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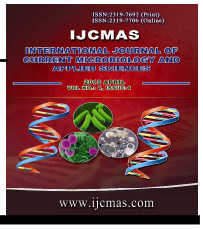

Original Research Article

Microalgal diversity of Parthasarathy temple tank, Chennai, India

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A B S T R A C T

India is one of the richest nations in terms of Biological diversity. Biological wealth is essential for economic development of a country. Biodiversity study is lagging behind in recent times. A comprehensive data of phytoplankton diversity of the water bodies is lacking in India. Biodiversity study of phytoplanktons has become the need of the hour. It will help in documenting the microalgal data and augmenting our biological wealth. India has a very rich variety of aquatic habitats. Every temple in India has a pond associated with it. Ponds are fresh water habitats classified under lentic ecosystem. Algae are aquatic plants with high potential. Pond ecosystem has a rich microalgal diversity with other aquatic organisms. The microalgal diversity study was conducted in Parthasarathy temple pond, Chennai, India. It showed a rich diversity of phytoplanktons. About 67 species from 31 genera of microalgae were identified in the study. The physico-chemical analysis of the temple tank water showed its suitability for the presence of diverse microalgae.

Keywords

Phytoplanktons, Biodiversity, Microalgae, Lentic ecosystem, Genera

Introduction

The number of species of plants, animals and microorganisms, the enormous diversity of genes in these species, the different ecosystems on the planet, such as deserts, rainforests and coral reefs are all part of a biologically diverse earth (1). Biodiversity includes the genetic diversity, species, populations, communities and ecosystems, provides countless benefits to humans. It provides man with economic and aesthetic benefits, scientific knowledge, etc.

According to Conservation International and the United Nations Environment Program's World Conservation Monitoring Centre there are 17 mega-diverse countries in the world. India is one among those 17 most biodiversity-rich countries in the world. India being a sub-continent has all kinds of ecosystem in it. It has diverse aquatic habitats in it with rich biodiversity. It consists of both fresh water ecosystems like rivers, lakes, ponds, temple tanks, streams and hot springs and coastal ecosystem.

Temple tanks are usually attached to temples. They play an important role in recharging of groundwater. At present, Tamilnadu has 2359 temples tanks (2). The Temple tanks along with the sacred trees and Sacred Groves are the three most important ecological traditions of South

India that have played a significant role in the protection and preservation of the environment (3). Each village in South India is associated with a temple, and each temple with a tank. The temple tanks are considered to be sacred, due to the reverence shown by the devotees. The temple tanks serve multiple purposes. The water is used for religious purposes, ritual baths and the annual float festival, and also for the all important task of water harvesting.

Temple tanks are examples of pond ecosystem. It has its own biotic and abiotic components. It is rich in flora and fauna like any other freshwater ecosystem. Phytoplanktons play an important role as producers of this ecosystem. The microalgae population is enormous in temple tanks.

Algae represent a large group of organisms representing many taxonomic divisions. Algae are photosynthetic organisms that include prokaryotes (Cyanobacteria) and unicellular and multicellular eukaryotes. A precise definition of the group is elusive; they share many obvious characteristics with higher (land) plants, whereas their distinguishing features from other plant groups are varied and more subtle (4). Microalgae are the photosynthetic organisms in the first levels of the aquatic food-chains, on which an ever growing part of our food will have to come from. Our challenge is to domesticate these plants, as we have done with higher plants, to allow us to manage their large scale production for a wide range of applications, including feeds.

Algae commonly grow in fresh water and seawater, and several species grow in extremely high-salt environments, such as the Great Salt Lake, Utah, and the Dead Sea, in Israel. Algae also grow in soils, inside rocks, in snow fields, and in more exotic locations, such as the fur of sloths and polar bears. Finally, algae can either be free living or exist in association with other organisms (Lichens). They possess chlorophyll and can manufacture their own food through the process of photosynthesis. Algae have been estimated to include anything from 30000 to more than 1 million species (5).

Algae perform roughly 50% of the photosynthesis on this planet (6) and thus are instrumental in supporting the biosphere. The phytoplankton community is extremely important for the open sea environment, as it contributes most of the organic carbon available to pelagic food chains (7).

Commercial products are obtained from macroalgae for a very long time. The products include Agar, Carrageenan, Alginate, Diatomaceous earth, etc. Using macroalgae as food is from time immemorial. Microalgae are an important source of vitamins, minerals, proteins, polyunsaturated fatty acids, antioxidants, etc. (8, 9). Edible oils from microalgae rich in some PUFAs are suitable for children, pregnant women, vegetarians and patients with fish allergies.

