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Short Communication

A Comparative Study of the Bacterial flora in a Tannery Polluted Environment and a Freshwater Fish Pond

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The present study was carried out to assess the total bacterial load, incidence of total coliform, faecal coliform (*Escherichia coli*) and *Salmonella* species in water and soil of a tannery polluted environment (river Buriganga) and a selected freshwater fish pond environment. Samples were analyzed for their monthly variation and made a comparative investigation between the two different environments. The highest viable bacterial count was observed in tannery polluted water (2.7×10^5 cfu/ml) in May 2005 and in soil (5.7×10^7 cfu/g) in August, 2005. The total coliform and faecal coliform counts were always very high (>2,400/100 ml) in water and soil (>240/g) of tannery polluted area as measured by the most probable number (MPN) method. *Salmonella* was always present in tannery polluted samples, and occasionally in fresh water pond samples. It was also observed that tannery polluted environment was heavily polluted due to presence of large number of pathogenic bacteria as a result of tannery wastes discharged into the area. This poses serious threats to aquatic organisms, especially fish, and also for human being living in the Hazaribagh area.

Keywords: Bacterial flora, Tannery polluted environment, Freshwater fish pond

Environmental pollution is a serious concern of the present day world, which affecting the entire human being and their assets. Pollution, as relates to air, water and soil, has over the year been variously defined depending upon the different interests involved. Tanneries are the most dominant sources of water pollution in Bangladesh, especially in Buriganga River. Now, the biodiversity of the river is degraded and facing great risk due to various polluting industries like Hazaribagh tannery industry. Water pollution is one for the main causes which inhibits the proper growth of fish and also kill the fish and ultimately decrease fish production[1]. Microbiological analyses of water distribution systems have tended to emphasize indicators of faecal contamination, in particularly the coliform group[2]. It has been suggested repeatedly that the bacterial flora of fish might reflect the bacteriological conditions of water and thus be a potential indicator of pollution[3].

The present study was conducted during April 2005 to September 2005 with the objectives of comparative investigation of total bacterial load and quantitative distribution of coliform, faecal coliform (*Escherichia coli*) and *Salmonella* to find out their monthly variation and effects of contamination due to tannery pollution. Two stations were selected for collection of water and soil samples at regular intervals. Site-1 was at Buriganga River side receiving tannery producing hazardous wastes situated behind Shikdar Medical College, Hazaribagh, Dhaka. Site-2 was a freshwater fish pond inside Zaharul Haque Hall at Dhaka University Campus, Dhaka. Water was collected in a sterilized glass bottle and soil was collected in a plastic jar using the sampler Ekman dredge. The samples were transported in an ice box with sufficient ice blocks to maintain the temperature around 4° to 6°C. The physicochemical and microbial tests were performed at the laboratory of Food Microbiology, IFST, BCSIR, Dhaka.

For bacteriological study, about 20 g of solid sample was suspended in 180 ml Ringer's solution and then serially diluted using the same diluents. Water samples were also taken directly for serial dilution. The culture media used for isolation and enumeration of bacteria included nutrient agar (NA) for total viable bacterial count (TVBC), eosine methylene blue (EMB) agar for *Escherichia coli* and bismuth sulphite agar (BSA) for *Salmonella*. Pour plate method was used for TVBC, while streak plate method was employed for the isolation of *E. coli* and *Salmonella*. The total and faecal coliform bacteria were enumerated by most probable number (MPN) procedures[4]. Incubation was carried out at 37°C for 24-48 h. The number of colonies from selected plates was counted by an automatic colony counter and the count was expressed as colony forming unit (cfu/ml).

The physicochemical properties of water and soil of studied area are shown in Table 1. In this study, only pH, colour and odour were recorded that showed distinct variation in different months in two different environmental samples. All water samples were found to be almost neutral with pH ranged from 7.3 to 7.5. The pH of the collected soil samples of both sampling site ranged from 6.8 to 7.1. Thus, there was no serious abnormality in pH of both polluted river and unpolluted freshwater pond.

