J. Indian bot. Soc Vol. 86 (3 & 4) 2007 : 36-41

BIOTIC COMPONENTS OF SEWAGE INFLUXED GOMATI WATER AT DISCHARGING POINTS INTO RIVER GOMATI AT JAUNPUR CITY (U.P.)

K.N. MISHRA, U.C. MISHRA AND D.P. SINGH
Dept. of Botany, T.D. College, Jaunpur, U.P. 222 002 (U.P.)
*E-mail : mishraknjnp06@rediffmail.com

Biotic Components of sewage influxed Gomati water at Jaunpur city, have been investigated and quantified. The phytoplankton constitutes the major portion of biota in sewage. However, the coliform bacteria has also been assessed to justify the faecal contamination into sewage influxed Gomati water. Collectively 87 species of algae belonging to Chlorophyceae (29 spp), Bacillariophyceae (28 spp), Cyanophyceae (25 spp) and Euglenophyceae (5 spp) have been isolated from the four different sampling sites (viz. Jahangirabad Ghat, Kila Ghat, Newbridge Ghat and Miyanpur Ghat).

Most of the phytoplanktons were pollution tolerant and their distributions were greatly influenced by physico-chemical quality, pollution load and nature of pollutants on various sewage receiving sites. However, the higher population densities of coliform bacteria were recorded throughout the study period at most of the sampling sites. The peak value of MPN for coliform bacteria(9600 / 100ml) was recorded at the Miyanpur ghat site indicating the maximum faecal contamination at this site.

Key words : Biotic, River Gomati, Sewage, Phytoplankton, Physico-chemical, Coliform bacteria.

Sewage is the cloudy dilute aqueous solution of wastes generated from the community, various anthropogenic activities of dwellers as well as from other domestic animal houses, which is extremely foul in nature, consisting of sludge discharge from latrines, urinals, stables, industries, soapy wastes, garbage, paper dirt, dirty water and numerous other substances (Sharma 2000). Sewage is always highly turbid, rich in organic wastes, phosphates, nitrate and urea etc. It is therefore eutrophic in nature and hence remains organically rich and polluted (Sharma et al. 1981). Various aspects of biological properties of sewage influxed river water have been investigated time to time by number of investigators in India and abroad (Ray, 1994; Mishra, 2000; Pandey and Dungarwal, 2004; Sharma and Joshi, 2005).

However, there was paucity of information in context to the biological properties of sewage influxed Gomati water at Jaunpur city. Therefore, in order to bridge the gap of knowledge and to provide the basic ecological data concerned with the biotic aspects of sewage influxed Gomati water. The present work has been conducted from January to December 2005. Depending on the intensity of sewage (organic load) the Gomati water samples were collected from the four different sites (viz Jahangirabad ghat,Kila ghat, Newbridge ghat and Miyanpur ghat sites) and analyzed for the various biotic components in general and for algal as well as coliform bacterial population dynamics in particular.

MATERIALS AND METHODS

Sampling sites and Sample Collection

The Gomati river centrally flows (West to East) through the Jaunpur city. Four sampling sites receive different sewage load, were selected for the detail study of biotic features of sewage influxed river Gomati water at discharging points in span(4 km.) of Jaunpur city. These are site first(Jahangirabad Ghat), site second (Kilaghat), site third (New Bridge Ghat) and site fourth(Miyanpur Ghat), situated upto down stream and carrying gradually higher load of sewage.

Sewage influxed Gomati water samples were collected in fresh plastic bottles (one liter capacity)

Table-1: Distribution of Algal Flora In Sewage Influxed Gomati Water

Class	Site Ist		Site I Ind		Site IIIrd		Site IVth	
	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.	Gen.	Sp.
Chlorophyceae	23	27	17	20	10	12	8	9
Bacillariophyceae	12	21	11	18	10	16	8	13
Cyanophyceae	5	9	5	13	8	21	8	24
Euglenophyceae	Nil	Nil	1	2	2	4	2	24
Grand Total	40	57	34	53	30	53	26	51

in triplicate from the discharging points of municipal drain into river, at monthly intervals. The plankton samples were obtained by filtering 10 liter waste water from each site through a standard plankton net of bolting silk (mesh No. 22).

Laboratory Examination

The sewage influxed river water samples were brought to laboratory and analyzed, following Greenberg APHA(1989), for physico-chemical properties. Simultaneously the plankton samples after collection brought to laboratory and preserved in "lugol" solution. The plankton cells were directly counted (Colonial forms counted as individuals units) and identified according to Presscott (1951). Total and faecal coliform bacteria were estimated by "Multiple tube fermentation technique" and MPN per 100 ml was determined following APHA(1989).

RESULTS AND DISCUSSION

The biotic Composition of sewage entering into river Gomati have been investigated for the two aspects of immense values given below.