Microalgae and Cyanobacteria, until recently in oblivion, uncared for and unrecognized, have shot into fame and popularity owing to a host of their innate properties that make them ideal organisms for use in a variety of ways to meet our needs and to promise us a bright future (10). The high protein content of various microalgal species is one of the main reasons to consider them as an unconventional source of proteins, and as microalgae are capable of synthesizing all amino acids, they can also be a source of the essential ones. Moreover, the average quality of most examined algae is equal, sometimes even superior in comparison to conventional plant proteins (11). Already

many microalgae are been used as single cell protein. *Spirulina* is the most dominating species among the microalgae used as single cell protein.

Microalgae can play an important role in the future. Microalgae are a potentially great source of natural compounds, which could be used as functional ingredients (9). They are one of the potential sources of foods and feeds provided by Nature with the potential to feed an ever growing and affluent population. Microalgae possess many unique and interesting biochemical properties that are playing an increasingly important role in many aspects of daily lives from nutrition through to energy production (12). Beside the nutritional improvement that microalgae incorporation in feeds versus higher plants may bring to animals health, they are the only biomass material that allows production with daily harvest all year round. This could bring more security of supply on raw materials to the feed market. They also possess advantages in terms of productivity, are very similar regarding photosynthetic efficiency and may be cultivated in non-arable areas.

Microalgae are being suitable for extraction of many commercial important products. Identifying and cultivating microalgae becomes very important. Biodiversity study of microalgae in various aquatic and terrestrial habitats is the need of the hour. The present study is concerned with species diversity of algae. It includes documenting the number of species in a temple pond in Chennai.

Materials and Methods

The present study area was Parthasarathy temple tank, Chennai, India. Parthasarathy temple is an 8th century Hindu Vaishnavite temple built by King Narasimhavarman I. The name of the area in which the pond is present is called as Triplicane. It owes its name to its historic existence as *Tiruvallikeni* or *Tiru-Alli-Keni* (Sacred Lily Pond, in Tamil) denoting the pond in front of the temple. The geographic coordinates of this temple pond is 13.05°N 80.28°E.

The study was done for six months from November 2013 to April 2014. The samples were collected twice a month. The water samples were collected randomly from different spots in pond.

The water sample was collected from the pond. The water was collected using a plastic water jug by scooping up the water from the pond surface. The water sample was immediately fixed with 4% formalin-pond water solution in glass jars. It was brought to the laboratory immediately and was observed under light microscope for identifying microalgae. The study was performed for six months periodically. The physico-chemical parameters of the pond water was also analysed in Tamil Nadu Water Supply and Sewerage Board.

Microalgae present in collected water samples were observed using compound light microscope. Species identification of microalgae was made by placing a drop on a glass slide. The microalgal cultures were microscopically examined using Olympus (HB) microscope and microphotographs were taken using Nikon digital camera (Coolpix E8400). Microalgae identification was done with the aid of standard books and monographs. (13, 14, 15). Internet resources were also used for identification.

Result and Discussion

The species identification revealed that there was very high diversity of microalgae in the study area. There was very high number of

green algae followed by Blue green algae and a Diatom. Green algae dominated with 60 species followed by blue green with six species and one diatom (Table -1).

Microalgae studied in the pond had 63 species under 37 Genera. About 56 species were representatives of Green algae under 30 Genera. The number of species of *Scenedesmus* was high and it was represented by 12 species. It is followed by *Tetraedron* represented by eight species. *Cosmarium* was represented by four species. Three species of *Pediatrum* was identified. *Micractinium*, *Kirchneriella*, *Ankistrodesmus*, *Tetrastrum*, *Dictyosphaerium* and *Schroederia* had a representation of two species. Blue green algae were represented by six genera. Only one species of diatom was identified.

Algae are the primary producers of the aquatic ecosystem, an area that covers 71% of the Earth's surface. Algae occur in oceans, lakes, ponds and streams as well as on and in soil, rocks, ice, snow, plants and animals. In total, 40% of global photosynthesis is contributed by algae. These are at least seven distinct phylogenetic lineages that arose independently during geological time and that evolved at different rates (based upon molecular clocks). Consequently, the algae *in toto* do not form a single, cohesive group, and they must be considered a polyphyletic assemblage.

