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Chlorococcalean Biodiversity of Reverine ecosystem with special reference to the pollution status

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ABSTRACT

Lotic water bodies like rivers and streams play very pivotal role in maintaining biodiversity and biological balance in nature. In India, most of perennial rivers and their tributaries are being used as sites for disposal of domestic and industrial wastes which impair their water quality, favour the growth of algal blooms and jeopardizing the survival of aquatic life. During present investigations, water qualities of riverine ecosystem like Godavari river was monitored for two year (August 2008-July-2010). From ten sampling stations water samples and algal samples were collected and monitored for qualitative analysis. Present studies revealed that, in all 25 genera and 55 species of Chlorococcales have been reported from all 10 sampling stations. Chlorooccalean flora was found to be dominant during summer. Its number was declined during monsoon and again increased during winter. The commonly found genera were *Ankistrodesmus, Scenedesmus, Pediastrum, Chlorella, Crucigenia, Golenkinia* etc. Disposal of municipal sewage and agricultural run-off favours the growth of Chlorococcalean flora. The commonly found pollution tolerant genera were *Ankistrodesmus, Scenedesmus, Chlorella* etc. Their flourished growth indicates pollution status of river at certain stations. The water flow and physico-chemical parameters influenced the occurrence and abundance of Chlorococcalean diversity in the Godavari river.

Keywords: Godavari river, Chlorococcalean flora, pollution.

INTRODUCTION

Algae constitute the important part of food chain of aquatic life. They are primary producers and acts as food for aquatic animals. As the algal growth and composition alters, they also affects the food web and food chain of aquatic ecosystem. Chlorococcales is one of the important group of algae belonging to class Chlorophyceae. The species diversity and distribution pattern of Chlorococcales was studied for two years from river Godavari. Godavari is the sacred river where Sinhstha Kumbha-mela is being held after 12 years time interval. It originats at Trymbakeshwar just 30 kms upstream of Nashik and flowing through Maharashtra and Andhra Pradesh, it joins the Bay of Bengal. The river receives huge quantitative of domestic matter and agricultural run-off causing organic pollution favouring the luxurious growth of algal blooms. Chlorococcales is the important group of green algae contributing the quality and aesthetic appearance of the water. Many workers has studied the diversity and distribution pattern of Chlorococcales diversity like Mruthunjaya *et al*[1], Jose and Patel [2], Habib and Chaturvedi [3], Habib and Chavan [4], Tiwari *et al*[5], Jyothi *et al* [6] etc.

Literature survey revealed that Chlorococcalean flora has been studied by many workers but still survey of Chlorococcalean flora from Nashik to Kopargaon is remained untouched. So present survey was made to monitor the water quality in relation to Chlorococcalean flora of river Godavari.

METHODOLOGY

For the collection of water samples 10 sampling stations were selected on river Godavari from Nashik to Kopargaon showing the range of variation. For physico-chemical parameters water samples were collected in cleaned plastic containers. For the study of Chlorococcalean flora the water samples were collected separately by using plankton net 200mesh/linear inch and preserved in 4% formaldehyde and Lugols solution. For physico-chemical parameters standard methods were used [7,8]. Identification of Chlorococcalean forms were made by using standard literature like Prescott [9, 10,11], Philipose [12] etc.

RESULTS AND DISCUSSION

Seasonal data of physico-chemical parameters is depicted in Table 1. Municipal sewage and human excreta is dumped daily in river water which resulted the higher Chloride values during summer and winter seasons. It might be due to less quantity of water in river water and found to be beyond the permissible limits. Higher values of nitrates and phosphates during summer and winter were due to the concentration effects and low water level, while during monsoon may be due to agricultural run-off [14]. Alkalinity was ranged more at all stations in all months. Higher values during winter season were noticed might be due to the use of soaps and detergents for washing the cloths and utensils by people, while during summer might be due to concentration of salts in water and domestic wastes. Due to washing of clothes, bathing, city sewage, agricultural run-off cleaning of automobiles and animals, the hardness values increased. Our results are agreeable with Singh *et al*. [15] and Mohanta and Potra [16].

Due to the organic matter and low water level the, BOD values recorded were in higher ranges. Free CO_2 values recorded were more during summer season and might be due to the discharge of huge quantity of sewage accompanied by increase in organic matter. During summer season DO values ranged from 1.5 to 5.1 mg/L. It was declined at certain stations and was due to high temperature, low dissolution of oxygen, and high oxidisable organic matter, while more during monsoon was due to low temperature and flood condition. Our result coincides with Venkateswarlu and Jayanti [17]. It was observed that the raised values of EC, Chlorides, hardness, alkalinity, BOD, free CO_2 while low values of pH and DO at certain stations showed the polluted nature of the river water.