1. **Phytoplanktonic Population :** It includes density and diversity index, of the phytoplankton.

2. **Coliform bacterial Population :** It includes the density of coliform bacteria (MPN) in sewage influxed river water samples.

Sewage influxed river water mostly remains organically rich and the algal population is affected variously. Severe organic pollution some times causes total deoxygenation resulting the elimination of all the algal flora, if however, few quantity of

Table-2: Monthly Variation in the Phoytoplankton Density of Sewage Influxed Gomati Water

Months (2005)	Sampling Sites			
	Ist	IInd	IIIrd	IVth
January	1300	1260	900	700
February	1180	1100	1050	900
March	1800	1760	1700	1200
April	2400	2350	2270	2000
May	2800	2650	2470	2300
June	1900	1850	1780	1500
July	1000	980	915	800
August	300	290	250	210
September	350	300	285	270
October	800	716	690	640
November	1100	1000	980	930
December	1120	1040	990	950

oxygen remains, the algae are reduced in their number (i.e. density) and nature (i.e. only pollution tolerant algae occurs) in sewage influxed river water. The fresh water flora are reduced or some what disappears and algae characteristics of polluted water becomes abundant due to lack of predation pressure (Mukherjee 1996).

During the course of present investigation the pollution tolerant algae belonging to Chlorophyceae, Bacillariophyceae. Cyanophyceae and Euglenophyceae have been isolated at the different additive points of sewage into river Gomati water. Collectively eighty seven (87 sp.) species of algae have been identified from four different sewage influxed Gomati water samples of the four study sites. Out of these 23 genera and 29 species belong to Chlorophyceae, 13 genera and 28 species to Bacillariophyceae, 8 genera and 25 species to Cyanophyceae and 2 genera with 5 species to Euglenophyceae. The distribution of algal flora at various sites varies highly influenced by physico-chemical properties, pollution load and nature of pollutants in sewage.

Phytoplankton

The water at site first carries comparatively least amount of sewage and possessed 57 species of algae belonging to Chlorophyceae (27 species), Bacillariophyceae (21 species), Cyanophyceae (9 species).

Table-3: Monthly Variation in Diversity Index of Sewage Influxed Gomati Water

Months (2005)	Sampling Sites			
	Ist	IInd	IIIrd	IVth
January	1.23	1.21	1.05	1.01
February	1.09	1.08	1.06	1.02
March	1.48	1.42	1.39	1.12
April	1.78	1.75	1.68	1.57
May	1.95	1.89	1.78	1.68
June	1.54	1.21	1.07	1.05
July	1.08	1.06	1.04	1.03
August	0.65	0.63	0.6	0.56
September	0.86	0.69	0.64	0.61
October	1.04	1.01	0.95	0.92
November	1.09	1.05	1.03	1.01
December	1.11	1.06	1.04	1.03

The site second (Kilaghat) receives a murky load of sewage and exhibited comparatively less number of algae than site first. It contains 53 species of algae including 20 species of Chlorophyceae, 18 species of Bacillariophyceae, 13 spcies of Cyanophyceae and 2 species of Euglenophyceae.

The third site (i.e. NBG) carries higher load of sewage from different localities. The sewage influxed river water samples at this site exhibited 53 species of algae with Chlorophyceae, 12 species, Bacillariophyceae, 16 species, Cyanophyceae, 21 species, and the Euglenophyceae, 4 species.

The water near Miyanpur ghat (fourth site) carries the maximum load of sewage including variety of waste products. There were 51 speeies of algae that have been identified at this additive point. Of these 9 species of Chlorophyceae, 13 species of Bacillariophyceae, 24 species of Cyanophyceae and 5 species of Euglenophyceae.

The phytoplankton population was observed to be maximum at the first study site (i.e. 57 species), however, it recorded minimum (i.e. 51 species) at the site fourth. The members of Chlorophyceae and Bacillariophyceae were maximum at the site first, however, they were observed to be minimum at the fourth site. Where as, the Cyanophyceae members exhibited luxuriant growth with maximum population at site fourth followed by site third. The Euglenoid members were at peak on site fourth though they were totally absent at site first. The Cyanophycean as well as Euglenophycean algae were predominant on the sites with greater sewage load (i.e. third and fourth sites) and shown a trend of increasing population with increasing concentration of sewage. However, the Chlorophyceae and Bacillariophyceae members decreased synchronously. Generally diatoms observed growing luxuriantly during winter months, though some of them recorded through out the study period.

Poor growth and hence least population of phytoplankton have been observed during the July to September (i.e. rainy months), which may be attributed to dilution of wastes, high velocity, oxygenation and turbidity of water due to clay particles, Saxena (1980), Tiwari *et al.* (1985), Sikandar (1987), Shukla & Tripathi (1989), Mishra (1992), Rawat (2003), Sharma and Joshi (2005) have also made similar findings.

