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Diversity of Saltpan Marine Cyanobacteria from Cape Comorin Coast of Tamilnadu

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Summary

Cyanobacteria are photosynthetic prokaryotes, which are found in a wide variety of habitats, namely, fresh water, marine, moist soil, saline and sodic soil as well as in thermophilic and psychrophilic conditions. In many environments, cyanobacteria are the primary producers at the base of the food web of the ecosystem such as marine water, hypersaline, brackish waters, soda lakes, freshwater, paddy fields, soils, deserts, cave walls, hot springs, polar regions and other extreme environments. Excess salt concentrations in sea water are said to be hypersaline environments. Salt pans are one of the hypersaline extreme environment exhibit wide range of environmental stress through salinity changes. The biodiversity of marine cyanobacteria were investigated in three salt pan regions such as Kovalam, Puthalam and Rajakamangalam in Kanyakumari district, Tamil Nadu, India. The cyanobacterial mats were cultivated in three different cultivation media such as ASNIII, MNIII and BG11 marine broth. Morphological characterization was done. Among the saltpan studied for cyanobacterial diversity Kovalam site showed about twelve genera of cyanobacteria such as *Oscillatoria, Lyngbya, Microcystis, Spirullina, Chroococcus* and *Calothrix* were dominant with 18 cyanobacterial species under five families were reported when compared with other two saltpan regions studied.

Key Words: Salt pan, *Oscillatoria*, Cyanobacteria, Diversity

Introduction

World is covered of 70% of water, named as lakes, rivers, seas and oceans by its salinity raised in due time. Likewise in extreme condition also arise naturally or by artificially. Salt-pans exhibits range of above 50 ppt salinity on such environments also occupied by most biotic organisms. Saltpans are one of the hypersaline environment which are man-made hypersaline shallow ponds shows high stress through the salinity changes. Among halophilic microbes, there is competitive, symbiotic and even associated interactions are seen in salt pans [1].

Cyanobacteria often called as Blue-green algae, belong to the eubacteria which utilize chlorophyll, for photosynthetic food production. It contains a wide range of habitat leads to wide biodiversity studies according to various environments [2, 3, 4]. Such cyanobacteria are the photosynthetic prokaryotes possess the tendency to help mankind in various ways such as energy fuel, food, medicine and also in bioremediation process. Recent trends of research are focusing to identify new potential organisms from its diversity which can be useful to mankind. Marine cyanobacteria show high value products and potential one [5].

Marine cyanobacterial distributions are mostly in shallow regions of sea and ocean, soft or porous rocks such as soft stones in the benthic region or simply said to be in the epipelagic zone. Such cyanobacteria are transferred to back water and estuarine regions by tides and water currents [6]. In marine, salinity is an important hydrographical factor and it showed wide spatial and temporal variations [7]. According to salinity and the location of saltpans, enrich some species of cyanobacteria. The present study covers the biodiversity of marine cyanobacteria of south western coastal saltpans of Tamil Nadu.

Material and Methods

Sample Location Area

The survey was carried out in salt pans extending from Cape of Comorin to Rajakamangalam particularly in the regions of Kovalam [8°05'03.03"N, 77°31'19.19E], Puthalam [8°06'03.91"N, 77°28'40.89E] and Rajakamangalam [8°07'14.90"N, 77°22'08.25E] about 20 kilometer of coastal region during the post monsoon season in the year 2010.

Sample collection

Salt pan water samples and visible cyanobacterial mats specimens were collected from reservoir and condenser region in sterile polythene bags and plastic containers with code markings of place and area of collections. Such collections are preserved temporarily in ice-bags.

Cultivation

The collected cyanobacterial samples were transferred to Erlenmeyer flasks containing ASN III, MN III and BGII marine broth [8]. They were maintained in culture room at the Research Department of Microbiology V.H.N.S.N College, Virudhunagar, Tamil Nadu, India under white fluorescent lamps of 2500 lux intensity at room temperature upto 15-20 days.

Purification

Standard microbiological methods were followed for the isolation of cyanobacteria. Algal samples were microscopically examined and plated on solid agar medium. The inoculated plates were incubated in culture room maintained at 25±2°C fitted with cool white fluorescent tube emitting 2500lux for 18hrs a day and sub cultured in BGII medium [9].

The microscopic observations were carried out at 40X magnifications using light microscope. Cyanobacterial specimens were identified using the publications of Desikachary [10]. Purified cyanobacterial samples were also subjected for their growth in various salinity levels (40, 80, 120 and 180 ppt). The statistical diversity indices like Simpson's index, Shannon's index, Margalef index, McIntosh Index, Pielou Evenness and McIntosh Evenness were calculated [11].

