

MANGROVE ASSOCIATED CYANOBACTERIAL DIVERSITY AT KOTTAYAM DISTRICT, KERALA, INDIA

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ABSTRACT: A survey on mangrove associated cyanobacterial diversity at Kottayam District has been carried out during the months October-November 2014. Certain physico-chemical parameters such as pH, salinity and temperature were analyzed and compared with the cyanobacterial diversity. 12 species of cyanobacteria were noticed which are coming under 4 families. The families Chroococcaceae and Oscillatoriaceae were mainly observed as on epiphytic organisms at mangrove plants. Dominant cyanobacterial diversity was observed on the pneumatophores of *Sonneratia caseolaris*.

Keywords: Diversity, Cyanobacteria, Mangroves, Physico-chemical parameters

1. INTRODUCTION

Mangroves are considered as highly productive ecosystems and play a very important role as the feeding and breeding areas of many organisms. Diversity of mangroves in Kottayam District is mainly continued to the places such as Kumarakom (60 hectares) and Mekkara near Vaikom Taluk (1.6 hectares).

Cyanobacterial population is the major component of the micro biota in every mangrove ecosystem and little is known regarding the mangrove associated cyanobacterial communities (Shamina *et al.*, 2014). Cyanobacteria usually colonizes in the submerged surface of sediments, roots, aerial roots and also on barks, leaves and trunks of mangroves (Kathiresan and Bingham, 2001; Nedumaran *et al.*, 2008).

Cyanobacterial biodiversity was observed mainly in two areas of Kottayam District. Mangrove associated cyanobacteria of Kerala

are not well explored and documented. There have been no reports on systematic survey of mangrove associated cyanobacterial diversity in these areas. Hence, the present investigation is aimed to study the mangrove associated cyanobacterial diversity at Kottayam District.

2. MATERIALS AND METHODS

The cyanobacterial samples were collected from the two localities such as Kumarakom (9° 36' 15.39" N, 76° 25' 53.92" E) and Mekkara near Vaikom Taluk (9° 48' 54.31" N, 76° 21' 57.54") (Figure 1) during October-November 2014. Visible and planktonic samples were collected using forceps, needles, scalpel and knives. Collected samples were transferred to the collection bottles and deposited in Plant Diversity Division, University of Calicut.

Microscopic analysis was done in the live condition for the identification of cyanobacteria. Microphotographs were taken using Leica DM 1000 LED compound microscope. Identification

of cyanobacterial specimen was done with the taxonomic publications of Desikachary (1959), Anand (1989) and Prescott (1982). Analysis of physico-chemical parameters of water such as pH, temperature, salinity was done with Oakton Multi-parameter PCS Tester 35.



Fig. 1. Map showing the study areas
(1. Kumarakom; 2. Mekkara)

3. RESULTS AND DISCUSSION

Kottayam District harbours abundant mangrove species comprising *Bruguiera sexangula*, *Bruguiera cylindrica*, *Sonneratia caseolaris*, *Excoecaria agallocha* and *Avicennia officinalis*. These species are more abundant in Kumarakom, while in Mekkara, the dominating members are *Avicennia officinalis*, *Sonneratia caseolaris*, *Excoecaria agallocha* and *Bruguiera gymnorrhiza*. Cyanobacterial species collected from mangrove areas in Kottayam District and given in the Table 1.

Totally 12 species of cyanobacteria belonging to 4 families (Chroococcaceae 3, Oscillatoriaceae 5, Nostocaceae 2, Scytonemataceae 2) were recorded. Out of the 4 families recorded, Oscillatoriaceae family showed maximum representation. Cyanobacterial species from

Mekkara mangrove area showed maximum species diversity. Detailed taxonomic description of cyanobacterial species, nature of habitat showed maximum species diversity and microphotographs are given below.

Taxonomic enumeration

1. Order: Chroococcales

Family: Chroococcaceae

Aphanocapsa roseana de Bary (Fig.2 a)

Gelatinous colony, thallus brownish green, cells 5.345 μm – 6.726 μm diameter; cells spherical-oval shaped.

Occurred as an epiphytic form on the pneumatophores of *Sonneratia caseolaris*

Locality: Mekkara

Aphanocapsa grevillei (Hass.) Rabenh. (Fig.2 b)

Thallus attached; cells greenish, spherical, 3.723 μm - 4.755 μm diameter, closely arranged in homogenous mucilage; individual envelope not distinct.

