Quality Study of Dhaka University Campus Drinking Water

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Introduction

Microbinal pollution of water is a serious problem in the developing countries. Waters are frequently contaminated and thus, degrade the quality of our water supply. But the study of microorganisms isolated from potable water or sanitary water is still unexploited field of research in Bangladesh, although the necessities for much investigations are greatly recognised.

According to Polczar and Reid the natural sources are the main outlet for drinking water of most cities. And the natural water supplies always has the possibility to be polluted with sewerage (1). Proges reported that the dangers involved in the use of water from unknown sources are great and also informed that water will contaminate food either directly or from hands, equipments, utensils etc. (2). Contaminated tap water used for eating place in a town was the cause of an outbreak of infectious hepatitis through faulty plumbing (3,4).

Karila and Lehr reported that the polluted well water caused an outbreak of Shigellosis in a camp (5,6). Most pathogens frequently transmitted through water are those which cause infections of the intestinal tract, namely dysentry, cholera, typhoid etc. The causative organisms of diseases are present in the faces or urine of an infected person and when discharged may again enter into the system of water that ultimately cause pollution in drinking water (7). When sewage is allowed to flow into rivers, lakes and seas, it contributes its flora, including pathogens (8). Sewage creates a nuisance, when raw domestic sewage is not properly treated by oxidation and is allowed to flow directly into natural waters (8).

Tap water microbiology is concerned with the natural microbial flora of surface water. Although this is a poorly understood subject at present but is of tremendous importance for the overall dwellers of Dhaka University campus. The present attempts was undertaken to gain more specific details on the quality of drinking water of few places of the campus.

Materials and Methods

Primarily, we selected samples for isolation and identification of the dominant flora which can play the key role in determining the quality of water. In this study water was taken form the tap of six representative places of Dhaka

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University like, (1) Institute of Nutrition and Food Science, (ii) Rokeya Hall (iii) University Administrative Building (iv) University Teacher's Quarter (v) Salimullah Muslim Hall and (vi) Carzon Hall.

Great care had been taken during the sampling procedure to prevent contamination of the sample. First of all the nozzle of each tap was cleaned thoroughly by heat sterilization (an alcohol lamp was used). The tap was cooled for a minute or two, after which samples were collected separately in sterile sampling bottle and brought to the laboratory and studied immediately.

Analysis of water was carried out with standard plate count method as well as with membrane filter techniques as described below.

Standard Plate Count

1 ml and O.1 ml of the sample were plated on the appropriate medium. The plates ware incubated at 35.C for 24 hrs., then a colony count was made and the number of bacteria per ml of the sample was calculated.

Membrane Filter Technique

A sterile filter disk was placed on a filter holder and clamped in position below the funnel and a volume of water (500 ml) was poured into the funnel and passed through the filter disk and collected by the aid of a vacum pump. After filtration the disk was removed by sterile forceps and placed on absorbent pad in a petridish which had previously impregnated with the appropriate medium. Then the petridishes were incubated at 35.C for 24 hrs. and studied. Thus the samples were collected and examined several times.

The different types of media which were recommended by Aiso et al (9), for fresh water bacteria were compared in this experiment for the better growth of bacteria isolated from the tap water. The colonies developed on the plates were compared and counted after incubation for 24 hrs. at 35.C. The composition of these 3 media were 1% polypeptone (DIFCO), O.3% beef extract (DIFCO), O.3% Yeast extract (DIFCO), and 1.5% agar (DIFCO). The media A, B and C (as shown in Table No.1) were dissolved in distilled water containing various amounts of mineral salts and 5% Glucose was supplemented in case of media C. The PH values of the media were adjusted to 7.0 in this experiment.

Representatives of the most numerous colonial types from all sources were selected from plates counting highest countable dilution. Bacterial isolates were then purified and maintained on the appropriate medium. Identification was facilitated according to the common procedures and a classification upto genus level was made according to Shewan et al (10), following the examination of colonial morphology, pigmentation, shape, staining characteristics, mortility of cells, as well as examination of the ability of the isolates to produce catalase and oxidase.

Other tests were: H2S productions Indole production, methyl red reaction and the oxidation/fermentation reaction.

To ascertain the existence of *E. Coli* and *Staphylococcus* the observation of the bacterial growth on the deoxycholate agar plates, Macconkey's broth and trypticase soy broth were examined. These identifications of the isolates was based on the modified schedmes of Gibbs (11), Jacob and Gerstein (12).