Result and Discussion

In this present investigation, 18 species of Marine cyanobacteria distributed in 3 different salt pans were recorded (Table, 1). Total of twelve genera belonging to five families such as Oscillatoriaceae, Chrococcaceae, Dermocarpaceae, Pleurocapsaceae and Rivulariaceae namely, *Aphanocapsa littoralis, Chroococcus minutus, Calothrix geitonos, Lyngbya* sp, *Microcystis* sp, *Microcoleus chthonoplastes, Myxosarcina burmensis, Oscillatoria chlorina, Oscillatoria limosa, Oscillatoria salina, Oscillatoria subbrevis, Spirulina subsalsa, Phormidium fragile, Phormidium tenue, Phormidium valderianum, Synechococcus aeruginosus, Synechococcus elongatus and Stichosiphon sansibaricus* were reported from the present study from the salt pan sites.

Among them, *Oscillatoria salina, O. chlorina, Phormidium tenue, P. valderianum, Aphanocapsa littoralis, Chrococcus minutus and Microcystis* sp were commonly found in all three salt pans.

The marine cyanobacterial growth abundance was also observed with different salinities ranges 40, 80, 120 and 180 ppt (Table, 2). At hyper saline conditions about 160 ppt, five species belonging to Oscillatoriaceae namely *Spirulina subsalsa, Oscillatoria subbrevis, O. salina, Phormidium fragile* and *P. tenue* had shown able-bodied. At 120 ppt salinity, only 8 species of marine cyanobacteria were found to be adopted. But in lower salinity level upto 80 ppt all the species showed confluent growth. It was in line with the earlier observations of the south eastern cyanobacterial bio-diversity work [12, 13, 14], that a variety of filamentous cyanobacteria example in the order nostocales has also been described in hypersaline lakes. One more interesting factors that kovalam salt pan shows high cyanobacterial bio-diversity than the other two salt pans.

Diversity indices of marine cyanobacteria were calculated (Table, 3). The highest Shannon's index H' = 1.084 occurred on reservoir region of Rajakamangalam site. In Evenness indexes both Pielou evenness and McIntosh evenness index shows that reservoir region of Puthalam has the highest value. In Richness indexes, Margalef's index shows highest d = 8.380 in reservoir region of Kovalam site.

Evenness index is used to calculate the species equal distribution [11]. It was confirmed that reservoir regions of the saltpans of Puthalam and Rajakamangalam the species were equally distributed. The most commonly used diversity measures based on proportional abundance of species are the Shannon-Wiener and Simpson indices [15]. From the observations, Kovalam site shows high marine cyanobacterial biodiversity than the other two saltpans. One more interesting factor that Kovalam saltpan showed homogenously distributed species.

Table.1. Marine cyanobacterial flora in different salt pans of Cape comorin coast

Name of the organisms	Sampling sites					
	Kovalam		Puthalam		Rajakkamangalam	
	R	C	R	C	R	C
Aphanocapsa littoralis Hansgirg	+++	-	-	-	+	-
Chroococcus minutus (Kutz.) Nag	++	+	-	-	-	-
Lyngbya sp	+++	+	-	-	+++	+
Oscillatoria chlorina Kutz. ex Gomont	++	++	++	+	+++	-
Oscillatoria limosa Ag. ex Gomont	++	+	++	-	++	-
Oscillatoria subbrevis Schmidle	+++	+	-	+	+	-
Oscillatoria salina Biswas	++++	+++	+	+	+++	+
Microcystis sp	++	++	++	+	++	+
Myxosarcina burmensis Skuja	++	+	++	-	+	-
Stichosiphon sansibaricus (Hieron.) Drouet et Daily	+	-	++	-	-	-
Spirulina subsalsa Oerst. ex Gomont	-	++	+	-	+	++
Phormidium fragile (Meneghini) Gomont	+++	+	+++	+	+++	-
Phormidium valderianum (Delp.) Gomont	+++	+	+	+	+++	+
Phormidium tenue (Menegh.) Gomont	++	+	+	+	+	-
Calothrix geitonos Skuja	+	+	+	-	+	-
Microcoleus chthonoplastes Thuret ex Gomont	++	++	-	-	++	+
Synechococcus aeruginosus Nag	+	-	++	+	++	-
Synechococcus elongatus Nag	+	-	+	-	+	-

R: Reservoir; C: Condenser, +: Present, ++: Co-abundant, +++: abundant, ++++: Dominant,
-: Not found

Table.2. Growth of saltpan marine Cyanobacteria with different salinities

Name of the organism	Salinity (ppt) 40	80	120	160
Aphanocapsa littoralis Hansgirg	+++	+++	-	-
Chroococcus minutus (Kutz.) Nag	+++	+++	+	-
Lyngbya sp	++	++	+	-
Oscillatoria chlorina Kutz. ex Gomont	+++	++	++	-
Oscillatoria limosa Ag. ex Gomont	++	++	-	-
Oscillatoria subbrevis Schmidle	+++	+++	+	+
Oscillatoria salina Biswas	+++	++	+	+
Microcystis sp	+++	+++	++	-
Myxosarcina burmensis Skuja	++	++	+	-
Stichosiphon sansibaricus (Hieron.) Drouet et Daily	++	+	-	-
Spirulina subsalsa Oerst. ex Gomont	+++	+++	++	+
Phormidium fragile (Meneghini) Gomont	+++	+++	++	+
Phormidium valderianum (Delp.) Gomont	+++	++	++	++
Phormidium tenue (Menegh.) Gomont	+++	+++	+	-
Calothrix geitonos Skuja	++	++	-	-
Microcoleus chthonoplastes Thuret ex Gomont	+++	+++	-	-
Synechococcus aeruginosus Nag	+++	+++	-	-
Synechococcus elongatus Nag	++	++	-	-

-: Not found, +: Present, ++: Co-abundant, +++: abundant,

Table 3: Diversity indices of cyanobacteria in salt pans of Cape comorin coast.