Occurred as an epiphytic form on the pneumatophores of *Avicennia officinalis*

Locality: Mekkara

Aphanothece pallida (Kutz.) Rabenh. (Fig.2 c)

Thallus gelatinous, soft, pale blue-green; cells elliptical-oblong, 5.829 μm -6.969 μm long; 2.868 μm -3.731 μm broad; sheath distinct.

Occurred as an epiphytic form on the pneumatophores of *Sonneratia caseolaris*

Locality: Mekkara

2. Order: Nostocales

Family: Oscillatoriaceae

***Oscillatoria annae* van Goor (Fig.2 d)**

Trichome straight, dull blue green, slightly constricted at the cross walls, cells 5.457 μm -5.781 μm long; 7.881 μm - 8.209 μm broad; attenuated at the ends, not granulated at the cross walls; end cell rounded.

Occurred as an epiphytic form on the stilt root of *Bruguiera gymnorrhiza*

Locality: Mekkara and Kumarakom (Benthic form)

***Oscillatoria ornata* Kutz. ex Gomont (Fig.2 e)**

Thallus dark blue green, trichome straight, uniform in thickness, constricted at the cross walls, granulated; cells 7.730 μm -8.309 μm long; 9.976 μm -10.469 μm broad; end cell rounded.

Occurred as an epiphytic form on the pneumatophores of *Sonneratia caseolaris*

Locality: Mekkara

***Oscillatoria boryana* Bory ex Gomont (Fig.2 f)**

Trichome short, straight, greenish, slightly constricted at the cross-wall, cells 6.223 μm -6.320 μm broad, slightly granulated at the cross-walls; end cells more or less rounded, not capitate; calyptra absent.

Occurred as an epiphytic form on the pneumatophores of *Sonneratia caseolaris*

Locality: Kumarakom

***Phormidium molle* (Kutz.) Gomont (Fig.2 g)**

Thallus mucilaginous, thin; trichome straight, distinctly constricted at the cross walls, not attenuated at the ends; cells 1.810-2.126 μm broad, 2.522 μm long, end cells rounded; calyptra absent.

Occurred as an epiphytic form on the pneumatophores of *Avicennia officinalis*

Locality: Mekkara and Kumarakom (Benthic form)

***Lyngbya aerugino-coerulea* (Kutz.) Gomont (Fig.2 h)**

Filaments single, sheath thin, firm; trichomes 8.808 μm long; 7.728 μm broad, not constricted at the cross walls, end cell flattened, almost rounded with slightly thickened outer membrane.

Occurred as an epiphytic form on the stilt root of *Bruguiera gymnorrhiza*

Locality: Mekkara

3. Order: Nostocales

Family: Nostocaceae

***Nostoc muscorum* Ag.ex Born. et Flah. (Fig.2 i)**

Thallus irregularly expanded, filaments yellowish brown, trichome barrel shaped, constricted at the cross walls, 4.109 μm -5.276 μm long; 4.197 μm -4.461 μm broad; heterocysts nearly spherical, 5.812 μm long; 5.620 μm broad,

Occurred as planktonic form and benthic form

Locality: Mekkara and Kumarakom

***Nostoc passerinianum* (De Not.) Bornet ex Born. Et Flah. (Fig.2 j)**

Thallus expanded, filaments densely entangled, trichomes 8.208 μm long; 5.001 μm broad, spherical; heterocysts nearly spherical, 7.928 μm long; 5.971 μm broad.

Occurred as benthic form

Locality: Mekkara

4. Order: Nostocales

Family: Scytonemataceae

Scytonema leptobasis Ghose (Fig.2 k)

Filaments false branched, 10.224 μm -12.235 μm broad, sheath thick, trichomes about 2.970 μm broad; 7.274 μm long; cells cylindrical, false branches swollen at the tips; heterocysts single, intercalary, 5.326 μm -6.134 μm broad and 8.002 μm -9.925 μm long.

Occurred as planktonic forms

Locality: Kumarakom

Scytonema bohneri Schmidle (Fig.2 l)

Thallus dark blue-green, filaments long, false branched, sheath thick, colourless, trichome bluish green, 5.831 μm -7.757 μm broad, 7.868 μm - 11.037 μm long; sheath colourless and thick; trichome blue-green, not constricted at the cross walls, cells rectangular, heterocysts intercalary, ellipsoidal to cylindrical, 11.553 μm long and 18.111 μm broad.

