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Microbiological Characteristics of Sewage Discharged in Yamuna River

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ABSTRACT: *In order to study the effect of contaminated river water of Yamuna where sewage water is discharged, an experiment was conducted during the year of 2003 to 2004 at three sites of Allahabad region. The site comprises of T_1 (Gaughat Nala No. 1), T_2 (Gaughat Nala No. 2) and T_3 (Baluaghat Chachar Nala). Four points were selected from each site for water collection and analysis were P_1 (Upstream of Yamuna river), P_2 (Downstream of Yamuna river), P_3 (Mixing point of Yamuna and sewage water) and P_4 (Sewage waste water). Maximum Total Plate Count, Total Coliform,* Faecal coliform *and* Faecal streptococci *was observed in sewage waste water of Gaughat Nala No. 2 followed by the sewage waste water of Baluaghat Chachar Nala in 2003 and 2004.Sewage waste water of Gaughat Nala No.1 recorded minimum Total Plate Count, Total Coliform,* Faecal coliform *and* Faecal streptococci *in both of the years. The Upstream of Yamuna River recorded minimum Total Plate Count, Total Coliform,* Faecal coliform *and* Faecal streptococci *and good for irrigation and bathing purpose but not for drinking.*

Keywords*: Total Plate Count, Total Coliform, Faecal coliform, Faecal streptococci, sewage water*

INTRODUCTION

A large part of the municipal sewage is still flowing into the aquatic environment without any treatment, thereby increasing the oxygen demand in shrinking water bodies and increasing the bacterial load of water, which is the main cause of water born diseases. On the basis of the existing circumstances, it is guessed that is near in future, good quality of water on account of the ever growing population and Industrialization, will become a scarce commodity and, as such normal living of humanity will become very difficult. Pollutants entering water sources are classified broadly into following categories; domestic sewage and oxygen demanding water; infectious agents; plant nutrients; chemicals such as insecticides; herbicides and detergents; other minerals and chemicals; sediments from land erosion; radioactive substances and heat from power and industrial plants.

Sewage polluted water is often a common source of diseases in human and animals (Craun, 1972). Waterborne diseases constitute one of the major public hazards in the developing countries. Worldwide, in 1955, contaminated water and food was responsible for more than 3 million of death, of which more than 80% were among children under age five (WHO, 1996). Besides conventional pathogens which are transmitted by water, several other emerging waterborne pathogens have become increasingly important during the last decade. In India, more than 70% epidemic emergencies are either waterborne or water related (Khera *et. al.* 1996). The present study was conducted to quantify some of the microbiological characteristics of raw sewage water.

MATERIALS AND METHODS

The present work was conducted in Department of Biological Sciences, Sam Higginbottom Institute of Agriculture Technology and Sciences Allahabad. The experiment was laid out in Randomized Block Design using two way classification with one observation per cell (Ray and Sharma 2004). Three sites were denoted at three replication and the significance of various factors were judged by calculating 'F' value at 5% level of significance. The experimental work was performed in the laboratories of SHIATS, Allahabad (U.P.) and IFFCO, Phulpur Allahabad (U.P.) situated at 25.67^0N latitude, 81.5^0E longitude and at an altitude of 98 m from mean sea level. This region has subtropical climate prevailing in the south-east parts of UP with both the extremes of temperature in summer and winter with an estimated population of more than fifty lakhs. The climate of the region was

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hot and humid. The seasons are extreme with temperature fluctuation from 48ÚC in summer and 6ÚC in winter. The average rainfall is 153.82 cm (Singh and Rai 2003). The river Yamuna enters the city from south west direction and joins the river Ganga at forthest southeastern part of the city. Three sites from which sewage water entered the Yamuna river body taken for study were T1 (Gaughat Nala No. 1), T2 (Gaughat Nala No. 2) and T3 (Baluaghat Chachar Nala) and four points at each site was taken for the analysis were P1(Upstream of Yamuna river), P2 (Downstream of Yamuna river), P3(Mixing Point of sewage water and Yamuna river) and P4(Sewage waste water). GaughatNala No.1 and Nala No. 2 both are situated near the Naini bridge about 3 to 5 km upstream of Sangam. The Chachar Nala is the biggest Nala which contribute about 27% of the total population of Allahabad. It discharges the entire water including a part of sewage and sludge near 'Baluaghat' in Yamuna River about 5.5km to the upstream of Sangam. Sewage water sample were collected in the first week of January 2003 to September 2004 in between 7.0 A.M. to 9.0A.M. at regular intervals of three months. The collection of the sample was done very carefully. The Microbiological parameters Total plate count (TPC) was determined by SPC method. Total Coliform (TC), Faecal Coliform (FC) and Faecal Streptococci (FS) were estimated by MPN method (APHA, 1989).

