

The occurrence of coliforms bacteria in water reservoir at different schools of district Peshawar

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Abstract: Water reservoirs are popular in houses, office buildings, commercial stores and schools. The quality of this source of drinking water has the potential to cause waterborne outbreaks, especially in sensitive and immune compromised subjects. The aim of this study was to determine the water quality of different reservoirs at schools of District Peshawar. For this purposes nineteen schools were selected for sampling of water. Thirty two (32) drinking water samples were collected and analyzed for total coliform bacteria, fecal coliform bacteria and *E. coli*. The data revealed that out of 32 samples 15 were fit for human consumption. Positive results for total fecal coliform bacteria were found in 37 % samples, while *E. coli* was present in 18 % samples. Highest contamination of total coliform bacteria (TCB) was >1100 MPN/ml and lowest was 9 MPN/ml.

Keywords: Drinking water, total coliform, fecal coliform, schools, Peshawar

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INTRODUCTION

The human body is primarily composed of water which contributes approximately 90% of blood plasma, 80% of muscles tissue, 60% of red blood cells and more than 50% of most other tissues. Water is extremely important nutrient for body. Its function varies from regulating body temperature to transporting waste products. Today's health conscious society, now more than ever, focuses on importance of water¹. Water covers about 73% of the earth's surface. It is the major constituent of the lithosphere and atmosphere and it is an essential requirement of all living organisms. The largest water requirement is for municipal use but standard of purity required for this purpose is one of the prime factors in deciding the growth of towns and cities as well as industries². Drinking water plays an important role in the bodily intake of true element by human. Even though some trace elements are essential to man, at elevated levels essential as well as non essential element can cause morphological abnormalities; reduce growth increase mortality and mutagenic effects^{3,4}.

Traditionally, bacterial indicators of fecal contamination notably fecal coliform and enterococci have been used to assess the microbial quality of water sources. In developing countries drinking water quality is not reliable because these countries often have poor water supplies and limited resources for water treatment and distribution. The World Health Organization has currently estimated that 1.1 billion people worldwide lack access to improved water supplies and 2.4 billion do not have access to proper sanitation facilities⁵. Water pollution is the specific impairment of water quality by agricultural, domestic or industrial wastes to a degree that has an adverse effect upon any beneficial use of water yet that does not necessarily create an

actual hazard to public health. Due to urbanization and industrialization, wastewater that is being discharged into natural water bodies results in serious ground water contamination⁶. The poor health status of Pakistan's population is reflected in high infant mortality rate of 12.6% and as low as 7% fertility rates. The scanty hospital's data shows that many of the diseases treated are caused by water borne microbes indicating that a substantial proportion of morbidity in Pakistan is due to use of polluted water. Gastrointestinal infections resulting in diarrhea show high frequency among children as well as adults, accounting for 25% of patients treated at hospitals and clinics^{7,8}.

Several researchers have reported different pollutants in drinking water sampled from different regions of Pakistan. Ahmed and saleem⁹ analyzed drinking water of NWFP for chemical pollutants. Water quality in different areas of Punjab including selected parts of Rawalpindi and Islamabad has been studied for nitrate contamination and nitrate level were found to exceed the Canadian standard for drinking water¹⁰. According to FAO¹¹ recent involvement of *E. coli* in several cases of food poisoning suggests that this organism, rather than fecal coliform group should be used as indicator of sanitary quality. Microbiological standards for drinking water in most developed countries rely on the detection of total coliform and *E. coli* as markers for enteric organism¹². The main objective of the reported study was to determine the contamination level of coliforms bacteria in water reservoirs at different schools of Peshawar.

MATERIALS AND METHODS

Samples collection

Thirty two schools of district Peshawar were selected for the sampling of drinking water.

Thirty two samples were collected from water reservoir (Tanks) in sterilized screw cap 500 ml white glass flasks (Pyrex), after a flow time of 5 min to eliminate any contaminant present. In order to neutralize the residual free chlorine, 10 % sodium thiosulfate solution was added in sterile bottles. After that the samples were placed in ice boxes and brought to laboratory. Water samples were analyzed by following the guideline and standards of World Health Organization¹³.

Bacteriological analysis

Total coliform bacteria

The MPN of total coliforms bacteria were determined by multiple tube fermentation technique¹⁴. 1 ml from the previously prepared 10^{-1} , 10^{-2} and 10^{-3} dilutions were inoculated into three replicate tubes containing 10 ml of LT Broth with inverted Durham tubes and incubated at $35^{\circ}\text{C}\pm 0.5^{\circ}\text{C}$ for 24 and 48 ± 2 hrs after inoculation. Tubes were examined for evidence of gas production at the end of 24 hrs incubation. Gas production was measured by gas displacement in the inverted vial and also effervescence produced when the tube was gently shaken. Negative tubes were re-incubated for additional 24 hr and again examined for gas production. Positive tubes with gas formation and turbidity were sub-cultured into BGB (Brilliant Green Lactose bile broth and incubated at 35°C for 48 hrs. Total coliform were calculated from tables¹⁴ as MPN per ml.

Total fecal coliform bacteria

Tubes having 10 ml E.C. broth with inverted Durham tubes was inoculated by means of 3mm loop from the presumptive fermentation tubes showing gas and incubated at 44.5°C for 24 hrs and examined for gas production. Fecal coliform were calculated from MPN tables¹⁴.

EMB Agar was used for the enumeration of *E. coli*. All the tubes of E.C. broth showing gas were subculture by streaking on EMB agar plates and incubated at 35°C for 18-24 hrs. Positive plates contained typical colonies with green metallic sheen were inoculated on PCA slants (plate count agar) and incubated at 35°C for 18-24 hrs. After 24 hrs incubation the typical colonies were confirmed by biochemical tests and also by kits (*E. coli* O157:H7 latex test reagent kit Pro Lab. Canada).

