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ORIGINAL ARTICLE

Initial studies on Diatom Ecology at Kengeri Lake

Harini P. Aiyer and A.H. Manjunatha Reddy*
Department of Biotechnology, RV College of Engineering, Mysore Road,
Bangalore – 560059, Karnataka, India
*Author for correspondence: ahmanjunatha@rvce.edu.in

ABSTRACT
As a major contributor to primary productivity in the aquatic ecosystem, diatoms play a pivotal role in the food chain. Due to their ubiquitous nature, they are abundantly present in aquatic environments. Diatoms not only serve as excellent candidates for biodiesel production. To be able to successfully utilise them for biodiesel production, a through exploration of their ecology is required. Kengeri Lake was developed by the state forest department in 1995. This lake was studied for epiphytic Diatom flora and water quality variables. The physico-chemical parameters recorded during the study were water temperature (27.3±0.6°C), pH (7.2±0.11) and dissolved oxygen (1.8±0.21 mg/L). Diatom community structure analysis at Kengeri Lake yielded six genera with Navicula showing the most abundance.
Keywords*: Diatom ecology, Diatom community structure, epiphytic diatoms, relative abundance, lakes*

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INTRODUCTION

Microalgae have attracted significant interest with respect to biodiesel production. More than half of the total primary production at the base of the food chain worldwide is accounted for by micro algae [1]. Over 200,000 species of microalgae have been identified [2]. The phytoplankton in aquatic systems have been subjected to various ecological studies to enable us to harvest them efficiently. Diatoms, popularly known as the Jewels of the Plant Kingdom, are microalgae belonging to Division Heterknotophyta and Class Bacillariophycophyta, They are a significant taxonomic group in the global carbon cycle and account for approximately 15% of the Earth's net annual primary production. Moreover, they control pathways of carbon flow via the formation of dominant species.

Diatoms are believed to have arisen around 200 million years ago following a secondary endosymbiotic event between a red eukaryotic alga and a heterotrophic flagellate [3]. Diatoms, derived from the Greek word *diatomos*, meaning 'cut in half' is an allusion to their signature cell wall or frustule, which is made up of two large intricately sculptured units called valves, that are uneven in size and fit together like a Petri dish.

Diatoms are an extremely rich species group, including over 450 genera of diatoms with over 100,000 species [4,5,6] that are subdivided into two orders- The Centrals and the Pennales. Centric Diatoms, eg: Cyclotella, are round with radial symmetry and have valve striae in relation to a point while Pennate are long, thin ellipses; bilaterally symmetrical, with valve striae in relation to a line. The Pennate diatoms may or may not possess raphe depending on their motility.

Ecology

Diatoms are either solitary or colonial in occurrence with a cosmopolitan distribution [7] in aquatic habitats that vary from marine to freshwater on a variety of aquatic substrates such as silt or mud (epipelic assemblages), sand (epipsammic assemblages), submerged plants (epiphytic assemblages) and on stones or pebbles (epilithic assemblages). Occasionally they are observed on animals as epizoic assemblages[5] as well as endosymbionts in dinofagellates and foraminifers [8]. This ubiquity can be characterised by their adaptability, distribution, biomass and relative antiquity [9].

Productivity

Diatoms are one of the most successful contemporary groups of photosynthetic eukaryotic micro-organisms. Diatoms are normally brownish or yellowish in colour due to the presence of chlorophyll A, chlorophyll C and carotenoid fucoxanthin, in the plastids. They pigments assist photosynthesis and improve the supply of oxygen. They have influenced the global climate by changing the flux of atmospheric carbon dioxide into the oceans. They have global significance in biogeochemical cycles, and provide 20–25% of globally fixed carbon and atmospheric oxygen [10]. Diatoms are also a dominant group of marine phytoplankton and constitute the base of the food web as they account for approximately 40% of oceanic primary productivity and over 50% of organic carbon burial in marine sediments [11]. Annually, diatom photosynthesis in the sea generates approximately as much organic carbon as all the terrestrial rainforests combined. However the organic carbon produced by diatoms is subjected to rapid consumption. In open oceanic systems, a considerable portion of this organic carbon rapidly sinks from the surface, thus serving as a food source for deep-water organisms as well [12]. Thus, it is essential to obtain a more sound understanding of how changes in diatom diversity could affect the dynamics of primary production and CO_2 uptake[13].

A thorough analysis of diatom community structures will behove our understanding of their ecology. This will in turn open new avenues to harvest diatoms to benefit humankind.

