CYANOBACTERIAL BIODIVERSITY FROM DIFFERENTFRESHWATER PONDS OF KARIMNAGAR, TELANGANA STATE (INDIA)

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Abstract: Cyano bacterial biodiversity from different freshwater ponds of karimnagar, Andhra Pradesh (India).Studies on the cyano bacterial biodiversity of 3 different freshwater ponds in and around Karimnagar, Andhra Pradesh during summer month (June, 2004) has been made and compared their variations among three different ponds. In addition, certain physic-chemical parameters of pond waters such as dissolved oxygen, net productivity, pH, carbonate, bicarbonate, nitrate, nitrite, total phosphorus, inorganic phosphorus etc. were also analyzed and statistically compared with the cyano bacterial diversity. Totally23 species of 08 genera of cyanobacteria were recorded in all 3 different ponds. Only 6 species of cyanobacteria were identified in Pond 1 (kothapalli), where a massive bloom of **Microcystisaeruginosa** was recorded, which had a significant effect in reducing the othercyanobacterial population. As many as five species namely **Aphano the cemi croscopica**, **Synechocystisaquatilis**, **Merismopediaglauca**, **Oscillatorialimnetica** and **O. subbrev is** were common in all the ponds surveyed except in Pond 1.

Key words: Biodiversity, ecosystem, cyanobacteria, *Oscillatoria*, *Microcystis*.

Introduction: Cyanobacteria (blue-green algae) are capable of both carbon assimilation and N-2fixation, thereby enhancing productivity in variety of environments. Apart from fixing atmospheric N_2, they secrete a number of biologically active substances. Tropical conditions such as those in India provide favorable environment for the luxuriant growth of these organisms in the natural ecosystem such as different types of soil, freshwater bodies, oceans, saline backwaters, estuaries, and also hyper saline saltpans(Subbaramaiah, 1972; Srivastava & Odhwani, 1992; Thajuddin&Subramanian,1992; Thajuddin*et al.* 2002; Rajkumar, 2004and Chellappa *et al.* 2004).Cyanobacteria, until recently in oblivion, uncared for and unrecognized, haves hot 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 (Thajuddin and Subramanian, 2005).Besides their ecological significance, offer gate potential tool as an organisms for the biotechnological interest such asmariculture, food, feed, fuel, fertilizer, medicine and combating pollution (De, 1939;Mitsui *et al.* 1981; Venkataraman1981,Venkataraman, 1983; Kannaiyan, 1985;Borowitzka, 1988; Gustafson *et al.*, 1989;Prabaharan & Subramanian, 1995;Subramanian & Uma, 1996). The present work was carried out to understand the diversity of cyanobacteria from three different fresh water ponds of Karimnagar district, Andhra Pradesh as an initiative study for exploiting their innate potentials.

Material And Methods:

Study area and sampling: Karmnagar is located in the centre-east of Andhra Pradesh state, India (Lat. 10□47’ N; Long. 79° 10’ N). Karimnagar district occupies3, 205 sq. miles [8,300 sq. km] in area in the part of flat, fertile Cauvery Delta region, which is one of the most important rice growing areas in India. There are several natural and artificial (temple) fresh water ponds are distributed more frequently in and

Fig. 1. Map showing the locations of 5 different ponds in Thanjavur. *Localizacióngeográfica de las 5 charcas en Thanjavur.*

Cyano bacterial biodiversity

Table 1. Diversity of Cyanobacteria in different fresh water ponds of karimnagar
Pond 1:Kothapalli; Pond 2;Manakondoorl; Pond 3:Shanigaram

