Evaluation of microbial quality of the surface water of Hatirjheel in Dhaka City

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Microbiological health risks due to environmental pollution are major concerning issue in all over the world. In Bangladesh, almost all the major water bodies (lake/khal) particularly in the urban or semi-urban area have been suffering severely pollutions. Therefore if we manage to safe our surface water in and around the city, we can reduce the demand of ground water for the city dwellers by the proper use of these lakes and ponds. This study was conducted to evaluate the microbial condition of Hatirjheel water located in Dhaka City. The microbial analysis was performed to trace the presence of bacterial and other pathogens. In 5 samples, total viable bacteria and fungi were found up to 2.0×10^6 cfu/ml and 3.4×10^2 cfu/ml, respectively. Specific pathogens such as *Klebsiella* spp. (3.0×10^2 cfu/ml), *Salmonella* spp. (2.0×10^2 cfu/ml), *Pseudomonas* spp. (8.3×10^2 cfu/ml) and *Vibrio* spp. (6.0×10^2 cfu/ml.) were also isolated. The findings of the study revealed that the water of Hatirjheel might not safe for human health and also indicated that this water may vulnerable for diarrhea, dysentery, typhoid fever, shigellosis, salmonellosis, parasitic worm infection, hemolytic uremina syndrome etc. water-borne diseases. The poor water quality suggesting contamination of the lake water by domestic and industrial wastes and other anthropogenic activities. So it is important to control the pollution for proper use of this water in various household purposes.

Key words: Water quality; Microorganisms; Pollution; Lake, Health impact

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Water is the most important components amongst the natural resources and fundamental for the continued existence of all living organisms. The environment, economic growth and development of Bangladesh are all highly influenced by water- its regional and seasonal availability and the quality of surface and groundwater. The inexorable rise in demand for water to grow food, supply industries and sustain urban and rural populations has led to a growing scarcity of freshwater in many parts of the world. The world is experiencing a steady decline in water quality and its availability. About 75 percent of the world's rural and 20 percent of its urban population has no ready water access to uncontaminated water (1). For many regions, water supplies are contaminated with toxic chemicals and pathogenic microorganisms. In terms of quality, the surface water of the country is unprotected from untreated industrial effluents and municipal wastewater (2-4).

Lakes and ponds are a vital part of a modern healthy city. Over the past few decades, as Dhaka started to grow into a mega city, we began to realize how important it is to have parks, natural wetland, lakes, and open spaces. The surface water area of Dhaka city is about 10-15% of the total land area. Hatirjheel, Gulshan Lake, Banani Lake, Ramna Lake and Dhanmondi Lake are the popular relaxation spot in the city, is being polluted by slums and sewages, the business firms and industries operating in the area, locals and environmentalists alleged. But unfortunately, the groundwater level in many areas of Dhaka city is drastically receding from about 0.3m per year at Banani to about 1m per year at Motijheel (5). Therefore if we manage to safe our surface water in and around the city, we can reduce the demand of ground water for the city dwellers by the proper use or these lakes and ponds.

Haitrjheel is a prominent depression within Dhaka metropolitan area. The Lake is about 302 acres of Tejgaon, Moghmazar, Rampura region and has been playing a vital role in maintaining the only drainage system of those areas. The open stage for cultural programs and a number of beautiful bridges and roads attract a large number of visitors every day. The situation is getting worse due to the lack of adequate entertainment spots in the capital. Tile Lake and its adjacent area become crowded during the weekends. Residents of the area also alleged that liquid wastes from sewages are dumped into the lake. Garbage and human faeces have made the water of the lake greenish. A research work showed that pH varied from 6.7 to 7.1, Color varied from 25 to 50 pt-Co units, turbidity varied from 0 to 13 NTU,

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from 0 to 13 NTU, carbon dioxide (CO_2) varied from 35 to 60 mg/l, alkalinity varied from 90 to 345 mg/l, hardness varied from 150 to 300 mg/l, chloride varied from 0.5 to 1.0 mg/l, BOD varied from 0.0 to 10 mg/l, COD varied from 28 to 60 mg/l at Hatirjheel water (6).