Algae being a vital group of plants in aquatic ecosystem are important component of biological monitoring programs for evaluating water quality. They are suited to water quality assessment because of their nutrient needs, rapid reproduction rate and very short life cycle. Algal community variability over time can result from seasonal changes in temperature and light availability (Biggs, 1996). Microscopic analysis of water samples collected from lakes, streams and other bodies determines the diversity and density of algal species and provides potentially useful early warning signs of deteriorating conditions.

With respect to the total number of described species worldwide the best source of information is provided by (16). He has used a mixture of databases and expert opinion to come up with a figure of 1.9 Million species (17). Among 1.9 Million described species, the number of described algae should be analysed. Most of the reliable estimates of algal species, such as (16) and the (18) relied on AlgaeBase for their figures. So we should look for the current numbers there (as of June 2012). AlgaeBase list shows that the total number of algal species described up to June 2012 is 43918. Around 28618 more is identified but yet to be described. About totally there are 72536 algae identified till date.

Microalgal diversity study of algae not only provides an opportunity to unearth the new species existing in this world. It also helps in culturing few species and finding its biochemicals and finding its commercially importance. High value biochemicals from micro-algae comprise of β-carotene, astaxanthin, vitamins, amino acids, antioxidants, polyunsaturated fatty acids (PUFAs) and polysaccharides which form an important commercial market (19).

Table.1 List of microalgae identified from Parthasarathy temple pond

S.No.	Species	S.No.	Species
Cyanobacteria (Blue green algae)		34	*Pediastrum simplex*
1	*Anabaena sp*	35	*Phacus sp*
2	*Arthrospira platensis*	36	*Pseudotetradesmus sp*
3	*Coelosphaerium sp*	37	*Scenedesmus acutus*
4	*Microcystis sp*	38	*Scenedesmus arcuatus*
5	*Merismopedia sp*	39	*Scenedesmus armatus*
6	*Oscillatoria sp*	40	*Scenedesmus bernardii*
Chlorophyta (Green algae)		41	*Scenedesmus denticulatus*
7	*Ankistrodesmus falcatus*	42	*Scenedesmus dimorphus*
8	*Ankistrodesmus sp*	43	*Scenedesmus insignis*
9	*Botryococcus sp*	44	*Scenedesmus javanensis*
10	*Carteria sp*	45	*Scenedesmus maximus*
11	*Chlamydomonas sp*	46	*Scenedesmus obliquus*
12	*Chlorella sp*	47	*Scenedesmus quadrispina*
13	*Chlorococcum sp*	48	*Scenedesmus sp*
14	*Closterium sp*	49	*Schroederia planktonica*
15	*Closterium venus*	50	*Schroederia setigera*
16	*Cosmarium contractum*	51	*Selenastrum sp*
17	*Cosmarium depressum*	52	*Staurastrum sp*
18	*Cosmarium quadrifarium*	53	*Tetradesmus sp*
19	*Cosmarium sp*	54	*Tetraedriella sp*
20	*Crucigenia sp*	55	*Tetraedron arthrodesmi forme*
21	*Dictyosphaerium pulchellum*	56	*Tetraedron minimum*
22	*Dictyosphaerium sp*	57	*Tetraedron muticum*
23	*Euglena sp*	58	*Tetraedron regulare*
24	*Golenkiniopsis sp*	59	*Tetraedron sp*
25	*Kirchneriella contorta*	60	*Tetraedron triangulare*
26	*Kirchneriella lunaris*	61	*Tetraedron trigonum*
27	*Korshikoviella sp*	62	*Tetraedron trilobulatum*
28	*Micractinium pusillum*	63	*Tetraspora sp*
29	*Micractinium sp*	64	*Tetrastrum punctatum*
30	*Monoraphidium sp*	65	*Tetrastrum staurogeniaeforme*
31	*Pandorina sp*	66	*Treubaria sp*
32	*Pediastrum duplex*	Bacillariophyta (Diatoms)	
33	*Pediastrum ovatum*	67	*Nitzschia sp*

Microalgal research has many advantages as they have the ability to convert CO2 to useful materials through photosynthesis. Microalgae are used as single cell protein as food supplement. They are used as human nutritional supplements, as animal feed additives, in aquaculture, and in cosmetics. It is used by astronauts during space travel. Microalgae are tapped as a source for useful secondary metabolites.

Recently, algae have been associated with regulating environmental pollution. These can help in removing pollutants from the surroundings, restoring contaminated sites and preventing further pollution.

Phycoremediation is a novel technique that uses algae to clean up contaminated soil and water. The first ever phycoremediation plant with *Chroococcus turgidus* has been working from September 2006 at SNAP industry very successfully (20).

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