RESULTS AND DISCUSSION

Microbiological Characteristics of Sewage Water

In the year 2003 and 2004, Total Plate Count (TPC) at siteT1 was observed maximum $65.0x10^5$cfu/ml in the sewage water while the river water showed a range from 0.04 to $1.82x10^5$cfu/ml. At site T2 the TPC in the years was found to be minimum $0.06x10^5$cfu/ml in the upstream of Yamuna River while the maximum was $72.8x10^5$cfu/ml in the sewage water. At site T3 the highest TPC was observed as $68.1x10^5$cfu/ml and the river water showed a range between 0.05 to $1.25x10^5$cfu/ml in both the years. Total Coliform (TC) at the site T1 was recorded minimum $2.5x10^3$ MPN/100 ml in upstream of Yamuna in the winter season of both the years while the maximum was $94.0x10^3$MPN/100 ml in sewage water in the monsoon season of 2004. At site T2 the TC in both the year was observed in minimum $2.8x10^3$ MPN/100 ml in the upstream of Yamuna River but in the sewage water an increase of 11.16% in between two seasons. At site T3 the TC was found to be maximum $94.5x10^3$MPN/100 ml in the sewage water while the river water showed a range from 19.5 to 26.2 MPN/100 ml of the year 2003 and 2004.

Faecal Coliform (FC) at site T1 was found to be highest $80.3x10^3$MPN/100 ml in sewage water while the river water showed a range from 1.9 to 21.0x 10^3MPN/100 ml in both the years. At site T2 FC in both the years observed minimum in Yamuna River water but there was an increase of 31.99% in between the two seasons. At site T3 lowest FC was $21x10^3$ MPN/100 ml in upstream of Yamuna in the winter season of year 2004 while the highest was $82.3x10^3$MPN/100 ml of the year 2004 and $82.0x10^3$ MPN/100 ml in the year 2003 in the summer season. *Faecal Streptococci* was observed minimum $2.1x10^3$MPN/100 ml in upstream of Yamuna in site T1 but there was an increase of 50% in between two seasons. At site T2 the minimum FS was $2.6x10^3$ MPN/100 ml in upstream of Yamuna in the winter season of Year 2003 while the maximum was $60.0x10^3$ MPN/100 ml in sewage water in the monsoon season of year 2004. At site T3 the FS was found to be maximum $59.0x10^3$ MPN/100 ml in sewage water while the river water showed a range from 2.3 to $24.6x10^3$ MPN/100 ml.

CONCLUSION

The above finding concludes that the pollution parameters like microbiological was variable for site to site depending upon the ecological conditions as well as quality and quantity of sewage waste. The river water is good for irrigation and bathing purpose but not good for drinking. The only drawback of the river water is high turbidity, BOD and COD values which may be due to the microbiological activities on decayed animals and vegetable waste. The parameters like total plate count, total coliform, *Faecal coliform* and *Faecal streptococci* exceeded the permissible limits and it is a biological indicator of pollution.

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Table 1
Microbiological Characteristics (Total plate count and Total coliform count) of Sewage Water Discharged in Yamuna River

