), Murshidabad (Pal and Santra, 1982, 1984; Pal et al., 1986), 24-Paraganas (Mukhopadhhyay and Chatterjee, 1981; Maity and Santra, 1985; Singh et al., 2001; Naskar et al., 2008) and Sunderban (Pal et al., 1988; Banerjee and Santra, 2001) and in continuation for further exploration in remaining Districts of the West Bengal, Maldah District was considered first keeping in view to explore cyanophycean forms taxonomically.

**Materials and Methods**

Maldah District is situated in West Bengal of north-east India and lies between 24°41′20″ and 25°32′08″ North Latitude and 87°45′50″ and 88°28′10″ East Longitude, extends over 3733.17 km² with total population 32,90,468 as per Census, 2001 (BAES, 2004) and English Bazar is the District Administrative Headquarter. The District is bounded to its south by the District of Murshidabad across the river Ganga, by Rajshahi District of Bangladesh and Dakshin Dinajpur District to its east and north-east, by Uttar Dinajpur District to its direct north and by the Purnea of Bihar to its direct west and by Sahibganj of State of Jharkhand across the Ganga to the South-West (Fig. 1).

During the survey all administrative blocks of Maldah District namely Ratua I, Ratua II, Harishchandrapur I, Harishchandrapur II, Chanchal I, Chanchal II, Manikchak, Gazol, Habibpur,
Bamangola, Old Maldah, English Bazar and Kaliachak were visited and Cyanophycean forms were sampled from 55 places / water bodies. Samples were sampled randomly towing Phytoplankton net to a distance of 1.0 - 5.0 m depending up on depth of water bodies. The samples were preserved in 15.0 ml screw cap Borosil glass specimen vials to avoid any chemical reaction. To take samples from another water bodies, Phytoplankton net was thoroughly washed with clean water after collection of each sample. Samples were preserved by adding 2-3 drops of 4% formalin solution. Specimens were observed under Leica DM 2500 Microscope and photomicrographs of each specimen were taken by DFC 500 digital camera with annotation using Leica QWin V 3.2 Image Processing and Analysis Software and Leica Application Suit V.4. Specimens were identified by consulting standard books, monograph (Geitler, 1932; Tiffany and Britton, 1952; Desikachary, 1959; Prescott, 1982; Anand, 1989, 1998; Komárek and Anagnostidis, 1998, 2005). The authority name of each species is cited in the text as described in ‘Authors of Plant Names’ (Brummitt and Powell, 1992) whereas Journals, Periodicals with Botanical content as described in 'Botanico-Periodicum Huntianum' (Bridson, 2004a, b).

Results

Systematic studies carried out on Cyanoprokaryotes from diverse water bodies of Maldah District, West Bengal. Taxonomic enumeration of identified 09 species new to India from Maldah District, W. B. are described here along with their details including nomenclature and distribution.

Fig. 1. Location of Maldah district in West Bengal

Chroococcales Wettst.

*Chroococcaceae Nägeli*

*Microcystis Kütz. ex Lemmerm.*


Colony large, irregular, compact, without holes, mostly flattened, often form cell clusters or sub colonies in common mucilage, later on disintegrated in to small groups of aggregated cells; margins of colonies irregular, indistinct, diffuse, irregularly overlapping cells; cells spherical, densely homogeneously and evenly accumulated (Fig. 2, A).

Dimension: Cells 2.0 - 3.7 µm in diameter.

Distribution: Pond (Bhadobartola).


Colony almost spheroidal and slightly flattened, sometimes cells aggregated together; cells densely agglomerated in the centre of the colony, few
solitary cells in enveloping mucilage (Fig. 2, B).
Dimension: Cells 2.3 - 6.0 µm in diameter.
Distribution: Dighi (Bara Sagar).


Colony flat, irregular with small holes; margins of the colonies smooth or irregular; cells regularly densely and smoothly accumulated (Fig. 2, C).
Dimension: Cells 2.5 - 4.9 µm in diameter.
Distribution: Pond (Bhadobartola).


Colony irregular, spheroidal to lobate or elongate with holes when old; mostly composed with connected spheroidal subcolonies; cells sparsely to densely accumulate often near the surface of subcolonies (Fig. 2, D i and ii ).
Dimension: Cells 4.0 - 8.6 µm in diameter.
Distribution : Dighi (Sukan).