RESULTS AND DISCUSSION

The highest TCB > 100 MPN/ml was calculated in samples S # 2, 8, 9, 10, 12, 17 and 26 are presented (Table 1). The presence of TCB in water reservoir indicates the exposure of water to the

external environment as coliforms are widely spread in the environment. Hence it can be assumed that the reservoir water was exposed at some point of the processing, either before storage or after. Shar *et al*¹⁵ were reported that the total and fecal coliform bacteria were present in all samples (100 %) of drinking water of Khairpur city, the source was surface water (municipal water).

The TCB in samples S#4, 5, 6, 13, 18, 19, 21, 22, 23, 24, 25, 27, 28, 29, 30, 31 and 32 were found less than 3 MPN/ml, conclude that these water sample were fit according to the WHO drinking water standards (Table 2). The TCB were found in samples S #1 (460 MPN/ml), S#39 (MPN/ml), S#7 (9 MPN/ml), S#11 (240 MPN/ml), S#15 (43 MPN/ml) and in samples S#16, 20 and 30 (64 MPN/ml). The highest TFC (MPN/ml) was calculated in sample S#14 and 17. Hasan *et al*¹⁶ studied that the drinking water from different sources such as river, ground and well water showed that 67% of total water samples were found contaminated with coli forms and fecal coli forms. The study of Hasnie *et al*¹⁷ on the water quality of storage tanks concluded that 71% samples were in very high health risk category. The analyzed samples S#3, 4, 5, 6, 7, 13, 18, 19, 21, 22, 23, 24, 25, 27, 28, 29, 31 and 32 were found no fecal contamination and fit for human consumption according to the WHO standards.

The study of Cheema *et al*¹⁸ on the drinking water quality of Muzaffarabad city reported that microbiologically 5 out of 28 samples collected from different houses did not meet the standards requirements of WHO. The TFC were found in samples S#1 (210 MPN/ml), S#2 (240 MPN/ml), S#10 (1100 MPN/ml), S#11 (23 MPN/ml), S#12 (240 MPN/ml), S#15 (15 MPN/ml), S#26 (64 MPN/ml), S#16 (20 MPN/ml), S#30 (43 MPN/ml), while in samples S#8 and 9 (460 MPN/ml). The 18% samples were contaminated with *E. coli*. The study of Mashitullah *et al*¹⁹ on drinking water sources (dug wells, tube wells) in Rawalpindi city showed that 52% of the collected samples have indicated presence of coli form.

Data differed widely depending upon the location from where these samples were taken. These initial investigations indicate the need for continuous monitoring of the status of pollution of water in school. Children are our future, we must be careful for their health because strong people built a strong nation. The present study can be used as a base line by health management authorities and also may enable the concerned authorities to pay attention to this important issue of common man's concern.

Table 1: Bacteriological analysis of water reservoir of different schools at district Peshawar

S#	Name of School	*TCB MPN/ml	**TFC MPN/ml	*** <i>E. coli</i>
1	Govt. Girls Middle School Kagawali	460	210	+ ve
2	Govt. Girls Primary School Sarband	>1100	240	+ ve
3	Govt. Girls Middle School Kaskoroona	39	<3	- ve
4	Govt. Middle School Muhammad Ali Kalay	<3	<3	- ve
5	Govt. Girls Middle School Garhi Jalaludin	<3	<3	- ve
6	Govt. Girls Primary School Shahgahai	<3	<3	- ve
7	Govt. Girls Primary School Faisal Colony	9	<3	- ve
8	Govt. Girls Primary School No#3 Faisal Colony	>1100	460	+ ve
9	Govt. Girls Middle School Pakha Ghulam	>1100	460	- ve
10	Govt. Girls Primary School No#1 Sarband Pura	>1100	1100	- ve
11	Govt. Middle School Arbab Landi	240	23	+ ve
12	Govt. Girls Middle School wazir Bagh	>1100	240	- ve
13	Govt. Middle School Forest College	<3	-ve	- ve
14	Govt. Girls Middle School Bahad Kalay	>1100	>1100	+ ve
15	Govt. High School Landi Arbab	43	15	- ve
16	Govt. Girls Primary School Landi Arbab	64	43	- ve
17	Govt. High School No#3 Cantt	>1100	>1100	+ ve
18	Frontier Youth Academy Hayat Abad	<3	<3	- ve
19	Zeshan Public School dean Bahar Colony	<3	<3	- ve
20	Sun Rise Public School Charsada Road	64	43	- ve
21	Al-Syed Model School Nothia	<3	<3	- ve
22	Root Montessori School Cantt	<3	<3	- ve
23	Cantonment School Saddar	<3	<3	- ve
24	Al-Khalid Public School Gulberge	<3	<3	- ve
25	Al-Falah Model School Sband	<3	<3	- ve
26	Athar Moddel School Pawaky	>1100	64	- ve
27	Khalil Islamia Moddel School Pawaky	<3	<3	- ve
28	Presentation Convent High School Cantt	<3	<3	- ve
29	The Quaid Educational Academy Sarband	<3	<3	- ve
30	A.K.K.School 7 College Bara Road	64	43	- ve
31	Morning Star Public School Pishtakhara Payan	<3	<3	- ve
32	Peshawar Frontier Model School Tehkal Bala	<3	<3	- ve

*TCB MPN = Total coliform bacteria most probable number

**TFC MPN = Total fecal coliform bacteria most probable number

****E. coli* = Escherichia coli**Table 2:** WHO standards of drinking water

S#	Bacteriological parameters	WHO Standards
1	Total coliform bacteria	<3 MPN/ml
2	Total fecal coliform bacteria	<3 MPN/ml
3	<i>E. coli</i>	Nil

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