The quality of water is of vital concern for mankind, since it is directly linked with human well-being. At present, the menace of water borne diseases and epidemics still loom large on the horizons of developing countries (7). The increasing urbanization and industrialization of Bangladesh have negative implications for surface water quality. The pollution from industrial and urban waste effluents and from agrochemicals in some water bodies and rivers has reached alarming levels (8-10). In Bangladesh, about 80% of all diseases are associated with water-borne microbes. About 300,000 children under five, die of diarrheal diseases every year, out of which one-third of the death occurs in the city slums and squatter settlements (11). The physicochemical features and bacterial flora of Dhanmondi Lake were investigated earlier (12-14).

Microbial safety of recreational water is one of the major human public health issues in developing countries. Water contamination occurs through contamination of streams, lakes, underground water, bays, or oceans by substances harmful to living things. If severe, water pollution can kill large numbers of fish, birds and other animals in some cases killing all members of a species in an affected area. Pollutions make streams, lakes, and coastal waters unpleasant to look at, to smell, and to swim in. People who ingest polluted water can become ill, and with prolonged exposure, may develop cancers or bear children with birth defect.

Aquatic microorganisms and their activities are of great importance in many ways. These organisms occupy a key position in the food chain by providing rich nourishment for the next higher level of aquatic life and may affect health of humans and other animals (15-18). Water quality maintenance means that natural waters should not be overloaded with organic or inorganic nutrients or with toxic, noxious, or esthetically unacceptable substances. They should not become vehicles of disease transmission from fecal contamination nor should their oxygenation, temperature, salinity, turbidity, or pH be altered significantly (19). Since water pollution is the common scenario, its effect on the environment must be studied thoroughly and regularly. Therefore, the present study was undertaken to evaluate the microbial quality of water, of Hatirjheel.

MATERIALS AND METHODS

Study Area and collection of Sample. The study area chosen for the current investigation was Hatirjheel of Dhaka city and a total of 5 surface water samples were collected aseptically in pre-sterilized screw caped bottles. Bottles were marked properly and transported to the laboratory as early as possible for microbiological analysis. Serial dilution of water samples were made in sterile normal saline up to 10^{-5} (15, 16).

Isolation and enumeration of total viable bacteria and fungi. 0.1 ml of each sample from 10^{-3} and 10^{-5} dilutions was dispensed in to the Petri plates with sterile nutrient agar medium. Plates were incubated at 37 °C for 24 hours. Similarly, sample from dilution 10^{-2} was inoculated on to Sabouraud Dextrose Agar (SDA) medium and the plates were incubated at 25 °C for 48 hours.

Isolation and enumeration of pathaogenic bacteria. For the isolation of *E. coli*, *Klebsiella* spp. and *Pseudomonas* spp. an aliquot of 0.1 ml of each sample from dilution 10^{-2} was inoculated on to MacConkey agar and cetrimide agar medium, respectively. The plates were allowed to incubate for 24 hours at 37 °C. TCBS (Thiosulfate-citrate-bile salts-sucrose) agar and *Salmonella-Shigella* agar medium were used for the isolation of *Vibrio* spp., *Salmonella* spp. and *Shigella* spp., respectively (15, 16).

RESULTS AND DISCUSSION

Microbial quality of water is usually expressed in terms of the concentration and frequency of occurrence of particular species of bacteria. Polluted water may contain pathogenic bacteria, viruses, protozoa or helminthes eggs. Some of the bacteria that indicate the presence of other kinds of pathogens are called indicator bacteria. They are usually present in the colon and excreted in large number by warm blooded animals (16-19).

