

**Original Research Paper** 

**Open Access** 

# First Identification of the Chlorophyte Algae *Pseudokirchneriella subcapitata* (Korshikov) Hindák in Lake Waters of India

## Vidya Padmakumar and N. C. Tharavathy

Department of Studies and Research in Biosciences, Mangalore University, Mangalagangotri, Mangaluru-574199, Dakshina Kannada, Karnataka, India

Nat. Env. & Poll. Tech. Website: www.neptjournal.com

Received: 13-06-2019 Accepted: 23-07-2019

Key Words:

Bioindicator Ecotoxicology Lakes of India *Pseudokirchneriella subcapitata* 

# ABSTRACT

The species *Pseudokirchneriella subcapitata* is a freshwater microalga belonging to Chlorophyceae. It is one of the best-known bio indicators in eco-toxicological research. It has been increasingly prevalent in many fresh water bodies worldwide. They have been since times used in many landmark toxicological analyses due to their ubiquitous nature and acute sensitivity to substances. During a survey of chlorophytes in effluent impacted lakes of Attibele region of Southern Bangalore, *Pseudokirchneriella subcapitata* was identified from the samples collected from the Giddenahalli Lake as well as Zuzuvadi Lake. This is the first identification of this species in India. Analysis based on micromorphology confirmed the status of the organism to be *Pseudokirchneriella subcapitata*.

## INTRODUCTION

*Pseudokirchneriella subcapitata* was previously called as *Selenastrum capricornatum* (NIVA-CHL 1 strain). But according to Nygaard & Komarek et al. (1986, 1987), this alga does not belong to the genus *Selenastrum* instead to *Raphidocelis* (Hindak 1977) and was renamed *Raphidocelis subcapitata* (Korshikov 1953). Hindak in 1988 made the name *Kirchneriella subcapitata* Korshikov, and it was his type species of his new Genus *Kirchneria*. But by the year 1990, Hindak realized that the name *Kirchneria* had already been in use for two other botanicals and hence further modified the name to *Pseudokirchneriella subcapitata*. Therefore, the species hence was correctly renamed as *Pseudokirchneriella subcapitata* (Korshikov) Hindak.

Though ubiquitous, this species has been recorded only in recent national and state lists which employed extensive analyses and hence a general indication of the distribution as *Pseudokirchneriella subcapitata* states its presence in Europe: Netherlands (Veen et al. 2015), Scandinavia, Slovakia, Spain and Korea (Cambra Sanchez et al. 1998).

*Pseudokirchneriella subcapitata* is a crescent shaped/ sickle shaped unicellular alga with an approximate 40-60  $\mu m^3$  in dimension. It belongs to the class Chlorophyceae (green algae).

#### **Classification:**

Empire:	Eukaryota
Kingdom:	Plantae
Subkingdom:	Viridiplantae
Infrakingdom:	Chlorophyta
Phylum:	Chlorophyta
Subphylum:	Chlorophytina
Class:	Chlorophyceae
Order:	Sphaeropleales
Family:	Selenastraceae
Genus:	Pseudokirchneriella

It has a uniform morphology and does not form chains. Colonies formed are non-mucilaginous with 4-16 cells forming matrix attaching their dorsal sides to each cell. Each cell has a single chloroplast. It is an extremely sensitive species which acts as a bio indicator detecting toxins and nutrient levels in extensively minute quantities. Hence it is considered one of the most important organisms in bioassays of water quality, algecides and environmental assessments. It has an exponentially high growth rate allowing large quantities to be grown in limited period of time (Guiry & Guiry 2017).

In March 2018, a water sample was collected from the

Lake Giddenahalli, and Lake Zuzuvadi, as part of algal diversity studies and water quality assessment in fresh water lakes of Tamil Nadu-Karnataka border zones of the south end of Bangalore region. The dominant species in both the samples collected were identified and confirmed as *Pseudokirchneriella subcapitata* by micro morphological analyses. The discovery of this species in fresh water samples in India is the first reported occurrence.

# MATERIALS AND METHODS

Lake Giddenahalli (Fig. 1) is a shallow (4 ft max depth) oligotrophic lake in the Attibele region of Karnataka (12.7825°N, 77.7593°E). It is surrounded by industries that produce bulk drugs and plastics. It is a lake with a circumference of approximately 900 meters facing the Hosur-Bangalore National Highway No. 7 on one side.

Lake Zuzuvadi (Fig. 2) is a eutrophic lake located in the Hosur district of Tamil Nadu (12.7706°N, 77.7817°E). It is also located amidst a set of industries at the Sipcot Industrial area (Phase 2). It has a circumference of 1.9 kms with one side of the lake facing the residential villa colony 'Upkar Royal Gardens'.

A two-litre sample of water from both the lakes collected during March 2018, using a 100  $\mu$  plankton net as part of algal diversity studies and water quality assessment of the freshwater lakes in the area. The samples collected were allowed to settle and the 200 mL of concentrated settled subsample was separated and preserved in Lugol's Iodine solution for identification of algae.

Enumeration of the algae along with the morphological studies were done using an Olympus microscope at 40x and 100x and Utermohl's settling chamber at 200x magnification for abundance was used.