Results

Viable counts of bacteria in three different media are shown in Table II. The media C indicated highest count.

The bacterial counts of water samples determined by plate counts and by filtration (immediately after opening the tap) are stated in Table III. The count gradually decreased during the flowing period of few seconds.

The morphological and physiological properties of the bacteria of the samples (water samples I through VI) are shown in Table IV.

Table I. *Composition of different media*

	Media (gm)		
	A	B	C
Polypeptone	10.0	10.0	10.0
Beef extract	3.0	3.0	3.0
Yeast extract	3.0	3.0	3.0
Nacl	1.6	1.5	1.6
Kcl	2.0	10.0	2.0
$MgSo_4\ 2H_2O$	0.6	3.0	0.6
$Cacl_2\ 2H_2O$	0.3	1.5	0.3
Glucose	–	–	5.0
Distilled water	1000 ml	1000 ml	1000 ml

All media were adjusted to PH 7.0

Table II. *Viable counts of the isolated bacteria from water sample in three diffrent media*

Media used'	No. of Samples	'Number X 10^1 /ml 'Coliform	/staphylococcus**
A	1	–	--
	2	–	
	3	2.0 X 10^1	
	4	8.0 X 10^1	
	5	–	
	6	–	
B	1	–	--
	2	1.5 X 10^2	
	3	2.0 X 10^2	
	4	1.0 X 10^1	
	5	5.0 X 10^1	
	6	–	
C	1	6.0 X 10	--
	2	1.2 X 10^3	
	3	3.5 X 10^3	
	4	1.2 X 10^2	
	5	8.0 X 10^2	
	6	9.0 X 10^1	

** Deoxycholate agar
MacConkey's broth
Tryptos soy agar

No. 1 = Institute of Nutrition and Food Science
No. 2 = Rokeya Hall
No. 3 = Administrative Building
No. 4 = Staff Quater
No. 5 = Sallimullah Muslim Hall
No. 6 = Carzon Hall

Table III *Bacterial count of samples before and after flowing of water for few seconds*

No. of samples	Samples collected immediately after opening the tap/ml	Samples collect after * flowing of water for few seconds/ml.
1.	6.0×10^1	2.0×10^1
2.	1.2×10^3	1.2×10^2
3.	3.5×10^3	1.5×10^2
4.	1.2×10^2	1.0×10^2
5.	8.0×10^2	9.0×10^1
6.	9.0×10^1	1.0×10^1

* Each figure represents average of duplicate detrimination.

Table IV *The characteristics of isolated bacteria from different samples (Samples I through VI)*

Sample No. I

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Genus name identified
1	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
2	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
3	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
4	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
5	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
6	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
7	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
8	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
9	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
10	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus

Sample No. II

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Genus name identified
1	Cocci	+	–	–	+	–	–	/NC*[1]	–	Micrococcus
2	Cocci	+	–	–	+	–	–	/F *[2]	–	Micrococcus
3	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
4	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
5	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
6	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
7	Cocci	+	+	–	+	–	+	/O	–	Bacillus
8	Cocci	+	+	–	+	–	+	/O	–	Bacillus
9	Cocci	+	+	–	+	–	+	/O	–	Bacillus
10	Cocci	+	+	–	+	–	+	/O	–	Bacillus

Sample No. III

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Identified genus
1	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
2	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
3	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
4	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
5	Rod	+	+	–	+	–	+	/O	–	Bacillus
6	Rod	+	+	–	+	–	+	/O	–	Bacillus
7	Rod	+	+	–	+	–	+	/O	–	Bacillus
8	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
9	Rod	–	+	+	+	–	–	/F	–	Pseudomonas
10	Cocci	+	–	–	–	–	–	/NC	–	Micrococcus

Sample No. IV

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Genus name identified
1	Cocci	+	–	–	–	–	–	/F	–	Micrococcus
2	Cocci	+	–	–	–	–	–	/F	–	Micrococcus
3	Cocci	+	–	–	–	–	–	/NC	–	Micrococcus
4	Cocci	+	–	–	–	–	–	/NC	–	Micrococcus
5	Cocci	+	–	–	–	–	–	/F	–	Micrococcus
6	Rod	+	+	–	–	–	+	/O	–	Bacillus
7	Rod	+	+	–	–	–	+	/O	–	Bacillus
8	Rod	+	+	–	–	–	+	/O	–	Bacillus
9	Rod	+	+	–	–	–	+	/O	–	Bacillus
10	Cocci	+	–	–	–	–	–	/F	–	Micrococcus

