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Volvox carteri F. Stein- A New Report from West Bengal, India

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Abstract

In the present paper, a brief description of *Volvox carteri* F. Stein along with illustration, habitat, limnological parameter, threat, significance, present status and distribution in India had been given. The species belong to the family Sphaerellaceae of the order Volvocales under class of Chlorophyceae. The alga is colonial, spherical and composed of vegetative cells and asexual reproductive bodies (gonidia). Both vegetative cells and gonidia are embedded in mucilaginous matrix. Coenobium is consists of 2500-3000 somatic cells. Most interestingly, when it was found in aquatic bodies, it occurred in great abundance. This alga was noted as green free floating form in the periphery of a pond at Madhusudanpur of Hooghly district in West Bengal. This was sporadic in occurrence in this locality and periodicity was observed from winter to summer. On the basis of published records, it appears to be a new report from West Bengal, India. Limnological study exhibited that the alga grew in moderate alkaline water and there were some organic loads in studied water body because higher COD (chemical oxygen demand), total alkalinity and total hardness values were recorded. Low levels of nutrients in respect of NO_3-N (nitrate-nitrogen) and PO_4^{3-} (phosphate) were measured that also supported the growth of this specie

Introduction

The members of Volvocales are unicellular or colonial. The colonial green alga *Volvox* L. (Chlorophyceae) has a number of important features that make it an excellent model for studying basic questions of development noticed in algae (Starr, 1970; Huskey, 1979). It includes about 20 species and found in diverse freshwater habitats such as deep permanent lakes and temporary (ephemeral) pools of rain water (Desnitski, 2000; Shelton *et al*., 2012). The colonies of *Volvox* L. species are visible to the naked eyes as green dots like appearance in the water bodies and they swim by means of thousands of flagella located on the surface of somatic cells (Drescher *et al*., 2009). The colonies (coenobia) consist of two kinds of cells- 1) a large number of small somatic cells and 2) a few large reproductive cells (Kirk, 1998; Schmitt, 2003).Vegetative cells are motile and appear to be like *Chlamydomonas* Ehrenb. cells. These cells are incapable of give rise to new colonies but gonidia undergo divisions and produce daughter colonies within the mother colony (Smith, 1950; Kochert, 1968; Starr and Jaenicke, 1974). *Volvox* L. reproduced both asexually and sexually. Sexual development is initiated by a glycoprotein name as pheromone (sex inducing hormone) that acts at a concentration below 10^{-16} Molar (Hallmann *et al*., 1998).

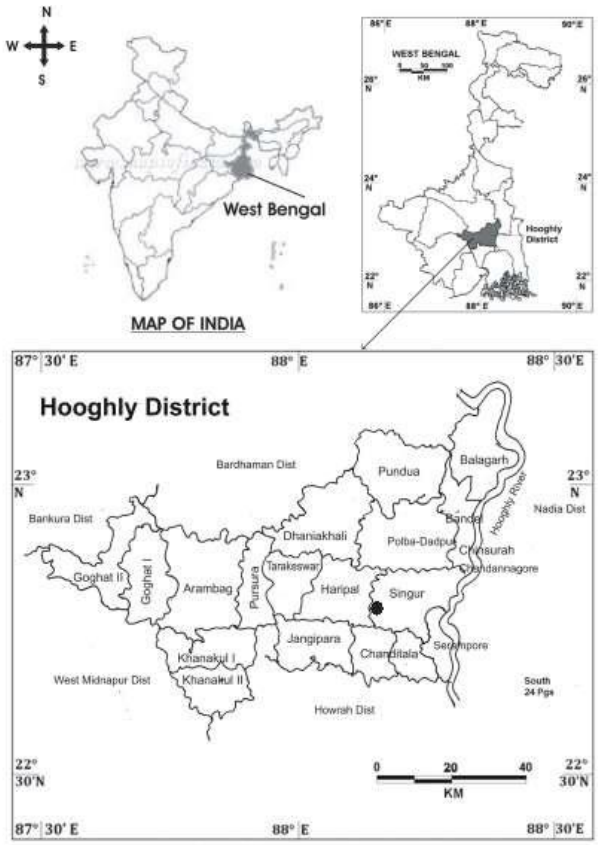
Phylogenetic analysis indicated that the genus is monophyletic in origin and shares common characters with the ancestor *Chlamydomonas* Ehrenb. Moreover, it existed about 200-220 million years ago in the earth. Thus, this alga provides a great opportunity to assess evolutionary road map leading from unicellular to multicellular nature with complete division of labor (Prochnik *et al*., 2010). Molecular genetics study showed that *Volvox* L. genomes contain ~14,500 protein-coding genes and they are slightly larger. The genomic diversity among the species probably helps this genus to evolve from a simple one-cell ancestor to a multicellular thallus with differentiated cell types (Kianianmomeni, 2014). Sequencing of nucleotides revealed presence of 138 megabase pairs genome and greater