Coelosphaerium Nägeli


Cells almost ovoid, blue-green or yellowish green, pseudovacuoles absent (Fig. 2, F).
Dimension: Cells 2.0 - 4.5 µm broad and 3.0 - 5.8 µm long.
Distribution: Dighi (Samda) and Pond (Damua).

Nostoccales Geitler
Oscillatoriaeae Kirchn.
Oscillatoria Vaucher


Trichome solitary, straight or slightly curved, pale blue-green or yellow-green, not or slightly constricted at the cross-walls; not attenuated at the end, not capitulate; cells usually longer than broad with two small or large polar aerotopes at the septa; apical cell almost rounded; calyptra absent (Fig. 2, E).
Dimension: Trichome 1.4 - 2.5 µm broad and cells 2.5 - 6.0 µm long.
Distribution: Jheel (Mahadhap).

Phormidium Kütz. ex Gomont


Komárek, Prac. Inst. 28: 374, f. 3 T - U and f. 4. 1956.
Thallus dark blue-green; filament short; sheath firm, attached to trichome, confluent within the colony; trichome cylindrical, not constricted or sometimes very slightly constricted at the cross-walls; not attenuated towards ends; cells usually broader than
long, granulated; apical cell usually rounded; calyptra absent (Fig. 2, G).

Dimension: Trichome 2.8 - 4.0 µm broad and cells 1.6 - 2.8 µm long.

Distribution: Bil (Jalsukha).

Nostocaceae Kütz.

_Pseudanabaena_ Lauterborn


Trichome curved sometimes more or less straight, short 8 to 80 celled, rarely more cells, distinctly constricted at the cross-walls; cells cylindrical; apical cell almost rounded (Fig. 2, H).

Dimension: Trichome 4.1 - 4.9 µm broad and cells 4.4 - 5.6 µm long.

Distribution: Bil (Chakla).


Trichome more or less straight or slightly bent; constricted at the cross-walls, not attenuated at the end; cells almost cylindrical, blue-green with rounded ends; cell contents homogenous; apical cell rounded; calyptra absent (Fig. 2, I).

Dimension: Trichome 1.2-2.0 µm broad and cells 2.8-5.0 µm long.

Distribution: Dighi (Bara Sagar).

**Discussion**

During investigation, altogether 09 species reported first time from India from 09 water bodies of Maldah District, West Bengal. Out of 09 species two species of _Microcystis_ viz., _Microcystis ichthyoblabe_ Kütz and _Microcystis panniformis_ Komárek have been recorded from Bhadobartola pond. Another two species of _Microcystis_ viz. _Microcystis novacekii_ (Komárek) Compère and _Microcystis weisenbergii_ (Komárek) Komárek have been observed from Bara Sagar Dighi and Sukan Dighi respectively. However, _Coelosphaerium collinsii_ F.E.Drouet and W.A.Daily recorded from two water bodies - Damua Pond and Sama Dighi. _Oscillatoria redekei_ Goor recorded from Mahadhap Jheel. _Phormidium rimosum_ (Komárek) Anagn. and Komárek and _Pseudanabaena crassa_ Vozžhenn. observed from Jalsukha and Chakla bil respectively. Another species of _Pseudanabaena_ i.e. _Pseudanabaena dictyothalla_ (Skuja) Anagn. recorded from Bara Sagar Dighi. In this way maximum 02 species new to India have been explored from Bara Sagar Dighi and Bhadobartola pond followed by Damua Pond, Sama and Sukan Dighi, Mahadhap Jheel, Jalsukha and Chakla Bil. _Microcystis ichthyoblabe_ Kütz. is toxic bloom forming species containing Ichthyopeptins A and B which is active against Influenza A virus. _Microcystis novacekii_ (Komárek) Compère is also toxic bloom forming species containing high quantity of Microcystin- LR and RR. It is recommended that fishing practices from eutrophic water bodies and marketing of fishes in the local market should be monitored to avoid Microcystin related health fatalities due to possible Microcystin contaminations.
This study fill the gap in our existing knowledge of the biodiversity of the Cyanoprokaryotes of this area as well as in this country.

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