MATERIALS AND METHODS

Study site

The study was conducted at Kengeri Lake, Bangalore: 12°54'57.05"N and 77°29'16.58" E (Figure 1). Kengeri Lake also known as Doddakere, is located in the south of Bangalore on the outer ring road, towards Mysore-Bangalore State Highway. Recreation facilities such as boating have been provided. These however, may increase the risk of anthropogenic waste.

Figure 1. Kengeri lake, Mysore road, Bangalore
Source: Google earth

Sample Collection

Epiphytic diatom samples were collected from water hyacinth. Following the protocol based on the method of Taylor *et al.* [19], 100 ml of concentrated diatom sample was collected. One litre of water sample was collected in non-reactive plastic bottles for water quality analysis. The samples were brought to the laboratory for further analysis in undisturbed condition. Preservation and enumeration of the diatoms were done following Karthik *et al*. [24].

Physico - Chemical Analysis of water

Temperature, pH, of the water sample was taken on site with the help of suitable instruments (Table 1). Water sample was collected for further analysis of Dissolved oxygen by using standard protocols.

Table.1. Mode of Measurement of Physico-Chemical parameters

Parameter	Method	Site of Measurement
pH	pH strips	In-situ
Temperature (°C)	Thermometer	In-situ
DO (mg/ml)	Winkler Iodometric	Laboratory

Community Structure Analysis

The diatoms were identified under the microscope using 100 X magnifications. For clearer view of the diatoms, the debris is discarded by centrifuging the sample obtained. Then the supernatant was focused under the microscope to identify different species of diatoms. With the help of a pipette samples were mounted on the slide and observed under microscope. Based on the structure and morphology of the diatoms, they are identified using standard manuals.

The percentage relative abundance was calculated using the following formulae:

$$\text{Relative abundance} = \frac{\text{Abundance of individual species}}{\text{Total abundance of the cells}} \times 100$$

RESULTS AND DISCUSSION

The samples were observed under the compound binocular microscope and found to have diversified diatom flora. Hence, 20µl of the sample was observed under the microscope and their relative abundance was calculated (Table 3). The physico-chemical parameters recorded during the study were represented in Table.2.

Table.2. Physico- chemical parameters recorded in the lake

Parameter	Value
pH	7.2±0.11
Water Temperature	27.3±0.6°C
Dissolved oxygen	1.8±0.21 mg/L

Table 3. Relative abundance of diatoms at Kengeri Lake.

Sl.No	Nomenclature	Relative abundance (%)
1.	Synedra	5.32
2.	Diatoma	16.49
3.	Nitzchia	6.38
4.	Gomphonema	3.19
5.	Navicula	65.96
6.	Encyonema	2.66

Six genera of diatoms were observed at the Kengeri Lake. A majority of the cells belonging to Navicula and Nitzschia appeared to be filled entirely with oil. These species have shown high levels of lipid accumulation [21-23]; this would render them suitable candidates for biodiesel production. Providing the congenial environment in situ will augment the production of oil and subsequently biodiesel from the lake.

REFERENCES

1. Guschina I.A, and J.L. Harwood. (2006). Lipids and lipid metabolism in eukaryotic algae. *Progress in Lipid Research*; 45:160-186.
2. Richmond, A. (2000). Microalgal biotechnology at the turn of the millenium: A personal view, *Journal of Applied Phycology* 12: 441–451.
3. Medlin, L. K.; Kooistra, W.; Gersonde, R.; Sims, P. A.; Wellbrock, U. (1997). Is the origin of the diatoms related to the end-Permian mass extinction. *NoVa Hedwigia*, 65: (1-4), 1–11.
4. Werner D. (1966). Die Kieselsaure im stoffwechesel von cyclotella crypotica Reimann, Lewin and Guillard. *Arch. Mikrobiol*, 55: 278-308
5. Round, F. E.; Crawford, R. M.; Mann, D. G.(1990) *The Diatoms, Biology& Morphology of the Genera*; Cambridge University Press: Cambridge,U.K.,
6. Fourtanieur, E., Kociolek, J. P., (1999). Catalogue of the Diatom Genera. Diatom. Res. 14: 1-190
7. Meenakshi Singh, Payal Lodha, Gajendra Pal Singh and Rajesh Singh. (2011). Studies on diatom diversity in response to abiotic factors in Mawatha lake of Jaipur, Rajasthan. International Journal of Life Science and Pharma Research. 1(1): 29-37.
8. Marleen De Troch, Vergaerde, Clio Cnudde, Pieter Vanormelingen and Magda Vincx. (2011). The taste of diatoms : the role of diatom growth phase characteristics and associated bacteria for grazing by the harpacticoid copepod Microarthridion littorale, Marine Biodiversity, 2nd World conference, Abstracts.
9. Werner, D. E. (1977). The Biology of Diatoms. Botanical Monographs 13. Blackwell Scientific Publications, 498 pp.
10. Mann, A. (1916). The economic importance of the diatom. *Ann. Rept.Smithsonian Inst.*, 386–397.
11. Daniel L. Rabosky and Ulf Sorhannus. (2009). Diversity dynamics of marine planktonic diatoms across the Cenozoic. *Nature*. 457: 183-186.
12. Armbrust, E. V.; Berges, J. A.; Bowler, C.; Green, B. R.; Martinez, D.; Putnam, N. H.; Zhou, S.; Allen, A. E.; Apt, K. E.; Bechner, M.; Brzezinski, M. A.; Chaal, B. K.; Chiovitti, A.; Davis, A. K.; Demarest, M. S.; Detter, J. C.; Glavina, T.; Goodstein, D.; Hadi, M. Z.; Hellsten, U.; Hildebrand, M.; Jenkins, B. D.; Jurka, J.; Kapitonov, V. V.; Kro¨ger, N.; Lau, W. W.; Lane, T. W.; Larimer, F. W.; Lippmeier, J. C.; Lucas, S.; Medina, M.; Montsant, A.; Obornik, M.; Parker, M. S.; Palenik, B.; Pazour, G. J.; Richardson, P. M.; Rynearson, T. A.; Saito, M. A.; Schwartz, D. C.; Thamatrakoln, K.;