S.No.	Name of the isolates Sampling Stations	Pond 1	Pond 2	Pond 3
1	*Microcystisaeruginosa*Kütz	-+-+-	-+-	+ + - - -
2	*Aphanothecemicroscopica*Näg*	---	---	++++
3	*Chroococcusturgidus*(Kütz.)Näg	++	++	+-+-
4	*Chroococcusminutus*(Kütz.)Näg*	+	+++	-++-
5	*Gloeocapsastegophila*(Itzigs.) Rabenh*	++	+++	--+--+
6	*Gloeothecesamoensis*Wille	+	++	--+--
7	*Synechococcuselongatus*Näg	++	+	+-++-
8	*Synechocystisaquatilis*Sauv	+	++	-++++
9	*Myxosarcinaconcinna*Printz	-	+++	-+-++
10	*Dermocarpaleibleinea*(Reinsch)Born.et Thur	-	-	---+-
11	*Merismopediaglauca*(Ehrenb.) Näg	-	-	-++++
12	*Spirulinasubsalsa*Oerst.exGomont	+	+	--++-
13	*Spirulinalabyrinthiformis*(Menegh.) Gomont	+	+	++++
14	*Spirulinameneghiniana*Zanard.	++	+	+-+--
15	*Oscillatoriacurviceps*Ag.exGomont*	+++	++	-+---
16	*Oscillatoriasubbrevis*Schemidle	++	+ +	+ +++
17	*Oscillatoriapseudogeminata*Schmid	+	+	-++--
18	*Oscillatoriatenuis*Ag. Ex Gomont	+	+	++ - -
19	*Oscillatoriaearlei*Gardner	+	+	--++ +
20	*Oscillatoriaformosa*Bory ex Gomont	++	++	-+-- -
21	*Oscillatoriabrevis*(Kütz.) Gomont	+	++	-++- - -
22	*Oscillatoriaboryana*Bory ex Gomont	+	++	--+--
23	*Oscillatorialimnetica*Lemm	+	+	-+ +++
24	*Oscillatoriaamphibia*Ag.exGomont	+	+	- ++--
25	*Phormidiumtenue*(Menegh.) Gomont	+	+	-+++ +
26	*Phormidium corium* (Ag.) Gomont	+	+	--++-
27	*Phormidium fragile* (Menegh.) Gomont	+	+	- ++--
28	*Phormidiummolle*(Kütz.)Gomont	-	-	- + - - -
29	*Lyngbyamartensiana*Menegh.exGomont	+	+	-++-+
30	*Lyngbyaceylanica*Wille	+	++	-+-+ -
31	*Lyngbyaallorgei*Fremy	+	+	--+--
32	*Lyngbyalutea*(Ag.) Gom.	+	+	--+--+--
33	*Schizothrix*sp	-	-	-+--+
34	*Calothrix brevissima* West,G.S.	+	+	-++-
35	*Calothrix*sp	++	+	- +---
36	*Scytonema*sp.	++	+	- ++-+
37	*Plectonema*sp	+	+	- +--+
38	*Nostoc carneum* Ag. ex Born. etFlah	++	+ +	--++ --
39	*Anabaena* sp	++	+ +	--+--

Total number of species/genera 6/4 25/15 26/14 18/13 13/11

20 C. Muthukumar*et al.*aroundThanjavur city with seasonal algalblooms.Visible and planktonic samples

were collected from various freshwater ponds in and around Thanjavur during June 2004,namely Pond 1 (Dabeerkulam), Pond 2(MariyammanKovil), Pond 3 (PadithurainearMariyammanKovil), Pond 4(Pulavarnatham) and Pond 5 (Sivalingamtemple) (fig. 1) using forceps, knifes andplankton net (mesh size 42m). Water samples were also taken from each site for analyzing physic-chemical and biological parameters such as plankton, pH, dissolved oxygen, net productivity, alkalinity, nitrate, nitrite, total phosphorous and inorganic phosphorus and by using standard methods(APHA, 1975).The collected cyanobacteria samples were transferred to conical flasks with BG11 medium (Ripken *al*., 1979).Cyanobacteria specimens were identified using the publications of Gentler, 1932;Desikachary, 1959 and tarmach, 1966.Photomicrography was taken using LeitzDiaplan photo micrographic unit (Germany).The correlation co-efficient analysis was made between physico-chemical properties of water and total cyanobacterial species.

Fig:1 Author collecting samples from fresh water pond 1.Kothapalli village.