The Gomati water at discharge points of municipal drains develop eutrophic condition due to flow of sewage containing organic matter (Round 1979), excess fertilizers of agricultural lands through run-off and detergents which ultimately brought about the condition of organic pollution, where only highly pollution tolerant algal flora may survive. The dominant algal species occurred at the various

Table-4: Density of Total Coliform Bacteria in Sewage Influxed Gomati Water. (Unit/100ML)

Months	Sampling Sites			
	Ist	IInd	IIIrd	IVth
January	1200	1300	1900	2600
February	1700	1900	1800	2100
March	4000	5200	6500	7500
April	3000	4000	5500	8200
May	4000	4600	5100	5000
June	4200	4500	5000	5200
July	3500	1800	3000	3600
August	3800	4000	7500	9600
September	2500	3000	4000	5000
October	1800	1900	2200	2400
November	1500	1700	1900	2100
December	1000	1100	1200	3500

Table-5: Total Faecal Coliform Bacteria in Sewage Influxed Gomati Water (Unit/100ML)

Months (2005)	Sampling Sites			
	Ist	IInd	IIIrd	IVth
January	160	450	475	1200
February	620	250	425	1300
March	450	1370	800	2200
April	475	750	490	2200
May	600	700	725	1500
June	400	700	900	2000
July	650	500	1100	2100
August	7000	1500	2600	3600
September	350	1400	2100	2100
October	450	790	1200	1300
November	200	540	1100	1400
December	115	225	700	250

sites are pollution tolerant. Some of these are *Actinastrum hantzschii, Ankistrodesmus falcatus, Chlorella vulgaris, Chlorococcum infusionum, Coelastrum microporum, Hydrodictyon reticulatum, Pandorina morum, Pediastrum duplex, Senedesmus dimorphous, S. bicaudatus, S. obligatus, Spirogyra affinis, Stigeoclonium tennue, Tetraedron minimum, Shizomeris libeinliies, Ulothrix subtilissima of Chlorophyceae; Acanthes exigua, Cyclotella glomerata, Fragillaria capucina, Melosira granulata, Navicula cryptocephala, N. accomoda, N. virdula, Nitzschia recta, N. palea, Synendra ulna of Bacillariophyceae; Anabaena constricta, Arthrospira jenneri, Lyngbya kuetzingii, L. aerugineo-coerulea, Microcystis aeroginosa, Oscillatoria chlorina, O. Formosa, O. curviceps, O.princeps, O. subbrevis, O. tenuis, Phormidium bohneri, P. luridum, Spirulina major of Cyanophyceae and Euglena viridis, E. acus, E. gracilis, Phacus longicauda, P. pusillus of Euglenophyceae.* These have shown a wide range of tolerance to physico-chemical variation in water and were most tolerant to organic pollution and therefore referred as "pollution indicator species". The report of Kumar *et al.* (1974), Rai and Kumar (1976), Round (1979), Palmer (1980), Prasad and Saxena (1980), Venkateswarlu (1981), Kant (1985), Mishra and Tripathi (1992), are in support of our findings.

Phytoplanktonic Density

Sewage influxed water of river Gomati exhibited marked fluctuation in Phytoplankton density (2.8 x 10^3 individual L^{-1}) was observed at the site first in month of May. However, it was reduced to minimum of (0.21 x 10^3 individual L^{-1}) at site fourth in month of August. At rest of the sites the Phytoplankton density ranged between (0.25 x 10^3 individual L^{-1}) at site third in month of August to (2.65 x 10^3 individual L^{-1}) in month of May at site second. It was lower during rainy months with respect to winter and summer months.

Diversity Index

The value of Shanon Weaver Diversity index (DI) were higher at the site first than that of the other sampling sites through out the study period. However, the lower index values were observed at site fourth in all the month. The peak value for diversity index (DI) was recorded (1.95 bits per individual) in month of May at site first. However, the lowest DI value was observed a site fourth (0.56 bits) in month of August. Generally the diversity index values were higher during winter months followed by summer and rainy months.

Coliform Bacterial Population in Sewage influxed gomati water

Higher population densities of coliform bacteria were recorded throughout the year at all the sampling sites. With increasing faecal contamination into water increase in MPN of coliform and Faecal coliform was also noted. The maximum coliform bacterial density (9600/100ml) was recorded at the site fourth and it was lowest (1000/100ml) at site first in the month of August and December respectively. However, the density of faecal coliform bacteria ranged form a minimum of 115/100ml in December at site first to a maximum of 3600/100ml in August at site fourth. There was a general trend of decrease in the bactetial density from September

to February and increase from March to May months, Dufour (1977), Prasad (1992), Shukla and Anjum (1993) have also reported the similar pattern. The common bacterial species isolated from the different sites are *E. coli, Klebsiella, Enterobacter* (Aerobater) and *Citrobacter*. In presence of sufficient nutrient and favourable conditions of temperature and moisture, the bacteria are very reactive (Rawat, 2003).