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Table 1. *Physicochemical analysis of water and soil of tannery polluted environment and a freshwater fish pond environment during April through September 2005*

Parameter	Sample	Month					
		April	May	June	July	August	September
Colour	TPW	Black	Blackish	Cloudy brown	Brown	Light brown	Light brown
	TPS	Black	Blackish	Black	Black	Blackish	Dark brown
	FPW	Green	Green	Green	Green	Green	Green
	FPS	Brown	Brown	Dark brown	Dark brown	Blackish	Dark brown
Odour	TPW	Bad	Bad	Bad	Bad	Bad	Bad
	TPS	Bad	Bad	Bad	Bad	Bad	Bad
	FPW	Good	Good	Good	Good	Good	Good
	FPS	Good	Good	Good	Good	Good	Good
pH	TPW	7.3	7.4	7.5	7.4	7.5	7.4
	TPS	6.9	7.1	7	6.8	6.8	7
	FPW	7.5	7.4	7.5	7.4	7.5	7.5
	FPS	6.8	6.9	6.8	7	6.9	6.8

TPW = Tannery polluted water; FPW = Freshwater pond water; TPS = Tannery polluted soil; FPS = Freshwater pond soil.

The colour and odour of tannery polluted environment was always worst and irritating than the freshwater pond samples. The overall condition was worst in pre-monsoon period (April to June) than the post monsoon period (July to September) in the polluted environment, whereas the colour and odour of soil and water of freshwater fish pond (FFP) were more or less same throughout the study period as shown in the Table 1.

The bacteriological analytical results are shown in the Table 2. Total viable bacterial count (TVBC), total coliform (TC), faecal coliform (FC) were done quantitatively from the study areas. However, *Salmonella* was identified qualitatively. There was distinct variation in bacterial load in every month's samples. The TVBC in tannery polluted area ranged from 2.5×10^5 to 5.7×10^7 cfu/g in soil and 2.9×10^4 to 2.7×10^5 cfu/ml in water. But in freshwater pond, TVBC ranged from 2.0×10^3 to 1.4×10^5 cfu/ml in water and 2.5×10^5 to 7.6×10^6 cfu/g in soil. The results clearly showed that water and soil of tannery polluted area were rich in high microbial contamination. It appeared that tannery effluents may enhance proliferation of various types of pathogenic bacteria by contributing good source of nutrients.

The freshwater pond water and soil contained low bacterial counts. The lowest TVBC was recorded from water (2.0×10^3 cfu/ml) and soil (2.5×10^5 cfu/g) of freshwater pond environment. Determination of TVBC is of very important to assess its role on the aquatic ecosystem. Presence of unlimited bacteria may break the energy flow in the water. They affect total biological, physical and chemical parameters which are interrelated and ultimately attack the fish and its production and obviously human health by spoilage of fish[5].

Table 2. *Bacteriological analysis of soil and water of tannery polluted and a freshwater fish pond environment during April through September 2005*

Parameter	Sample	Month					
		April	May	June	July	August	September
TVBC (cfu/ml)	TPW	5.5×10^4	2.7×10^5	7.1×10^4	2.9×10^4	1.5×10^5	8.7×10^4
TVBC (cfu/ml)	FPW	6.5×10^4	2.0×10^3	3.8×10^4	2.7×10^4	1.4×10^5	1.8×10^4
TVBC (cfu/g)	TPS	3.3×10^6	3.5×10^5	3.9×10^6	2.0×10^7	5.7×10^7	7.5×10^6
TVBC (cfu/g)	FPS	6.5×10^5	2.5×10^5	1.6×10^5	5.8×10^5	5.8×10^5	7.6×10^6
TC/100 ml	TPW	>2,400	>2,400	>2,400	>2,400	>2400	1,100
TC/100 ml	FPW	21	17	460	1,100	1,100	28
TC/g	TPS	>240	>240	>240	>240	>240	110
TC/g	FPS	43	43	23	240	240	21
FC/100 ml	TPW	1,100	>2400	>2400	>2400	>2400	93
FC/100 ml	FPW	7	43	240	460	1,100	20
FC/g	TPS	>240	>240	>240	>240	>240	4.3
FC/g	FPS	43	7	NF	23	110	0.7
Salmonella/100 ml	TPW	+	+	+	+	+	+
Salmonella/100 ml	FPW	-	+	-	+	+	-
Salmonella/25 g	TPS	+	+	+	+	+	+
Salmonella/25 g	FPS	-	+	-	-	+	-

TPW = Tannery polluted water; FPW = Freshwater pond water; TPS = Tannery polluted soil; FPS = Freshwater pond soil; TVBC = Total viable bacterial count; TC = Total coliform; FC = Faecal coliform.

