

## SHORT REPORT

# Abundance of *Aeromonas* spp. in River and Lake Waters in and Around Dhaka, Bangladesh

SALINA PARVEEN<sup>1,3</sup>, M. SIRAJUL ISLAM<sup>1</sup>, AND ANWARUL HUQ<sup>2</sup>

<sup>1</sup>International Centre for Diarrhoeal Disease Research, Bangladesh, GPO Box 128, Dhaka 1000, Bangladesh;

<sup>2</sup>Department of Microbiology, University of Maryland, College Park, MD 20742;

<sup>3</sup>University of Florida, Gainesville, FL 32611, USA

## ABSTRACT

*Aeromonas* spp. are widely distributed in the aquatic environment. In Bangladesh, seasonal distribution of these organisms in aquatic environment was studied during July 1986-August 1987. Water, sediment, plant, and plankton samples were collected monthly from the Dhanmondi lake and the Buriganga river during the study period. *Aeromonas* spp. were isolated from all samples throughout the year. The seasonal peak of *Aeromonas* spp. was observed in warmer months (April-May) in the surface waters. In the sediment, the highest peak was observed in March and August. In most plants, the highest peak was observed during the winter months (December-February). In the plankton samples of the Dhanmondi lake and the Buriganga river, the highest counts were obtained in July and February respectively. In both the sampling sites, plants were observed to contain more *Aeromonas* than did the water and sediment samples. The prevalence of *Aeromonas* spp. throughout the year in aquatic environment suggests the autochthonous nature of these organisms and that there is an association of *Aeromonas* with the aquatic environment.

**Key words:** *Aeromonas*; Water microbiology

## INTRODUCTION

*Aeromonas* spp. are widely distributed in nature and were found in aquatic vegetations, soil, drinking water and chlorinated tap water (3,4,11,18). *Aeromonas* spp. have been reported to be associated with phyto and zoo plankton in the coastal waters of Japan (20) and also from hydrophytic plants and freshwater prawns from Bangladesh (7,16). These organisms cause infection in a variety of animals, such as fish, reptiles, birds, cattle, etc. (1,15,16,19). Diseases produced by *Aeromonas* spp. span a wide spectrum of localized and systemic illnesses in human (10). These organisms are now being recognized as an important pathogen of human, and can cause various extraintestinal and gastrointestinal diseases (8).

The seasonal distribution of *Aeromonas* spp. particularly of *A. hydrophila* and their relationship with physicochemical properties of water were studied by several investigators (2,4,7,9,18). The distribution and

survival of motile *Aeromonas* spp. in brackish water receiving sewage effluent have been studied, and *Aeromonas* spp. showed seasonal cycles of prevalence in the pond effluent (13). In Bangladesh, the presence of *Aeromonas* spp. in plants, water, phytoplankton and soil was reported in pond ecosystems, but little information is available on the abundance of *Aeromonas* spp. in lake and river ecosystems. Therefore, the present study was undertaken to investigate the prevalence and abundance of *Aeromonas* spp. in lake and river ecosystems in Bangladesh.

## MATERIALS AND METHODS

### Collection of samples

Surface water, bottom sediment, aquatic hydrophytes, including *Eichhornia crassipes*, *Pistia stratiotes*,

---

Correspondence and reprint requests should be addressed to:  
Dr. Anwarul Huq

*Telanthera philoxeroides* and plankton samples, were collected monthly from July 1986 to August 1987 from the Dhanmondi lake, a recreational lake also used for fishing, and from the Buriganga river near Sadarghat terminal which receives the Dhaka City waterways discharge.

Water samples were collected in a sterile 4 oz. glass bottle from 5 cm depth, and the sediment samples were collected by core sampler developed by the International Centre for Diarrhoeal Disease Research, Bangladesh. Aquatic hydrophytes were picked by sterile forceps in plastic bags. The plankton samples were collected by a towing plankton net (number 20, mesh 77  $\mu$ m) for 20 minutes.

Samples were labeled in the field and transported to the laboratory in a coolbox with ice packs and were processed within 3 hours of collection.