*Pseudokirchneriella subcapitata* was noted to be found in abundance compared to other algae and hence came into immediate notice due to its unique morphological characteristics.

Further isolation of the algal species was done using Agar plating technique for studies on micromorphology and to establish correct identity documentation of the discovered species.

## RESULTS

The concentration of the algae *Pseudokirchneriella subcapitata* in the samples collected in March 2018 from the lake Giddenahalli and Zuzuvadi was  $6.3 \times 10^5$  cells/mL and  $5.4 \times 10^5$  cells/mL respectively. The strain obtained from both the lakes confirmed to species descriptions suggested from natural populations as explained by Hindak (1990).

The observed micro morphological characteristics that pertained for confirmation of the species type included the following: Unicellular and solitary species-forming nonmucilaginous colonies (few-celled clusters) during cell



Fig. 1: Lake Giddenahalli - An overview.



Fig. 2: Lake Zuzuvadi - An overview.



Fig. 3: The alga Pseudokirchneriella subcapitata.

division occasionally. Cells are helical shaped with semi circularly curved during the vegetative phase twisting one and half turns. The diameter of the 154-360° arc ranges from 4.8-10.8 $\mu$ m, width from 1.6-4.4 $\mu$ m and depth/width ratio being 1.7-4.1 (Fig. 3). The chloroplast is parietal, devoid of pyrenoid. Reproduction is generally by division of the mother cell into 2, 4 and 8 autospores (Nygaard & Komarek 1986). It is often described as a common species in planktonic environments representing both oligotrophic and eutrophic fresh water ecosystems (Vigneault & Campbell 2005).

## DISCUSSION

This study has been successful in providing micro morphological clarifications for the presence of *Pseudokirchneriella subcapitata* in the freshwater lakes of the Indian Subcontinent. It is seen to be a ubiquitous species but still has received only recent mentions in National as well as State lists of few countries. It has been recorded in the Netherlands by Veen et al. (2015) and Slovakia, Scandinavia, Spain and Korea by Cambra Sanchez et al. (1998), which are a few to mention. Studies on different lakes in many other countries have led to

the mention of the species in national and state level lists that are issued in public interest in many countries.

This species has been of wide use in eco toxicological studies and algal toxicity tests. Records of the Karnataka Biodiversity Board and the authorities were referred for clarification and establishment of this work being the first identification of occurrence of the algae in Indian fresh water ecosystems.

Over the last decade, large number of works has been done on aquatic eco toxicity using the species and has been discovered in many lakes across countries growing especially in oligotrophic and eutrophic lakes and hence being bio indicators.

Micro morphological data observed in this study clearly suggest that it is *Pseudokirchneriella subcapitata*. This is the first report of the organism in India. Since the species is not been mentioned in the standard checklists published by the state as well as central Biodiversity board, it is plausible that the species was either left unidentified or misidentified.

Increased taxon sampling from other parts of India is necessarily needed to elucidate the presence and distribution of the species in the country. Further research and investigations on the genetic and phylogenetic diversity needs to be conducted in future.

## REFERENCES

- Cambra Sanchez, J., Alvarez Cobelas, M. and Aboal Sanjurjo, M. 1998. Floristic and bibliographic list of chlorophytes (Chlorophyta) of the Iberian Peninsula, Balearic Islands and Canary Islands. Spanish Association of Limnology, Burgos.
- Guiry, M.D. and Guiry, G.M. 2017. Algaebase, world-wide electronic publication. Galway: National University of Ireland, Retrieved from https://www.algaebase.org
- Hindak, F. 1977. Studies on the Clorococcal algae (Chlorophyceae) I Biologicke Prace 6. XXIV, Bratislava.
- Hindak, F. 1988. Contribution to the taxonomy of some Cyanophyte genera. Preslia, 60: 289-308.
- Hindak, F. 1990. Studies on the Chlorococcal algae (Chlorophyceae). V Biologicke Prace, 36: 1-227.
- Korshikov, O.A. 1953. Viznachnik prisnovodnihk vodorostey Ukrainsykoi RSR [Vyp] V. Pidklas Protokokovi (Protococcineae) Bakuol 'ni (Vacuolales) ta Protokokovi (Protococcales). The Freshwater Algae of the Ukrainian. (English translation by Lund, J.W.G. and Tylka, W. 1987).

Korshikov, O.A. 1987. The Freshwater Algae of the Ukranian SSR. V. Subclass Protococcineae Vacuolales and Protococcales. Bishen Singh Mahendra Pal Singh, Dehradun and Koeltz Scientific Books, pp. 412.)

Nygaard, G. and Komarek, J. 1986. Opera Botanica, pp. 90. Nygaard, G. and Komarek, J. 1987 Opera Botanica, pp. 46.

- Veen, A., Hof, C.H.J., Kouwets, F.A.C. and Berkhout, T. 2015. Rijkswaterstaat Waterdienst, Informatihuis Water [Taxa water management the Netherlands (TWN)].
- Vigneault, B. and Campbell, P.G.C. 2005. Uptake of cadmium by freshwater green algae: Effects of pH and aquatic humic substances. Journal of Phycology, 61-55: 41.