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Research Article

ASSESSMENT OF CYANOBACTERIAL POPULATION IN THREE DIFFERENT WATER RESERVOIRS OF SIVAKASI

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ABSTRACT

Cyanobacteria live in a diverse range of environments with a number of features which contribute to their success. In the present study, the cyanobacterial population of three different ponds of Sivakasi (Virudhunagar district, Tamilnadu, South India) was studied. During the period September 2014 to October 2015, the survey revealed the presence of 59 species of cyanobacteria belonging to 14 genera and four families. The physico-chemical parameters like pH, temperature, carbonate, bicarbonate, nitrate, nitrite, ammonia, total phosphorus, inorganic phosphorus, calcium, magnesium, chloride and algal flora were studied in all the three water sources. In all the three pond systems, the species observed were *Lyngbya, Oscillatoria, Phormidium, Microcystis, Synechococcus, Gloeocapsa, Synechocystis, chroococcus, Arthospira, Nostoc, Anabaena, Spirulina, Plectonema and Aphanocapsa* were found to be predominant with 80 %. High representation of these species indicates their capacity to thrive in this type of man-made habitat. It is clear that physico-chemical characters together with biological monitoring provide converging lines of evidence for evaluation of polluted habitat. The present work would be helpful for future pollution abatement programs.

INTRODUCTION

Cyanobacteria, the oxygenic, photosynthetic prokaryotes are found in almost every aquatic and terrestrial environment. They show remarkable degree of morphologial and developmental diversity. Traditionally, their taxonomy is based upon morphologically diverse having unicellular, colonial and filamentous form (Whitton and Potts, 2000).They play a vital role in the various biogeochemical cycles such as nitrogen, carbon, phosphorus and oxygen. For a long time, the economic importance of cyanobacteria was limited to their use as bio-fertilizer in agriculture but during the last few decades they have been recognized for their high potential in a wide variety of biotechnological application. (Thajuddin and Subramanian, 2005; Spolaore *et al*, 2006). Cyanobacteria are commonly found in polluted and non-polluted waters and due to this behavior they are generally considered useful to determine the quality of water at very low cost. They are very suitable organisms for the determination of the impact of toxic substances on the food chain and also have consequence on the higher level. Clean water would support a great diversity of organisms, with one or few dominant forms (Trainer, 1984).

Few reports have been available on cyanobacteria flora from different regions of India (Desikachary, 1959; Prasad and saxena, 1980; Tararand Bodkhe, 1997, Mahadevand Hosmane, 2004; Parikh, *et al,* 2006; Gupta, *et al*., 2006; Sankaran, 2006; Chaudhary and Kumar Mukesh, 2006; Saha, *et al*., 2007; Kumar Mukesh, 2010; Kumar Mukesh, *et al*., 2011). Some algal infestations have been reported from Kanpur by various workers in time and space (Ahked, 1973; Shukla, 1983; Tripathi and Pandey, 1989; Tiwari, *et al*., 2001; TiwariandShukla, 2007, Rishi and Awasthi, 2012). During the past few decades research on cyanobacteria were mostly academic oriented and now proved as potential candidates for much biotechnological utilization (Richmond, 1990; Sundararaman and Sekar, 2001; Thajuddin and Subramanian, 2005). Cyanobacteria have been an unexplored arena for biological researchers at large. Mostly the microbial analysis was done taking the bacterial and fungal strains into account leaving behind the mostly notable autotrophic microbial strains in the name of algae. Cyanobacteria strains which do possess the character of nitrogen fixation add up to value addition of these microbial strains mainly in the field of man culture, food,

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feed, fuel, fertilizer, medicine and combating pollution (Muthukumar *et al*. 2007)

MATERIALS AND METHODS

Sampling

Algal samples were collected from three different ponds in and around Sivakasi. Algal species inhabiting these water bodies were collected in the sterilized polythene bags and wide mouthed bottles. The samples were brought to the laboratory for isolation, purification and identification purposes. Collected samples were examined to identify the algal species. Isolation and purification of algal strains was done by repeated sub culturing on solidified and in liquid medium (BG11) by dilution and pour plate technique. The samples were then placed in an incubator at 28$\pm$1^{0}C, with 16h light/dark cycle. Light was provided by a single 58 watt fluorescent tube (luminex, cool white) at 25µmolQuanta m^{-2} $^{s-1}$ for 18 days. Each sample was observed under Olympus light microscope. The different environmental parameters data prevailing on each of the sampling site was studied.