transposon/repetitive DNA contents in this alga. Furthermore, the genome of *Volvox* L. shows a lower GC content *Ca* 56% (Merchant *et al*., 2007; Prochnik *et al*., 2010). *Volvox carteri* F. Stein represents the simplest version of an immortal germline producing specialized somatic cells (Hallmann, 2011). Recently, two genes encoding putative [FeFe]-hydrogenases (*HYDA1* and *HYDA2*) were identified from the genome of this species that are responsible to produce hydrogen gas through the H_2 metabolism process (Cornish *et al*., 2015).

Only a few studies are conducted on the taxonomy and occurrences of freshwater Volvocales from India. The classical pioneer workers on the taxonomy of Volvocales were those of Carter (1859), Iyenger (1933), Apte (1936), Dixit (1937), Rao (1947), Kamat (1962), Sethi *et al*., (2012). Iyenger (1933) in his monograph "Volvocales" had given first time an account of the species of *Volvox* L. Apte (1936) enumerated a few species of *Volvox* occurring in Poona and its neighbouring area. *Volvox carteri* F. Stein was first reported from Bombay presidency by Carter (1859). So, after the establishment of genus *Volvox* by Linnaeus (1758) a few species had been explored from India. Due to lack of sufficient taxonomical and distributional information about this phycoflora in this state, the present work had been undertaken.

Material and Methods

The algal sample was collected in sterilized plastic and glass containers from a fresh water pond at Madhusudanpur (23.01°N and 88.40°E) of Hooghly district (**Fig.1**). Detailed taxonomic study was made by examining specimens under Olympus microscope (Model-CH20i) for determination of species. Sample was preserved in 4% formalin. Identification of the taxon was accomplished through authentic literatures (Iyenger and Desikachary, 1981). The limnological parameters of water were analyzed as described earlier (Halder and Sinha, 2015).



Map of Hooghly district, W.B

Fig. 1

Fig 1. Showing the map of Hooghly district, West Bengal, India

Results and Discussion

Volvox carteri F. Stein, a Chlorophycean member under the order Volvocales, had been described systematically with some valuable information for the first time in Hooghly district, West Bengal. Currently accepted name had been provided with its author name. The systematic position of the alga was given according to Fritsch classification (1935).

Morphotaxonomic description

Class: Chlorophyceae; Order: Volvocales

Family: Sphaerellaceae; Genus: *Volvox* L.

Volvox carteri F. Stein, in Org. Infus. 3(1): 134. 1878 (**Pl.1, Figs. A-B**)

Bombay: *Volvox globator* Sensu Carter, 1859

Description: Thallus colonial; colony (coenobium) dioecious, globose; 460.0-520.0 µm in diameter; vegetative cells embedded in mucilage and interconnected by delicate cytoplasmic strands; cells ovoid, 5.5-5.8 µm in diameter; sheath confluent; chloroplast cup shaped; male colony globose with 32-64 antherozoids; female colony with oospores about 380.0-440.0 µm in diameter; oospores spherical, slight yellow, 40.0-45.0 µm in diameter.