Sample No. V

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Genus name identified
1	Rod	+	+	–	+	–	+	/O	–	Bacillus
2	Rod	+	+	–	+	–	+	/O	–	Bacillus
3	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
4	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
5	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
6	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
7	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
8	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
9	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
10	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus

Sample No. VI

Strain No.	Shape	Gram stain	Motility	Oxidase	Catalase	H_2S production	Nitrate reduction	Hugh & Leifson	Methyl red	Genus name identified
1	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
2	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
3	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
4	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
5	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
6	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus
7	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
8	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
9	Cocci	+	–	–	+	–	–	/F	–	Micrococcus
10	Cocci	+	–	–	+	–	–	/NC	–	Micrococcus

NC : Not clear; F : Fermentation; O : Oxidation.

Discussion

A variety of bacteria are regarded as nuisance bacteria in water system because they create problems of odour, colour and taste as well as precipitation of insoluble compounds within pipes that reduce or obstruct water flow. Iron and Sulfar bacteria can also produce slime, discolour water and cause undesirable odours and taste (13).

Plate counts standards had not been suggested for water because water with a few bacteria of a pathogenic variety is obviously more dangerous than water yielding a high count of only saprophytic bacteria (7).

Viable counts were compared among media which have different concentrations (Table II). The bacterial counts immediately after opening the tap were higher (Table III). Surface waters usually contain more organic matters than deep waters and thus support microbial life better. In cities, surface waters are frequently contaminated with sewage and in the country with sewage as well as manure (14). According to Bryan, surface waters contain varieties of microorganism, the deeper the water goes, the cleaner it becomes (15).

According to the results given in Table IV no significant amount of bacteria were isolated. In the present investigation, although *Micrococcus* and *Bacillus* were the predominant flora in sample I, IV and V, Bacillus was not available in I and VI water sample. A few gram negative rods were isolated and later identified as *Pseudononas* only from sample III. No other bacteria except *Micrococcus* was isolated from sample I and sample IV. The bacteria found in drinking water are mainly *Micrococcus, Pseudomonas, Acromobacter, Chromobacterium,* and *Vibrio* (7). Harigan and Margaret (16) also reported that the soil dwelling bacteria which may be washed by rain into streams, ponds etc. include species of *Bacillus* and *Streptomyces.*

The present study indicated that the Dhaka University campus water supply is generally good. There was no coliform or Staphylococcus ideitifiable in Macconkey's broth, deoxycholate agar plate or Trypticase soy broth. But sample

collected from the Administrative Building showed a bacterial count in the higher side. Water of good quality is expected to give a low count less than 100/ml (17)

However, following the results of our present investigation it is suggested to collect water each and every time after allowing the water to flow for few seconds for minimizing the possibilities of collecting the contaminated water due to surface contamination.

It can be mentioned that the dweller should be conscious of a situation when public water supply becomes contaminated with pathogens. Drinking water may be contaminated with sewage in various ways. Today water borne epidemics like typhoid and dysentery are rare in the advanced countries but still it is a threatening in Bangladesh. Therefore, the sanitation of drinking water here should be well controlled and the source of supply must be checked periodically. It is suggested that the disposal of sewage should be strictly controlled and should be separated from private water supply systems. In the context of the present study a few quality standards and requirements for a public water supply may be listed below (18):

1. That it shall contain no organisms which cause disease. 2. That it be sparkling clear colourless.

3. That it be good tasting, free from odours and preferably cool. 4. That it be neither scale-forming nor corrosive

5. That it be neither scale-forming nor corrosive. 6. That it be reasonably soft.

7. That it be free from objectionable gas and objectionable minerals. 8. That it be plentiful and low in cost.

Summary

This study on the actual condition of normal water supply of Dhaka city, particularly the Dhaka University campus water was carried out to determine the real status of bacterial flora in drinking water which is summerized below:

(a) The tap water of six specific places of University campus were mainly composed of the genus *Micrococcus,* and *Bacillus* of a so called terrestrial type.

(b) A few gram negative rods were isolated which were identified as *Pseudomonas* from the water samples of one place out of six tested places.

(c) The bacterial count is high, if water collect immediately after opening the tap, whereas, the flora decreases in number when the sample was collected after flowing for few seconds.

(d) No existence of E. *Coli* or *Staphylococcus* which are supposed to cause infection of the intestinal tract, were observed in any of the water sample of the tested places.

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