Sites	*Place*	*Total plate count x 10^5 CFU/ml*						*Total coliform count x 10^3 MPN/100 ml*					
		2003			*2004*			*2003*			*2004*		
		S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
T_1	P_1	0.03	0.06	0.14	0.04	0.07	0.15	2.5	3.7	4.5	2.5	4.0	4.6
	P_2	0.15	0.25	0.38	0.14	0.27	0.39	7.2	10.2	16.3	7.2	10.7	16.6
	P_3	1.10	1.49	1.79	1.06	1.50	1.82	40.3	48.8	79.0	41.0	52.8	80.0
	P_4	32.0	45.9	64.3	33.0	46.0	65.0	84.7	90.2	93.6	83.2	89.0	94.0
T_2	P_1	0.06	0.07	0.16	0.08	0.09	0.17	2.8	4.1	5.0	2.9	4.2	5.2
	P_2	0.17	0.32	0.42	0.18	0.35	0.45	7.4	10.9	17.8	7.5	11.8	17.6
	P_3	1.15	1.59	1.97	1.17	1.62	1.99	44.2	56.9	84.3	44.0	57.6	85.8
	P_4	36.2	47.3	70.5	36.0	48.5	72.8	88.0	92.8	96.0	87.8	93.0	97.6
T_3	P_1	0.05	0.06	0.14	0.06	0.07	0.15	2.7	3.9	4.7	2.8	4.1	4.8
	P_2	0.16	0.29	0.39	0.17	0.28	0.42	7.2	10.4	16.8	7.3	10.5	16.7
	P_3	1.13	1.50	1.95	1.15	1.54	1.95	43.2	53.4	82.9	43.3	55.4	85.0
	P_4	33.0	46.2	68.1	33.9	47.0	68.0	84.5	91.4	94.5	84.0	91.5	94.2
Years		Places	Sites	Seasons				Years		Places	Sites	Seasons	
2003	SEM	3.24	-	2.8				2003	SEM	3.36	-	2.91	
	CD	6.63	-	5.73					CD	6.88	-	5.96	
	(P=0.05)								(P=0.05)				
2004	SEM	3.28	-	2.85				2004	SEM	3.4	-	2.94	
	CD	6.72	-	5.84					CD	6.96	-	6.02	
	(P=0.05)								(P=0.05)				

Table 2
Microbiological Characteristics (*Faecal coliform* and *Faecal streptococci*) of Sewage Water Discharged in Yamuna River

Sites	*place*	*Faecal coliform x 10^3 MPN/ 100 ml*						*Faecal streptococci x 10^3 MPN/ 100 ml*					
		2003			*2004*			*2003*			*2004*		
		S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3	S_1	S_2	S_3
T_1	P_1	1.9	2.5	3.2	1.9	2.6	3.0	2.1	2.6	3.2	2.2	2.5	3.3
	P_2	6.2	7.0	10.0	6.0	6.8	10.2	3.7	5.2	8.2	3.9	5.3	8.5
	P_3	12.8	15.8	20.6	12.9	17.0	21.0	16.6	21.0	23.0	16.5	22.0	24.0
	P_4	61.0	65.0	79.6	61.8	67.0	80.3	39.2	44.2	57.4	40.0	45.0	58.8
T_2	P_1	2.2	2.7	3.5	2.4	3.0	3.8	2.6	2.9	3.9	3.0	3.2	4.1
	P_2	6.8	7.2	11.6	6.9	7.5	11.8	5.0	6.1	8.5	5.2	6.3	9.0
	P_3	14.7	18.0	22.6	15.8	18.9	22.5	16.8	22.8	25.2	17.9	23.0	25.6
	P_4	64.7	72.3	85.2	65.6	73.0	85.4	40.0	45.0	59.7	42.8	46.5	60.0
T_3	P_1	2.2	2.6	3.2	2.1	2.8	3.2	2.3	2.7	3.3	2.5	2.9	3.4
	P_2	6.6	7.0	11.2	6.5	7.1	11.3	4.2	5.4	8.3	4.6	5.5	8.7
	P_3	14.2	17.0	22.0	13.6	18.0	22.1	16.5	21.9	24.6	17.0	22.5	24.4
	P_4	61.2	66.2	82.0	62.1	68.0	82.3	39.2	44.6	58.2	40.6	45.3	59.0
Years		Places	Sites	Seasons				Years		Places	Sites	Seasons	
2003	SEM	1.69	-	1.46				2003	SEM	1.53	-	1.32	
	CD	3.46	-	2.99					CD	3.13	-	2.70	
	(P=0.05)								(P=0.05)				
2004	SEM	1.43	-	1.24				2004	SEM	1.52	-	1.32	
	CD	2.93	-	2.54					CD	3.11	-	2.70	
	(P=0.05)								(P=0.05)				