Habitat: Pond water at Madhusudanpur, Hooghly, West Bengal in India

Collection no.: NH 647; **Dated:** 18.04.10

Ecological note: The alga was phytoplanktonic, free floating and swimming in water, green dots like appearance in the water body at periphery.

Limnological parameters: At the time of algal collection, water sample was collected from the above site and some physico-chemical parameters were analyzed. Here, the result of this study was given. Water temperature: 30.0ºC; pH: 7.5; NO_3-N: 0.2 mg/l; PO_4^{3-}: 0.32 mg/l; DO: 6.2 mg/l; COD: 160.0 mg/l; TDS: 172.0 mg/l; total alkalinity: 174.0 mg/l; total hardness: 168.0 mg/l; chloride: 42.0 mg/l.

Threats: Anthropogenic activities and increasing level of water pollution were found major threats for disappearance or demolish of this algal species.

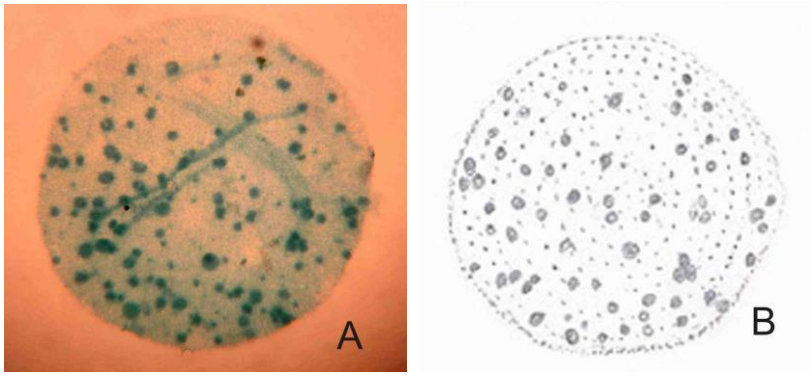
Significances: It plays significant role as primary producer in water body and used as food for zooplanktons and fishes.

Present status: The alga is sporadic in occurrence in this locality of West Bengal. During the systematic survey of the order Volvocales in 2010, the authors collected the algal sample from only the above mentioned spot in Hooghly district, West Bengal but in the second time attempt, this species were not found from that site.

Indian Distribution

It is cosmopolitan in India in respect of distribution. Previously, the taxon was reported from several places of India like Maharashtra: Bombay (Mumbai) and Poona (Pune) cities, Tamil Nadu: Madras (Chennai), Uttar Pradesh-Lucknow, Gujarat: Ahmedabad and Orissa: Ganjam district.

The occurrence and diversity of green algae in aquatic systems are influenced by the physico-chemical and biological characteristics of the water (Bellinger and Sigee, 2010). Hence, the analysis of some limnological parameters had been carried out and the result was given above. At the time of algal collection, temperature and dissolved oxygen values were recorded as 30ºC and 6.2 mg/l, respectively. Increased temperature and higher dissolved oxygen favoured the periodicity of green algae (Venkateswarlu, 1969). This was found to be true in this investigation. Besides these, higher COD, total alkalinity and total hardness values were observed that indicated presence of some organic loads in this water body. On the other hand, nitrate -nitrogen and phosphate levels were recorded lower in terms of nutrition status. At low concentration of nitrate green algae were found abundant (Zafar, 1964). The present study confirmed this argument. Alkaline pH was helpful for phytoplankton growth (Agale *et al*., 2013). The present result also supported this opinion because authors also recorded pH as 7.5 which was moderately alkaline. Therefore, in addition to taxonomic information the present work documented some other valuable information that can enhance our knowledge of Volvocales members.



150µ

Figs. A- B

Plate-1: Fig: A, Microphotograph of *Volvox carteri*; B, Diagrammatic view of the taxon

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