Chlorococcalean Diversity:

The distribution pattern of different species of Chlorococcales is influenced by physico-chemical parameters of water. A total of 25 genera and 55 species of this group were recorded (Table 2). This class has been represented by the genera like *Characium, Ankistrodesmus Pediastrum, Tetrastrum, Scensdesmus, Coelastrum, Dimorphococcus, Golenkinia Actinastrum, Dictyosphaerium , Kirchneriella, Excntrosphaera sps. etc.*

Table 1: Seasonal variation in physico-chemical parameters of Godavari river. Aug.2008 - July.2010)

Sr. No.	Parameters	Summer	Monsoon	Winter	WHO standard
1	Light penetration in cm	28 - 190	14 – 78	17 - 156	-
2	Temp (^{O}C)	23 - 35	16 – 24	15 – 22	40^{o}C
3	E.C. m mho/ cm	0.66 – 1.06	0.52 – 1.22	0.26 – 1.59	1 m mho/cm
4	TDS	180 - 678	201 - 821	163 - 716	500 mg/L
5	pH	6.6 – 8.3	7.0 – 8.2	7.0 – 8.2	7.0 – 8.5
6	Chlorides	118 – 252	102 - 208	49 - 219	200 mg/L
7	Nitrates	0.39 – 1.98	0.0 – 1.89	0.1 – 2.08	45 mg/L
8	Phosphates	0.8 – 2.55	1.2 – 2.30	0.98 – 1.98	-
9	Alkalinity	42 - 119	58 - 256	44 - 198	100mg/L
10	Hardness	69 – 179	73 – 289	67 - 202	100 mg/L
11	BOD	5.2-19.3	1.5-3.2	5.4-15	6 mg/lit
12	Free CO_2	1.1 – 5.4	1.1 – 4.1	2.2 – 10.0	30 mg/L
13	DO	1.5 – 5.1	5 - 11	2.5 – 7.3	5 mg/L

Table 2: Chlorococcalean algae encountered during investigation period

Sr.No.	Name of Chlorococcalean algae	Sr.No.	Name of Chlorococcalean algae
1	Characium acuminatum *A.Braun in Kuetzing*	29	Coelastrum cambricum *Archer*
2	Characium limneticum *Lemmermann*	30	Coelastrum reticulatum (*Dang) Senn.*
3	Ankistrodesmus fulcatus *(Corda.) Ralfs.*	31	Coelastrum microporum *Naegeli in A. Braun*
4	*Ankistrodesmus spiralis* (Turner)Lemmermann	32	Coelastrum sphaericum *Naegeli*
5	Ankistrodesmus convolutus *Corda*	33	Oocystis gigas *Archer*
6	Dimorphococcus lunatus A.Brown	34	Oocystis solitaria var. major *Wille*
7	*Botrycoccus braunii* Kuetzing	35	Actinastrum gracillimum *G.M.Smith*
8	Hydrodictyon reticulatum *(L) Lagerheim*	36	Actinastrum hantzschii *Lagerheim*
9	Crucigenia tetrapedia *Kirch. West & West*	37	Actinastrum hantzschii var. fluviatile Schroeder
10	Selanastrum minutum (*Naegeli) Collins*	38	Actinastrum sp.
11	Scenedesmus incrassatulus var.mononae *G.M.Smith*	39	Golenkinia paucispina *West & West*
12	Scenedesmus acuminatus *Chodat*	40	Golenkinia radiata *(Chod) Wille*
13	Scenedesmus dimorphus *(Turp)Kuetzing*	41	Tetraedron duospinum *Ackleg*
14	Scenedesmus longus var. Naegelii *G.M.Smith*	42	Tetraedron minimum *(A.Braun) Hansgirg*
15	Scenedesmus obliquus *(Turp.) Kuetzing*	43	Tetradron muticum (A.Braun) Hansgirg.
16	Scenedesmus quadricauda var. Westii *(G.M.Smith)*	44	Chlorococcum humicola *(Naeg.) Rabenhorst*
17	Scenedesmus quadricauda var. maximus *West & West*	45	Dictyosphaerium pulchellum *Wood*
18	Scenedesmus quadricauda var. parvus *G.M.Smith*	46	*Sorastrum spinulosumNaegeli*
19	Scenedesmus abundans var. longicauda *G.M.Smith*	47	Echinosphaerella limenetica *G.M.Smith*
20	Scenedesmus hystix var.linearis *Hansg*	48	Schroederia setigera *(Schrod)Lemmermann*
21	Scenedesmus muzzaensis *Hyber Pestalozzi*	49	Actidesmium Hookeri *Reinsch*
22	Scenedesmus acutiformis *Schroeder*	50	Tetrastrum heterocanthum *Nordst Chod.*
23	Pediastrum tetras *Ralfs.*	51	Chlorosarcina consociata *(Klebs) G.M.Smith.*
24	Pediastrum simplex var. deodenarium *(Bailey) Rabenhorst*	52	Kirchneriella lunaris *(Kirch) Moebius*
25	Pediastrum duplex var. cohaerens *Bohlin*	53	Excentrosphaera viridis *G.T.Moore*
26	Pediastrum Boryanum *(Turp.) Meneghini*	54	Chlorella vulgaris *Beyerinck*
27	Pediastrum duplex var. gracilimum *West & West*	55	Micractinum pusillum *Frescenius*
28	Pediastrum biradiatum *Meyen*		