Occurred as planktonic form

Locality: Kumarakom and Mekkara

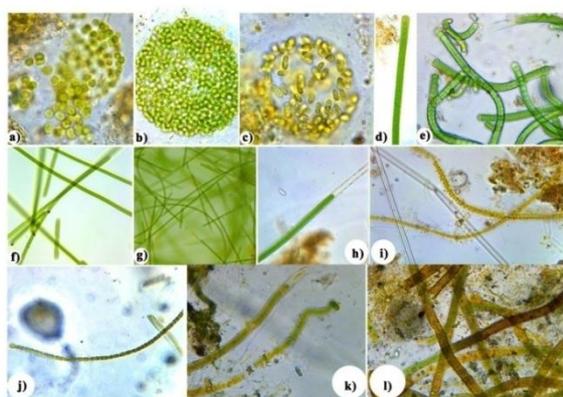


Fig.2. a) *Aphanocapsa roseana*; b) *Aphanocapsa grevillei*; c) *Aphanothece pallida*; d) *Oscillatoria annae*; e) *Oscillatoria ornata*; f) *Oscillatoria boryana*; g) *Phormidium molle*; h) *Lyngbya aeruginosa*; i) *Nostoc muscorum*; j) *Nostoc*

passerinianum; k) *Scytonema leptobasis*;
l) *Scytonema bohneri*

Table 1. Cyanobacterial diversity at different mangrove areas of Kottayam District

Sl No	Species	Mangrove areas	
		Kumarakom	Mekkara
1. Chroococcaceae			
1	<i>Aphanocapsa roseana</i>	-	+
2	<i>Aphanocapsa grevillei</i>	-	+
3	<i>Aphanothece pallida</i>	-	+
2. Oscillatoriaceae			
4	<i>Oscillatoria annae</i>	+	+
5	<i>Oscillatoria ornata</i>	-	+
6	<i>Oscillatoria boryana</i>	+	-
7	<i>Phormidium molle</i>	+	+
8	<i>Lyngbya aeruginosa</i>	-	+
3. Nostocaceae			
9	<i>Nostoc muscorum</i>	+	+
10	<i>Nostoc passerinianum</i>	-	+
4. Scytonemataceae			
11	<i>Scytonema leptobasis</i>	+	-
12	<i>Scytonema bohneri</i>	+	+

(- absence; + presence)

The families Chroococcaceae and Oscillatoriaceae were mainly observed as epiphytic organisms on mangrove plants. Maximum cyanobacterial diversity was observed on the pneumatophores of *Sonneratia caseolaris*. Out of the 4 families recorded, Oscillatoriaceae showed higher representation followed by Chroococcaceae, Nostocaceae and Scytonemataceae. Of the 12 cyanobacterial species collected in the present study, only 4 heterocystous cyanobacteria such as *Nostoc muscorum*, *Nostoc passerinianum*, *Scytonema*

leptobasis and *Scytonema bohneri* were recorded.

Number of cyanobacterial species was higher in Mekkara (10 species) than Kumarakom (6 species). Mekkara mangrove area was naturally developed and having rich cyanobacterial diversity, but the major areas of Kumarakom mangrove area was artificially developed, hence low cyanobacterial diversity was recorded.

Table 2. Physico-chemical parameters of mangrove areas

Month	Parameters	Kumarakom	Mekkara
October	Temperature (°C)	29.6	28.5
	pH	8.4	7.9
	Salinity (ppm)	283	271
November	Temperature (°C)	28.4	31.0
	pH	7.1	7.5
	Salinity (ppm)	260	263

Physico-chemical parameters of mangrove area were measured and given in the Table 2 showed, pH ranges from acidic to alkaline at Kumarakom while in Mekkara, and it is purely alkaline. But cyanobacteria can thrive well both in acidic and alkaline soil, even though it prefers to grow in alkaline soil. Acidic soils are one of the stressful environments for the growth of cyanobacteria; still certain species of *Nostoc*, *Oscillatoria* and *Scytonema* can grow well in these environments.

Since these cyanobacteria can fix atmospheric nitrogen, the occurrence of these cyanobacteria increases the nutrient content of the soil which in turn influences the growth of other planktonic organisms as well as other biota dwelling in the soil.

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