Table I Physiochemical parameters of water samples in three water stations

Sl.NO	PARAMETER	POND I	POND II	POND III
1	pH	7.5	6.5	7.5
2	Temperature	30	31	30
3	Carbonate	40	30	30
4	Bicarbonate	90	110	120
5	BOD	120	110	100
6	COD	632	744	624
7	DO	3.7	3.1	3.35
8	Nitrate	59	66	62
9	Nitrite	34	32	34
10	Ammonia	276	261	284
11	Total phosphorus	88	66	102
12	Inorganic phosphate	32	36	40
13	Organic	56	30	62
14	Calcium	50.46	54.66	46.25
15	Magnesium	19.40	33.02	30.19
16	Chloride	159	119	114

RESULTS AND DISCUSSION

In the present Study, the cyanobacteria community of three different ponds of Sivakasi was studied. Totally 59 species of cyanobacteria belonging to four families, 13 genera have been identified from different sampling stations during the period from September 2014 to October 2015 (Table 2). Among them, pond II recorded the maximum number of species (46) followed by pond I (38) and pond III (28). Among the ponds, heterocystous forms were identified in pond I and II and were not recorded in pond III. Heterocystous cyanobacteria such as *Nostoc calcicola* was recorded in pond I and II. On the other hand *Nostoc linckia, Anabaena aphanizomenoides* were recorded only in pond II, while *Nostoc calcicola* recorded in pond I and II (Table 2). In total, 20 species of cyanobacteria were recorded in common to all the ponds analyzed. Of them, *Oscillatoria* with 15 species was the dominant genus, followed by *Phormidium* (11), *Lyngbya*(10), *Microsystis* (3) *Synechococcus* (2) and *Synechocystis* with single species (Table 2). The rich growth of cyanobacteria is believe to be due to favorable content of oxidisable organic matter and less dissolved oxygen (Table I) an observation which supports Vijayakumar *et al*., (2007) Gomathi *et al.,* (2011) and Mathumathi and Vijayakumar (2013).

Table II Population density of cyanobacteria in three different pond system

Sl.No	Cyanobacterialspecies	Pond-I (percentage)	Pond-II (percentage)	Pond-III (percentage)
1.	*Synechocystis aquatilis*	33	n.d	41
2.	*Synechococcus elongatus*	66	33	25
3.	*Chroococcus minor*	33	58	n.d
4.	*Chroococcus sps.*	66	68	58
5.	*Microcystis flos aquae*	75	58	66
6.	*Microcystis robusta*	41	n.d	75
7.	*Microcystis aeruginosa*	100	100	83
8.	*Arthrospira platensis*	75	66	n.d
9.	*Spirulina platensis*	n.d	91	n.d
10.	*Spirulina sps.*	25	n.d	n.d
11.	*Oscillatoria curviceps*	50	66	25
12.	*Oscillatoria earlei*	100	91	100
13.	*Oscillatoria late-virens*	91	100	83
14.	*Oscillatoria limentica*	n.d	50	75
15.	*Oscillatoria princeps*	n.d	75	66
16.	*Oscillatoria pseudogerminata*	100	91	91
17.	*Oscillatoria rubescens*	41	n.d	50
18.	*Oscillatoria salina*	100	83	16
19.	*Oscillatoria subbrevis*	83	75	66
20.	*Oscillatoria willie*	91	66	41
21.	*Phormodium ambiguum*	75	50	66
22.	*Phormodium corium*	91	83	100
23.	*Phormodium tenue*	83	75	75
24.	*Phormodium uncinatum*	n.d	25	16
25.	*Phormodium laminosum*	n.d	8	n.d
26.	*Phormodium anomala*	25	n.d	n.d
27.	*Oscillatoria tereberiformis*	91	100	83
28.	*Oscillatoria brevis*	75	50	41
29.	*Oscillatoria animalis*	n.d	75	n.d
30.	*Oscillatoria chlorine*	25	8	16
31.	*Lyngbya aestuarri*	50	75	8
32.	*Lyngbya borgerti*	25	8	16
33.	*Gloeocapsa polydermatica*	75	50	66
34.	*Lyngbya confervoides*	91	83	75
35.	*Lyngbya martensiana*	66	n.d	41
36.	*Lyngbya majuscule*	25	50	16
37.	*Lyngbya putealis*	16	n.d	8
38.	*Lyngbya spiralis*	n.d	50	66
39.	*Lyngbyatrunicola*	66	75	83
40.	*Nostoc linckia*	n.d	100	n.d
41.	*Nostoc calcicola*	66	91	n.d
42.	*Anabaena aphanizomenoides*	n.d	41	n.d
43.	*Plectonema radiosum*	n.d	41	n.d
44.	*Chroococcus minutus*	25	n.d	n.d
45.	*Chroococcus schizodermatica*	8	n.d	n.d
46.	*Chroococcus minor*	16	n.d	n.d
47.	*Phormidium africanum*	50	n.d	n.d
48.	*Phormidium sps.*	66	n.d	n.d
49.	*Oscilatoria limosa*	n.d	n.d	n.d
50.	*Phormidium foveolorum*	n.d	41	n.d
51.	*Phormidium mucicole*	n.d	50	n.d
52.	*Arthospira tenuis*	n.d	66	n.d
53.	*Synechococcus cedroren*	n.d	50	n.d
54.	*Phormidium jenkelianum*	n.d	41	n.d
55.	*Arthospira massartii*	n.d	50	n.d
56.	*Chroococcus gomontii*	n.d	66	n.d
57.	*Phormidium fragile*	60	75	80
58.	*Lyngbya gracilis*	n.d	50	n.d
59.	*Aphanocapsa sps.*	n.d	81	n.d