Municipal sewage and domestic waste is responsible for the growth of algal forms. Similar result was obtained by Mruthunjaya *et al* [1] and Jose and Patel [2]. Chlorella and Scenedesmus were found dominant in the water with oxdisable organic water. Similar results were obtained during investigation. During present studies it was also observed that *Pediastum sp.* was found in dominant condition. Our results matches with that of Munnawar [18] and Seenayya [19] who opined that oxidisable organic matter supports the growth of Chlorococcales. The growth of Chloococcalean flora flourishes by the presence of high pH. Similar condition was found during present investigation during summer. Our results matches with that of Habib and Chaturvedi [3] who opined that tropical climate and mineral rich condition was favourale for the luxurious growth of algae. Chloococcalean flora was found dominant at all sampling stations during the investigation period.

Throughout the investigation period at all stations Chlorococcales were found dominant as compared to other members. *Scenedesmus* comprised 13 species, while six species of *Pediastrum* were recorded. Besides this, *Coelastrum* are also found abundantly. *Characium and Ankistrodesmus,* were found more in number during summer season. Thus, it was observed that Chlorococcalean flora was flourished during late winter and summer seasons. Tiwari *et al.*,[5] also found the same results from river Ganga. Low level of DO, high BOD and nutrients during summer season favours the growth of phytoplankton [20, 21]. Pandey *et al* [22] encountered maximum density of Chlorococcalean flora during the month of April and May and least in September from river Kosi and showed co-relation with the temperature and pH which matches with our findings.

Discharge of anthropogenic wastes in river stream drastically affects the water quality and consequently the algal flora inhabiting it. Chlorococcalean flora flourishes well both in polluted and unpolluted habitats (Tiwari *et al* [5]. According to Palmer's organic pollution indices the common pollution tolerant forms encountered were *Ankistrodesmus fulcatus, Chlamydomonas* species, *Chlorella vulgaris, Scenedesmus quadricauda,* grew well at station S2, and S3 and S10 showing the polluted nature. Sedamker and Andgadi [23] were of opinion that higher values of alkalinity, nitrates, phosphates and BOD attribute the growth of Chlorococcalean group.

Chlorococcalean forms were dominant at all stations during the investigation period and their number was more during summer. Our results were co-relates with Sheeba and Ramanujan [24] and Lakshminarayana [25].

Thus, it was observed that fluctuation in physico-chemical parameters favours the growth of Chlorococcales. It was also observed that Chlorococcalean forms flourished well in water that was rich in nitrates and phosphates. Thus, periodicity and population (abundance) of Chlorococcales depended upon the mode of nutrition, changes in water level, transparency and temperature.

CONCLUSION

During present studies of Godawari river physico-chemical parameters were showing the range of variation during various seasons of the year. River water showed high values of chlorides, alkalinity, hardness, BOD and low values of pH and DO which indicate the organic pollution of river. River water was always alkaline and it favours the growth of Chlorococcalean flora. Bright sunlight during summer resulted the increase in population and diversity of Chlorococcalean flora. Due to dumping of municipal sewage and domestic waste of Nashik city, the algal flora was flourished imparting the unpleasant odour to water. To protect this ecosystem there should be proper management and planning of dumping the municipal sewage for health hygiene and sustainable environment.

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