Diversity Indices		Site Kovalam R	C	Puthalam R	C	Rajakamangalam R	C
Richness	Margalef index (d)	8.380	6.865	6.410	5.784	6.547	3.121
	McIntosh Index (Mc)	0.807	0.795	0.962	0.778	0.799	0.588
Evenness	Pielou Evenness (J')	0.893	0.954	1.000	0.955	0.973	0.8599
	McIntosh Evenness (Mc E)	0.939	0.953	0.967	0.949	0.973	0.836
Diversity	Simpson's Diversity	0.929	0.920	0.920	0.902	0.925	0.764
	Shannon 's Diversity (H')	1.075	1.063	1.081	0.955	1.084	0.669

R-Reservoir region, C-Condenser region

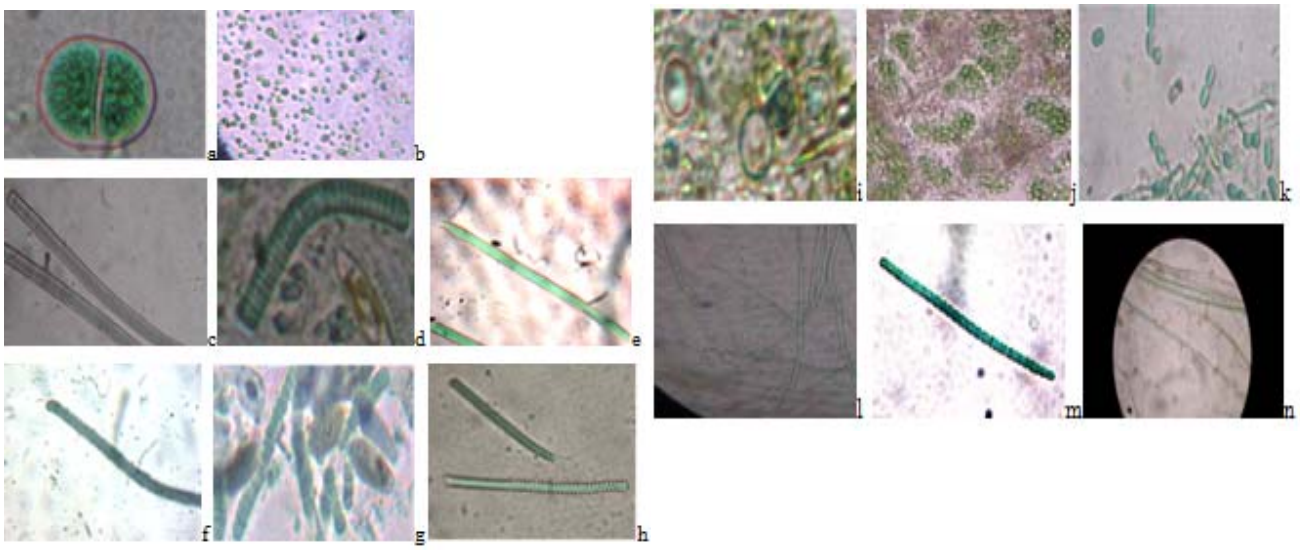

Plate.1 Microphotograph of some of the marine cyanobacterial isolates of salt pan of Cape Comorin coast.
a-*Chroococcus minutus* (Kutz.) Nag, b - *Aphanocapsa littoralis* Hansgirg, c-*Oscillatoria limosa* Ag. ex Gomont, d-*Oscillatoria subbrevis* Schmidle, e-*Oscillatoria salina* Biswas, f,g- *Calothrix* sps, h-*Spirulina subsalsa* Oerst. ex Gomont, i-*Synechococcus* sps, j-*Myxoscarcina burmensis* Skuja, k - *Synechococcus aeruginosus* Nag, l - *Lyngbya* sps, m - *Stichosiphon sansibaricus* (Hieron.) Drouet et Daily and n- *Phormidium valderianum* (Delp.) Gomont

Conclusion

As a result of this study, it was found that most of the marine cyanobacteria are moderate halophiles. Another interesting factor that all diversity indices and evenness results were generally close and highly resemble to each others, and thus all of these indices can be used in such studies carrying out in undisturbed areas.

From the above observations, it is very clear that the salt pans of Southwest Coastal region of Tamil Nadu are rich in marine cyanobacterial diversity. So it is inducing to find out its genetic complexity and correlates with our morphological complexity in the aspects of exploring biopotentials from these marine cyanobacterial species.

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