The study reveals that calcium is one of the important minerals which supports the growth of Cyanobacterial population. Favouring the growth of cyanobacteria is not only by calciumbut also high amount oxidizable organic matter, traces of dissolved oxygen, considerable amount nitrate and phosphates also Hamed *et al*. 2008, Senthil *et al*. 2012, Vijayakumar, 2012 and Mathumathy and Vijayakumar, 2013 Vijakumar *et al*., 2005 Gomathi *et al*. 2011 reported that cyanophyceae grow luxuriantly with great variety abundance in ponds having rich calcium Muthukumar *et al*. (2007) and Vijayakumar and Manoharan (2012) reported that high values of BOD, COD, phosphates and nitrate with very low DO favored the growth of algae. Their findings were supported by Jaeyachitra *et al*. (2013) and Vinoth Rishi and Awasthi (2015). The present study showed considerable amount nitrate and phosphate with increased level of BOD, COD along with very low DO level. However, Senthil *et al*. (2012) observed that, correlation between abundance of planktonic cyanobacteria and concentration of dissolved oxygen could be due to the depletion of oxygen.

In the present study, heterocyst us cyanobacteria *Anabaena aphanizomenoides*, *Nostoc linckia*, *Nostoc calcicola* were observed (Table 2). Hamed *et al* (2008) Gomathi *et al* (2011) Mathumathy and Vijayakumar (2012) reported that *Calothrix*, *Nostoc carneum* and *Anabaena* species in fresh water lakes. Gurstafsom *et al* (2008) and Gomathy *et al* (2011) reported that the genus *Oscillatoria* has been found tobe very tolerant and frequently inhabit the polluted waters. Similarly, Mathumathy Vijayakumar (2012) and Jeyachithra *et al* (2013) reported *Oscillatoria*, *Phormidium* were the most dominant genera in lakes and ponds respectively. The present study reveals the presence of *Oscillatoria*, *Phormidium* along with *Lyngbya* in all the ponds studied (Table). Senthil *et al*. (2012) emphasized the use of algae as reliable indicators of pollution. Certain members of Cyanobacteria are tolerant to organic pollution and resist environmental stress caused pollutant such species can be used as indicators particular habitat (Vijayakumar, 2012). In the present study, pond I with 13 species followed by pond II with 19 species and pond III with11 species each (Table II), the percentage values of which were 75and above should be considered as indicators of the respective ponds are reported by Gomathy *et al*. (2011). Of the indicator species observed in different ponds, *Microcystis aerunginosa, Oscillatoria earlei, Phormidium corium* were found to be more than 80% representation in all the ponds and thus considered as an indicators of the algal population. From the foregoing discussion, it is concluded that the physicochemical characters together with biological monitoring provided converging lines of evidence for evaluation of polluted habitat in this case as in some other studies (Murugasen, 2005; Gomathi, 2011).

CONCLUSION

The present study, undertaken to analyze the presence of cyanobacterial population revealed that no significant variation in the occurence and distribution of cyanobacteria which would be correlated to the physico-chemical parameters of water. The cyanobacterial species investigated in the present study are highly recommended for beneficial bioremediation applications for *in-situ* and off-site removal of pollutants.

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