Fig: 2 Fresh water pond at Manakondoor village

Results: Totally 39 species belongs to 20 genera of **cyanobacteria** were recorded in all 5 ponds(tab. 1, figs. 2 to 15). Five species of the cyanobacteria viz., ***Synechocyst is aquatilis,Aphanotheceicroscopica, Merismopediaglauca, Oscillatorialimnetica,*** and ***O.subrevis*** were common in all ponds except pond 1, where a massive bloom of *Microcystis aeruginosa* (fig. 2) was recorded. Maximum 26 species of 14 genera were recorded from Pond 3 followed by 25species belonging from 15 genera, 18 species from 13 genera, 13 species from 11 genera and 6 species from 4 genera in Pond 2, Pond4, Pond 5 and Pond 1 respectively (tab. 1).As per the diversity and abundance of cyanobacteria, the members of the family Oscillatoriaceae were dominating in most of the ponds surveyed. As many as five species namely

Aphanothece microscopica,Synechocystisaquatilis, Merismopediaglauca, Oscillatorialimneticaand ***O.subbrevis***were common in all the pondssurveyed except in Pond 1.Physico-chemical analysis of water revealed that the pH range from 6.5 to 7.3,dissolved oxygen from 0.8 to 1.4 mg l-1, net productivity from 0.4 to 0.6 mg cm3-1l-1,alkalinity (carbonate from 1.0 to 1.8 mg l-1and bicarbonate from 25.6 to 45.0 mgl-1),nitrate from 5.0 to 9.9 mg l-1, nitrite from2.6 to 5.5 mg l-1, total phosphorous from 2.6to 5.7 mg l-1 and inorganic phosphorus from4.2 to 5.5 mg l-1 in all the ponds studied (tab.2). The correlation co-efficient analysis of physico-chemical properties of water samples and total cyano bacterial species revealed that the significant positive correlation between Total Cyan bacterial Species (TCS) and dissolved oxygen($r=0.9803$; $p<0.01$), TCS and bicarbonate ($r=0.9928$; $p<0.01$) and TCS and carbonate($r=0.941$; $p<0.05$) (tab. 3).

Discussion: In any ecosystem, not a single species grows independently and indefinitely, because all the species are interlinked and has cyclic transformation of nutrients. The physicochemical changes in the environment may affect particular species and induce the growth and abundance of other species, which leads to the succession of several species in a course of time. In Pond 1, low diversity of cyanobacteria was attributed to Cyanobacterial biodiversity 15 Microphotographs of some cyanobacteria isolated from different fresh water ponds of Thanjavur.

2: *Microcystis aeruginosa;*
3: *Aphanothece microscopica;*
4: *Merismopediaglauca;* 5:*Myxosarcinaconcinna;*
6: *Chrococcusturgidus;*
7: *Spirulinameneghiniana*;
8: *Oscillatorai subbrevis;*
9: *Oscillatoriaearlei;*
10: *Oscillatoriaformosa;*
11: *Oscillatoria boryana;*
12: *Oscillatoria tenuis*;
13: *Phormidiumtenue;*
14: *Anabaena* sp.;
15: *Nostac carneum. Algunas de lasciano bacteriasaisladasen diferentes charcas de Thanjavur.*22 C. Muthukumar*etal.*

Table 2. Physico-chemical properties of different pond water samples.
Pond 1:Kotthapalli;
Pond 2:Manakondoor;
Pond 3: ;
Pond 4: Pulavarnatham;
Pond 5: Sivalingamtemple.

Propiedadesfísico-químicas de lasdiferentescharcas de Thanjavur.
Charca 1: Dabeerkulam;
Charca2: MariyammanKovil;
Charca 3: Padithurai;
Charca 4: Pulavarnatham;
Charca 5: templodeSivalingam.

S.No.	Properties	Pond 1	Pond 2	Pond 3
1.	pH	7.3	6.5	6.7
2.	Dissolved Oxygen (mg l-1)	0.8	1.2	1.4
3.	Net productivity (mg cm3-1l-1)	0.6	0.6	0.4
4.	Carbonate (mg l-1)	1.0	1.8	1.6
5.	Bicarbonate (mg l-1)	25.6	39.0	45.0
6.	Nitrate (mg l-1)	9.9	5.0	9.6
7.	Nitrite (mg l-1)	3.0	5.5	4.2
8.	Total phosphorus (mg l-1)	4.4	2.6	5.0
9.	Inorganic phosphorus (mg l-1)	5.5	4.2	5.4