The MPN values for the total coliform counts in tannery polluted area varied from 1,100 to >2,400/100 ml in water and 110 to >240/g in soil. Faecal coliform counts of this area varied from 93 to >2,400/ 100 ml in water and 4.3 to >240/g in soil. But freshwater pond showed a great fluctuation of TC counts that ranged between 17 and 1,100/100ml in water and 21 and 240/g in soil (Table 2). The MPN values of FC in this area also varied from 7 to 1,100 in water and 0.7 to 110/g in soil except in June where it was not detected. Freshwater pond was less polluted than tannery polluted area in terms of faecal contamination. These results are also in agreement with the findings of Morshed *et al*.[6-7] and Aziz *et al*.[8], who studied on Buriganga River water and soil quality.

Salmonella were also isolated from the studied area. They were found in water and soil samples of tannery polluted area in every month but in freshwater pond water and soil, they were absent in April, June and September. Cherry *et al*.[6] distinguished *Salmonella* as an index of pollution of surface water. From their view, tannery polluted area could be considered as very much contaminated.

It has been reported that high amount of bacteria in environment give high load to the organisms[7]. So, the presence of high number of pathogenic bacteria in tannery polluted environment might create a severe injury to fish and their population. In present, it was observed that this area of the river Buriganga become more or less free of fish during dry reason (winter).

In conclusion, it is suggested that tannery industries should be relocated to another place as quickly as possible to save the environment for fishes and also for human being living around the area. The urgent need therefore is to gather detail information on the extent of pollution of water and soil of the water body and protect our resources.

References

1. Bhuiyan AM. 1970. Primary production of a fish pond. *J Zool Rajshahi Univer*. **4**: 55-58.
2. McFeters GA. 1990. Enumeration, occurrence and significance of injured indicator bacteria in drinking water. In *Drinking Water Microbiology* (Mcfecters GA ed), pp 478-492. Springer verlay, New York.
3. Geldreich EE & Clarke NA. 1966. Bacterial pollution indicators in the intestinal tract of freshwater fish. *Appl Microbial.* **14**: 429-437.
4. APHA. 1981. *Standard Methods for the Examination of Water and Waste Water*, 15th edn. American Public Health Association (APHA), Washington DC.
5. Huq A, Colwell RR, Rahman R, Ali A, Chawdhury MAR, Parveen S, Sack DA & Russek Cohen E. 1980. Detection if *Vibrio cholerae* O1 in the aquatic environment by fluorescent monoclonal antibody and cultural methods. *Appl Environ Microbol.* **56**(8): 270-273.
6. Morshed MG, Aziz KMS, Islam MS & Khan MR. 1985. Presence of coliform bacteria and their relative abundance in three sampling stations on Buriganga river. *Bangladesh J Microbiol*. **2**(1&2): 6-10.
7. Morshed MG, Aziz KMS, Islam MS & Khan MR. 1986. Abundance of coliform bacteria in the river sediment at three sampling stations on the Buriganga river. *Bangladesh J Microbiol.* **3**(1): 5-9.
8. Aziz KMS, Morshed MG, Chowdhury MAR & Islam MS. 1986. Isolation of entero-toxigenic *Escherichia coli* from the Buriganga river. *Bangladesh J Microbiol*. **3**(2): 1-6.
9. Boyd CE. 1982. Water quality management for fish culture pond. Aquaculture and Fisheries, Vol 9, p 318. Elservier Scientic Publishing Company, Amsterdam.
10. Cherry WB, Hanka JB, Thomason BM, Murlin AM, Biddle JW & Croom JM. 1972. *Salmonellae* as an index of pollution of surface water. *Appl Microbiol.* **24**: 334-339.