The outcome of microbial analysis performed on samples collected from different locations of Hatirjheel of Dhaka, Bangladesh appears in Table 1. All of the samples contained huge array of bacterial load. Maximum total viable bacterial load (2.0×10^6 cfu/ml) found in sample 2 and minimum (2.8×10^5 cfu/ml) found in sample 5. Total fungi count on SDA agar ranged between 0 to 3.4×10^2 cfu/ml. Two samples were devoid of fungi. *E. coli* was absent from all samples (Table 1). The lowest load of *Klebsiella* spp. (1.6×10^2 cfu/ml) was recorded in the sample 5 while the highest number (3.0×10^2 cfu/ml) was in the sample 3. The highest load of *Pseudomonas* spp. on Cetrimide agar medium was 8.3×10^2 cfu/ml. No *Shigella* spp. was found in all samples and *Salmonella* spp. count ranged between 0 to 2.0×10^2 cfu/ml. The *Vibrio* spp. count on TCBS agar ranged between 0 to 6.0×10^2 cfu/ml (Table 1).

According to WHO Standards, *E. coli* or thermotolerant coliform bacteria must not be detectable in any 100 ml of sample (20). This study clearly revealed that the surface water was loaded with bacterial species. Saha et al. (13) found *Bacillus* spp., *Salmonella* spp., *Escherichia* spp., *Enterobacter* spp., *Serratia* spp., *Pseudomonas* spp. and other pathogens in Dhanmondi Lake water in their study. It indicates that many species were potentially pathogenic and are able to cause a spectrum of infections in susceptible populations. Water intended for drinking and household purposes must not contain any water borne pathogens (15, 16). The pathogenic groups includes bacteria, viruses and protozoa, which causes diseases that vary in severity from mild gastroenteritis to sever fatal-diarrhoea, dysentery, hepatitis, typhoid fever etc,. Apart from routine microbiological examination for evidence of

TABLE 1. Microbial count (cfu/ml) of surface water samples of Hatirjheel

Sample	TVB (cfu/ml)	Total Fungi (cfu/ml)	*Klebsiella* spp. (cfu/ml)	*Pseudomonas* spp. (cfu/ml)	*Salmonella* spp. (cfu/ml)	*Vibrio* spp. (cfu/ml)
S-1	4.6×10^5	0	0	5.8×10^2	0	0
S-2	2.0×10^6	3.4×10^2	2.0×10^2	0	2.0×10^2	0
S-3	6.5×10^5	3.0×10^2	3.0×10^2	1.0×10^2	0	0
S-4	3.4×10^5	0	2.6×10^2	0	0	6.0×10^2
S-5	2.8×10^5	1.6×10^2	1.6×10^2	8.3×10^2	0	0

TVB= Total viable bacteria
E. coli and *Shigella* spp. were absent in all samples

fecal contamination, other pathogenic microorganisms must be tested. Absence of indicator microorganism in water body does not actually indicate that absence of infection potential. The detection of pathogens i.e., *Salmonella* spp., *Klebsiella* spp. and other pathogens from natural waters is still to be established due to their low concentration (21, 22).

Surface waters are vital and vulnerable fresh water systems that are critical for the sustenance of all life. Social, economic and political development has been largely related to the availability and distribution of freshwaters contained in surface water systems. Surface water systems can be considered as arteries of the land supplying life giving water to an abundance of organisms whilst at the same time supporting modern civilizations (13, 14). Since it is directly linked to the human welfare, water quality is of major concern for mankind (7).

CONCLUSION

Microbial study revealed that the microbial quality of different location of Hatirjheel was diverse. The microbial analysis was performed to trace the presence of organisms and pathogens such as *E .coli*, *Salmonella* spp., *Shigella* spp., *Klebsiella* spp. and *Vibrio* spp. Presence of pathogenic bacteria in water indicates that water is not safe for household purposes and might vulnerable for causation and spread of different water-borne diseases. The findings of the current study suggest that the purpose of the Hatirjheel project will not be fully gained until the water pollution from different sources is controlled. So, it is need to take necessary steps to stop the pollution of water and increase the quality of water such as setup effluent treatment plants (ETP) at the sewage and waste water discharging points. Regular monitoring is needed to get the desired water quality, continuing the sound water quality and to restore and maintain the physical, chemical and biological integrity of water bodies to achieve the required water quality, which ensure protection and propagation of fish, wildlife, plants and also recreation in and on water.

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