a massive bloom of *Microcystis aeruginosa***.**

Low amount of dissolved oxygen (0.8mg l-1) in pond -1, which had a significant effect in reducing the other cyanobacterial population (tab. 2). The similar type of results has also been reported (Subha & Chandra, 2005; Pingale & Deshmukh, 2005;Rani*et al.*, 2005). Frankelin (1972)reported that *Microcystis* is one of the dominant organisms that is associated with almost permanent blooms in tropical fresh waters that are exposed to constant sunshine, warmth, and nutrients like phosphate, silicate, nitrate, CO_2 and lime. Formation of cyano bacterial blooms in freshwater bodies is essentially due to buoyant nature of these organisms.

Buoyancy of cyanobacteria is imported by the gas vacuoles which forms dense growth on the water surface in ponds, reservoirs and lakes and cause serious nuisance because of visual appearance, production of toxins (Carmichael, 1994) and unpleasant odour produced by substances such as geosmin (Juttner, 1987). Jeyaraman(1972) and Qasim (1972) reported that thedominance of cyanobacterial blooms ingeneral, *Trichodesmium* bloom in particularmay be due to two reasons: it may be a caseof the superiority of the organism competing with the other organisms for the nutrient supply from the environment or it may be an instance where the metabolic products of the dominating species and creatingun favorable condition in the environment forthe growth of other organisms.Murphy *et al.* (1976) and Bailey &Taub(1980) reported that the development of cyanobacterial blooms in any ecosystems,

The siderophore mediated iron uptake inbelieved to be a contributing factor in their ability to dominate other microalage. Whereas the other cyanobacterial forms that apparently cannot synthesize siderophore are able to utilize siderophore produced by other bacteria (Ferreira & Straus, 1994). As also reported in other publications addressing the persistence and stability of various organisms in fresh water ecosystems(Duncan & Blinn, 1989; Scarsbrook, 2002;Soininen& Eloranta, 2004), cyanobacteria particularly forms their extreme bloomst hrough out the main part of the summer. The crucial role of the physico-chemical parameters in the ecosystem on the Cyanobacterial biodiversity 23distribution of algal community has been Extensively analyzed in tropical and temperate freshwater ecosystems (Lund1965; Reynolds, 1984; Köhler, 1994).Chellappa *et al.* (2004) reported the collective dominance by the species of cyano bacteria was due to their capacity to grow in turbid water and low light intensity to maintain buoyancy and the capacity to grow exponentially in wet period in which nitrogenous nutrients were high. The dailywater level fluctuations attributed to increaseand decrease in phytoplankton speciesdiversity.

Pingale & Deshmukh, (2005)identified 87 algal species belonging to 43genera from Kalsubai-Ratangal, Ahmednagar .Subha& Chandra (2005) studied the algal flora from temple tanks in and around the city of Chennai and reported 17 species of algaebelonging to Cyanophyceae, Chlorophyceae, Bacillariophyceae and Euglenophyceae. Of the39 species of cyanobacteria recorded in the present study, only 5 heterocystouscyanobacteria such as *Calothric brevissima,Calothrix* sp., *Scytonema* sp., *Anabaena* sp.and *Nostoc carneum* were recorded. Hoyslew& Pearson, (1979) and Oren & Shilo, (1979) reported that the high levels of sulfidecontent, and anaerobic conditions wasbelieved to exclude the heterocystous forms. High levels of nitrogen source in the environment is also eliminatingheterocystous forms, since nitrogen freemedia is commonly used for the isolation andpurification of heterocystous cyanobacteria.The significant positive correlationbetween the cyanobacterial diversity andmicronutrients (zinc and nitrite) was observed and also reported by Govindasamy& Azaraiah (1999). In the present study thesignificant positive correlation was observedbetween the Total Cyanobacterial Species(TCS) and dissolved oxygen ($r=0.9803;p<0.01$), TCS and bicarbonate ($r= 0.9928;p<0.01$) and TCS and carbonate ($r=0.941;p<0.05$). Hence the present study conclude dinspite of the fact that the cyanobacteria areubiquitous, their population dynamics are often influenced by the available nutrients and the physico-chemical conditions of the ecosystem.

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