### Bacteriological examination

One millilitre of water was taken in a tube of 9 ml phosphate buffered saline (PBS), and appropriate log dilutions were made for plating.

One gram of sediment and one gram of plant and plankton were similarly diluted in PBS after the samples were homogenized by mortar and pestle for 2 minutes. The plankton samples were homogenized by hand using teflon-tipped tissue grinder (Wheaton Scientific, Millville, NJ) for 2 minutes. All the samples were then plated onto McConkey's agar (15,16) taken from various dilution tubes depending on the season and incubated at 37 °C for 18 to 24 hours. The oxidase-positive lactose non-fermenting colonies were streaked on a gelatin agar plate to test their susceptibility to vibriostatic O/129 compound. Resistant to O/129 isolates was further identified through a battery of biochemical tests as described elsewhere (14). Finally, the number of colony-forming units (CFU) per ml and per gram of samples were calculated.

### RESULTS AND DISCUSSION

Numbers of *Aeromonas* spp. in various water samples in the Dhanmondi lake and the Buriganga river are shown in figure 1 and 2 respectively. *Aeromonas* spp. were found in abundance throughout the study period (July 1986-August 1987) in both the sites. In the Dhanmondi lake, the counts ranged from  $1.9 \times 10^2$  to  $9.0 \times 10^3$  CFU/ml. The highest count was found in April 1987 and the lowest in May 1987. In the Buriganga river water, the counts ranged from  $1.0 \times 10^2$  to  $1.2 \times 10^3$  CFU/ml, and the highest peaks were observed in May 1987 and the lowest in November 1986.

In the sediment of the Dhanmondi lake, the counts ranged from  $2.5 \times 10^2$  to  $5.5 \times 10^5$ /g. The highest count was found in March 1987, and the lowest in April 1987. In

the sediment of the Buriganga river, the counts ranged from  $1.5 \times 10^3$  to  $7.5 \times 10^4$  CFU/g. The highest count was found in August 1987 and the lowest in December 1986.

In the Dhanmondi lake, the counts ranged from  $6.0 \times 10^4$  to  $6.4 \times 10^6$  CFU/g for *Eichhornia crassipes*. The highest and the lowest counts were observed in May 1987 and August 1986 respectively. For *Telanthera philoxeroides*, the counts ranged from  $4.5 \times 10^4$  to  $1.6 \times 10^7$  CFU/g. The highest count was observed in December 1986 and the lowest in October 1986. For *Pistia stratiotes*, the counts ranged from  $5.4 \times 10^4$  to  $2.3 \times 10^6$  CFU/g. The highest and the lowest counts were recorded in August 1987 and May 1987 respectively.

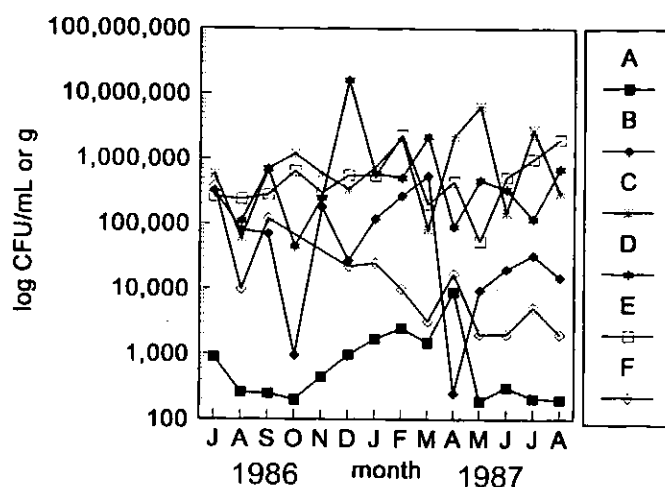


Fig. 1. Counts of *Aeromonas* spp. in various samples of Dhanmondi lake  
A=Water, B=Sediment, C=*E. crassipes*,  
D=*T. philoxeroides*, E=*P. stratiotes*, F=Plankton