REFERENCES

Aher N.H., D.S. Jain, M.R. Kumawat & S.N. Nandan 2005 Studies of water pollution of Mosam river of Baglan Tahsil (Maharashatra) pp.113-114. In Abstract proceeding of Plant Science 92nd *Indian Science Congress*, Ahmedabad.

APHA 1989 *Standard Methods For the Examination of Water and Waste Water.* 17th edn. American Public Health Association, Washington, D.C.

Kant 1985 *Algae as indicator of organic pollution of cit,* pp 77-86.

Kumar H D 1994 Screening and chracterization of pullution strategies of river Sabarmati, Gujrat, India, *Geobios.* **21**(4) 283-289P.

Mishra B P 1992 *Ecological studies on pollution and management of river Ganga in Varanasi.* Ph.D. Thesis Botany, B.H.U. Varanasi.

Mishra, M K & R N Trivedi 1998 Anaerobic digestion of organic fractions of municipal solid wastes and domestic sewage of Patna. *J. Mendel,* **15**(1-2) 31-32.

Mishra R 1968 *Ecology Work-Book* Oxford and IBH Publishing Co, Calcutta, Bombay. New Delhi. pp 1-244.

Mishra U C 2000 *Ecological Investigation of River Gomati under the influence of municipal wastes at Jaunpur City* (U.P.) Ph.D. Thesis V B S Purvanchal University, Jaunpur-222 001 (U.P.)

Mukherjee1996 "Environmental Biology" P.502 – 524 Tata Mc Grahill Publishing Company Ltd., New Delhi.

Palmer C M 1980 *Algae and water pollution,* Castle House Publi. Ltd. ISBH 071940052x.

Pandey Usha & Hemant Kumar Dungarwal 2004 Algal flora from tank of Ekling Ji Temple of Udaipur, Rajasthan. *Plant Archives* 4 No. 2 pp 483-485.

Prasad B N & M Saxena1980 Ecological study of blue green algae in river Gomati *Indian J. of Environ. Hlth.* **22**(2) 151-168.

Presscott G W 1951 Algae of Western Great Lakes area. Institute of Science London. U.K. Bulletin 31.

Purandra B K, Varadarajan N & Jayashree K 2003 Impact of sewage on ground water quality. Case study. *Polln. Res*, **22**(2) pp 189-197.

Rai L C & H D Kumar 1976 Algal growth as a means of evaluation of nutrient status of a fertilizer factory near Shahupari. Varanasi. *Trop Ecol* **17**(1) 50-56.

Rawat Mamta 2003 Presumptive coliform count test for the assessment of faecal contamination of two water reservoirs of Jodhpur region. *Eco. Env. conserv,* **9**(1) 51-53.

Ray P 1974 Limnological studies on Yamuna, Delhi India. The dynamics of potamoplankton population in the river Yamuna. Archiv. Fur. *Hydrobiologique* **73** 492-570.

Round F E 1979 *The Ecology of algae,* Cambridge University Press, P. 653.

Saxena P N 1979 Algae and the Sewage Problem. In *Progress in Plant Research,* pp. 1-114. Silver Jubilee Publ. NBRI, Lucknow I.

Sharma B K 2000 *Environmental Chemistry. Secetion IV Water pollution* 5th edn. Goel Publishing

house, Krishna Prakashan Media (P) Ltd. Meerut (U.P.) India.

Sharma K D N Lal and P D Phatak1981 Water Quality of Sewage drains, entering Yamuna at Agra. *Indian J. Environ. Hlth.* **23** pp.118-122.

Sharma Vivek & B D Joshi 2005 Studies on some physicochemical Parameters of river Yamuna & its Two minor Tributaries from Garhwal Region pp-13 in Advance Abstract proceedings of Animal veterinary and fishery Sciences 92nd Indian Science Congress Ahmedadabad.

Shukla S C & B D Tripathi 1989 Biological treatment of domestic waste water of water hyacinth and Algal culture, *Science and Culture* **55** 209-211.

Shukla A C & Anjum 1993 Biological aspects of Ganga river ecosystem. *Aquatic. Sc. In India* p. 93-103.

Sikandar Md. 1987 *Ecology of river Ganga with special reference to pollution* Ph.D. thesis B.H.U. Varanasi.

Tiwari D and H D Kumar 1985 Algal Dynamics in relation to some factors causing eutrophication. In advances in applied Phycology (Eds. A.C. Shukla and S.N.Pandey) Op. Cit. pp. 251-261.

Venkateswarlu 1981 Ecology of Algal blooms comparative study. *Indian J Bot* **4** 31-36.