Valentin, K.; Vardi, A.; Wilkerson, F. P.; Rokhsar, D. S. (2004) The genome of the diatom *Thalassiosira pseudonana*: Ecology, evolution, and metabolism. *Science*, 306 (5693): 79–86.

13. Ward, B. B. (2008). Phytoplankton community composition and gene expression of functional genes involved in carbon and nitrogen assimilation. *Journal of Phycology* 44: 1490-1503
14. Khan, S.A., Rashmi, M.Z. Hussain, S. Prasad and U.C. Banerjee, (2009). Prospects of biodiesel production from microalgae in India. *Renew.Sust. Energ. Rev.*, 13: 2361–2372
15. Fukuda, T., Kato-Murai, M., Suye, S.I., Ueda, M., (2007). Development of high-throughput screening system by single-cell reaction using micro chamber array chip. *J. Biosci. Bioeng.* 104: 241–243.
16. Timothy P. Durrett1, Christoph Benning and John Ohlrogge. (2008). Plant triacylglycerols as feedstocks for the production of biofuels. *The plant journal*, 54(4): 593-607.
17. Mansour M.P., Volkman, J.K., Jackson, A.E. and Blackburn, S.J. (1999). The fatty acid and sterol composition of five marine dinoflagellates. J. Phycol., 35: 710-729.
18. Schiebel, R., Zeltner, A., Treppke, U. F., Waniek, J., Bollmann, J.,Rixen, T., and Hemleben, C. (2004). Distribution of diatoms, coccolithophores and planktic foraminiferes along a trophic gradient during the SW monsoon in the Arabian Sea, Marine Micropaleontology, 51: 345–371,
19. Taylor, J. C., Prygiel, J, Vosloo, A., Rey, P. A., d. l., and Rensburg, L., v. (2007). Can diatom-based pollution indices be used for biomonitoring in South Africa? A case study of the Crocodile West and Marico water management area. *Hydrobiologia*, 592: 455–64.
20. APHA (2005). Standard methods for examination of water and wastewater (17th ed.). Washington DC, USA: APHA, AWWA, WPCF.
21. Lee Seung-Hong Karawita, Rohan, Affan, Abu, Lee, Joon-baek Lee, Ki-wan Lee, Bae-jin Kim, Dong-woo Jeon, You-Jin. (2009). Potential of *Acnanthes longipes* and *Amphora coffeaeformis* and Navicula sp. (Bacillariophyceae) as Antioxidant Sources, 24(1): 47–55.
22. Sanjay, K. R., N, N. P. M., Anupama, S., Yashaswi, B. R., & Deepak, B. (2013). Isolation of diatom *Navicula cryptocephala* and characterization of oil extracted for biodiesel production,7(January), 41–48. doi:10.5897/AJEST12.066
23. Anderson, R., B. P. Livermore, M. Kates, and B. E. Volcani. (1978). The lipid composition of the non-photosynthetic diatom *Nitzschia alba*. *Biochimica et Biophysica Acta (BBA)-Lipids and Lipid Metabolism*. 528(1): 77-88.
24. Karthick B., Jonathan Charles Taylor, Mahesh M.K. and Ramachandra T V. (2010). Protocols for collection, preservation and enumeration of diatoms from aquatic habitats for water quality monitoring in India. *The ICFAI University Press.* 3(1).

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