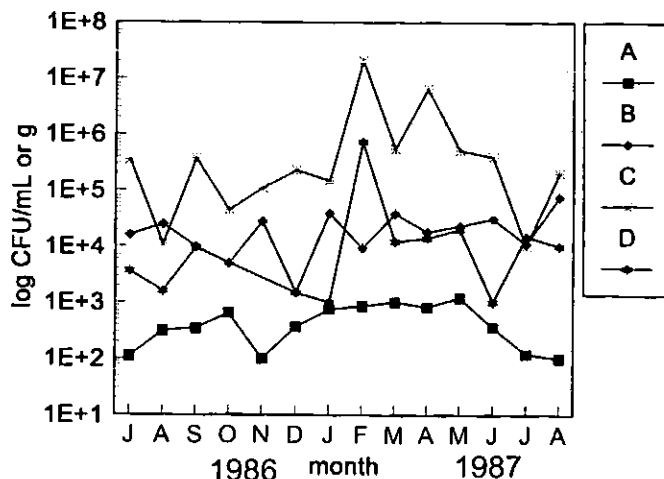


Fig. 2. Counts of *Aeromonas* spp. in various samples of Buriganga river  
A=Water, B=Sediment,  
C=*E. crassipes*, D=Plankton

For *Eichhornia crassipes* of the Buriganga river, the counts ranged from  $1.0 \times 10^4$  to  $2.1 \times 10^7$  CFU/g. The highest count was obtained in February 1987, and the lowest in July 1987.

For plankton of the Dhanmondi lake, the counts ranged from  $2.0 \times 10^3$  to  $3.8 \times 10^5$  CFU/ml. For plankton of the Buriganga river, the counts ranged from  $1.0 \times 10^3$  to  $7.3 \times 10^5$  CFU/ml. The highest peak was found in February and the lowest in January and June 1987.

The counts in water, sediment, and plankton of the Dhanmondi lake were higher than those of the Buriganga river. In both the sampling sites, the counts were greater in plants than in any other samples.

The objective of this study was to determine the abundance of *Aeromonas* spp. in open (river) and close (lake) water systems in Bangladesh. It revealed that *Aeromonas* is ubiquitous in both lake and river ecosystems of Bangladesh.

In the sediment of the Buriganga river, the highest count was found in August (Fig. 2). The persistence of *Aeromonas* spp. in sediment suggests that the organisms probably attached on substrates and gradually deposited into the sediments.

The association of *Aeromonas* spp. with different floating hydrophytes was studied earlier in Bangladesh (7,16). In the present study except *Eichhornia crassipes* and *Pistia stratiotes* of the Dhanmondi lake, the highest counts were found during the winter (December-February) when the water evaporation rate is very high. These plants consume large quantities of water which goes through a filtering system of the roots, a method that concentrates organisms present in water.

The association of *Aeromonas* spp. plankton was studied by several investigators (7,20). It was observed in our study that the plankton samples of the Dhanmondi lake provided the highest counts in July, and the plankton of the Buriganga river had the highest count in February. These results differ from the studies reported earlier (2,7,9,12). The results of our study suggest that these organisms grow better when associated with aquatic macrophytes as well as plankton and sediment and may possess a complex nutritional requirement for growth and survival of the organisms. It was found that in both the sampling sites, the counts were higher in plants than in other samples which indicated that plants may have been providing necessary support for *Aeromonas* spp. to persist in nature. From this study, it can be concluded that the presence of *Aeromonas* spp. in high concentrations in these environmental water sources can pose a public health problem and needs to be further studied.

## ACKNOWLEDGMENTS

This research was supported by the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B). ICDDR,B is supported by countries and agencies which share its concern for the health problems of developing countries. Current donors include: the aid agencies of the Governments of Australia, Bangladesh, Belgium, Canada, China, Japan, Saudi Arabia, Sweden, Switzerland, the United Kingdom and the United States; international organizations, including the Arab Gulf Fund, the United Nations Children's Fund (UNICEF), the United Nations Development Programme (UNDP), and the United Nations Population Fund (UNFPA).

We thank Mr. Manzurul Haque for secretarial assistance.

## REFERENCES

1. Boulanger Y, Lallier A, Cousineau G. Isolation of enterotoxigenic *Aeromonas* from fish. *Can J Microbiol* 1977;23:1161-4.
2. Burke V, Robinson J, Gracey M, Peterson D, Meyer N, Haley V. Isolation of *Aeromonas* spp. from unchlorinated domestic water supply. *Appl Environ Microbiol* 1984;48:367-70.
3. Clark JA, Pagel JE. Pollution indicator bacteria associated with multiple raw and drinking water samples. *Can J Microbiol* 1977;23:456-70.
4. Hazen TC, Fliermans CB, Hirsch RP, Esch GW. Prevalence and distribution of *Aeromonas hydrophila* in the United States. *Appl Environ Microbiol* 1978;36:731-8.
5. Heywood R. *Aeromonas* infection in snakes. *Cornell Vet* 1968;58:236-41.
6. Huq A, Small EB, West PA, Huq MI, Rahman R, Colwell RR. Ecological relationship between *Vibrio cholerae* with special reference to planktonic crustaceans copepods. *Appl Environ Microbiol* 1983;45:275-83.
7. Islam MS, Alam MJ, Tzipori S. Abundance of *Aeromonas* spp. in various components of pond ecosystems in Dhaka, Bangladesh. *Int J Environ Stud* 1992;39:297-304.
8. Janda JM, Duffey PS. Mesophilic aeromonads in human disease: current taxonomy, laboratory identification and infectious disease spectrum. *Rev Infect Dis* 1988;10:980-97.
9. Kaper JB, Lockman H, Colwell RR. *Aeromonas hydrophila*: ecology and toxigenicity of isolates from an Estuary. *J Appl Bacteriol* 1981;50:359-77.
10. Khardori N, Fainstein V. *Aeromonas* and *Plesiomonas* as etiological agents. *Ann Rev Microbiol* 1988;42:395-419.
11. Lechevalier MW, Evans TM, Seidler RJ, Daily OP, Merrell BR, Rollins DM, Joseph SW. *Aeromonas sobria* in chlorinated drinking water supplies. *Microbiol Ecol* 1982;8:325-33.
12. Millership SE, Chattopadhyay B. *Aeromonas hydrophila* in chlorinated water supplies. *J Host Infect* 1985;6:75-80.
13. Monfort P, Baleaux B. Distribution and survival of motile *Aeromonas* spp. in brackish water receiving sewage treatment effluent. *Appl Environ Microbiol* 1991;57:2459-67.
14. Popoff M. Genus III *Aeromonas* Kluyver and Van Niel. Krieg NR, Holt JG, editors. *In: Bergey's Manual of systematic bacteriology*, v. 1. Baltimore: Williams and Wilkins, 1984:545-8.
15. Rahim Z, Sanyal SC, Aziz KMS, Huq MI, Chowdhury AA. Isolation of enterotoxigenic, hemolytic and antibiotic resistant *Aeromonas hydrophila* strains from infected fish in Bangladesh. *Appl Environ Microbiol* 1984;48:865-7.

16. Rahim Z, Aziz KMS, Molla MAZ. Isolation of *Aeromonas hydrophila* from root system of five common water plants of Bangladesh. *J Bot* 1985;14:90-1.
17. Rippey SR, Cabelli VJ. Occurrence of *Aeromonas hydrophila* in limnetic environment: relationship to the organism to trophic state. *Microbiol Ecol* 1980;6:45-54.
18. Seidler RJ, Allen DA, Lockman H, Colwell RR, Joseph SW, Daily OP. Isolation, enumeration and characterization of *Aeromonas* from polluted water used for diving operations. *Appl Environ Microbiol* 1980;39:1010-8.
19. Shotts EB, Jr., Gaines JL, Martin L, Prestwood AK. *Aeromonas* induced deaths among fish and reptiles in an eutrophic island lake. *J Am Vet Med Assoc* 1977;161:603-7.
20. Von Graevenitz A. *Aeromonas* and *Plesiomonas*. In: Lennette EH, Balows A, Hausler WJ, Jr, Shadomy HJ, editors. Manual of clinical microbiology. 4th ed. Washington, D.C.: American Society for Microbiology, 1985:278-81.