

*International journal of medical science and clinical invention**Volume 1 issue 5 2014 page no.194-202 ISSN: 2348-991X***Bacteriological Assessment of the Quality of Water Stored in Household Poly Tanks in Student Hostels in the Korle-Bu Teaching Hospital, Accra, Ghana****George A. Pesewu^{1*}, Venus Norshie¹, Nana A. Boakye¹, Michael A. Olu-Taiwo¹, David N. Adjei¹, Felix C. Mills-Robertson², Samuel Osei-Djarbeng³, Richard H. Asmah¹, and Patrick F. Ayeh-Kumi¹**

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Abstract: Good quality drinking water can be polluted in many several ways of which faecal and soil pollution are the most important with respect to microbial agents. The aim of the study was to assess the contamination status of drinking water stored in household poly tanks in 5 selected student hostels at the Korle-Bu Teaching Hospital (KBTH), Accra, Ghana. Questionnaires were administered to residents to obtain information about the poly tanks and the usage of water from the tanks by users. Samples of the poly tank water were collected aseptically and 100 ml filtered through sterile membrane filters with 47 mm diameter and 0.45 µm pore size obtained from Merck Millipore, USA. The membrane filters were aseptically placed on prepared sterile agar plates including, Harlequin agar for total coliforms and *Escherichia coli*, media-faecal coliforms (m-FC) for faecal coliforms, and plate count agar for total viable counts, respectively. The inoculated Harlequin and plate count agar plates were incubated at 37° for 24 h while the inoculated m-FC plate was also incubated at 44° for 24 h. From the questionnaires administered, 26% of the study participants said they use the poly tank water for drinking, 70% uses it for cooking, while all use it for bathing, and washing purposes. Mean counts of the indicator bacteria in the household storage poly tanks ranged 2.5-3.5 log₁₀ CFU/100 ml for total viable count, 2.3-3.2 log₁₀ CFU/100 ml for total coliforms, 2.1-2.6 log₁₀ CFU/100 ml for *E. coli*, and 0.5-2.9 log₁₀ CFU/100 ml for faecal coliforms. From the study all the selected household storage water poly tanks were contaminated with faecal indicator bacteria including faecal coliforms and *E. coli* above the recommended World Health Organization (WHO) standards of concentration of faecal coliforms must be zero in safe drinking water. However, further studies are also recommended to be done to understand the effect of type of water storage tank (i.e. plastic, concrete, etc) on the water contamination.

Key words: Poly Tanks; Drinking Water; Total Coliforms; Faecal Coliforms; *Escherichia coli*

1. Introduction

All living organisms depend on water for their existence and good drinking water with a high quality is essential for the well-being of all people around the world (Pund & Ganorkar, 2013). An adequate supply of water is necessary for a healthy life but waterborne diseases are major causes of death in most parts of the world especially in developing countries due to the consumption of contaminated water (Fawell & Nieuwenhuijsen, 2003).

It is known that there are various sources of obtaining drinking water but the two most important sources include surface water (rivers and reservoirs) and ground water. Unfortunately, many pathogens can be transmitted through the water supply and there are reports that some of these pathogens enter water from the faeces of infected people and are then ingested and thereby transmitted to others according to the World Health Organization (WHO, 2003). A lot of diseases including cholera, typhoid fever,

bacillary dysentery, and others can be transmitted in this manner (Cabral, 2010). Therefore microbial contamination of drinking water remains a significant threat and constant vigilance is essential, especially in developing countries including Ghana. For example, the erratic supply of pipe borne water and shortage of water in the Accra Metropolis for some time now has resulted in people depending on commercial water supplies. These water supplies may not be of good quality and may even contain pathogenic microorganisms which can cause all forms of diarrhoeal diseases including typhoid or enteric fever. Considering the nature of our Ghanaian setting where these days there is indiscriminate disposal of human excreta even into rivers and other water bodies; and the water distribution system is mostly compromised with polluted water seeping into the water supplies it is worthwhile investigating these household water tanks for possible bacteria contaminations to prevent an outbreak of gastrointestinal infections in the future. Therefore the objective of this study

was to assess the bacteriological contamination status of drinking water stored in household poly tanks in the student hostels at the Korle-Bu Teaching Hospital (KBTH), Accra, Ghana

II. Materials and Methods

Sample Collection and Transportation

In the present investigations, student hostels at the KBTH were selected for the study. The selected hostels included: Accra School of Hygiene, School of Allied Health Sciences, Medical School hostels (Blocks B and Q), and College of Health Sciences hostel (Block D). Before the start of the investigations prepared questionnaires were administered to the students to find out their use of water from the tanks. Hostel managers were also interviewed for information about the poly tanks. A total of 100 samples were collected from the household water tanks of the various student hostels. Samples of the water for the laboratory investigations were collected according to the American Public Health Association (APHA, 1998) sampling guidelines on the standard operating procedures for bacteriological examination of water and wastewater. About 200

ml of water samples were collected from the storage tanks into sterile bottles aseptically. Each sample collected was preserved in a light-proof insulated ice chest with ice-packs to ensure that the microorganisms remained viable though dormant. The samples were then transported immediately to the Microbiology Laboratory (ML) of the Water Research Institute (Council for Scientific and Industrial Research, CSIR), Accra, for the bacteriological analysis.

Bacteriological Analysis

The membrane filtration method was used in the determination of three parameters, namely; total coliform, faecal coliform, and *E. coli* counts. Total viable count was also determined using the standard pour plate method.

Total Coliform and E. coli Determination

The membrane filter was removed with a sterile forceps and then incubated on a Harlequin agar (HA; Lab M Limited, Topley House, UK) at 37°C for 24 h. The membrane filter was placed on the medium by rolling action to prevent air bubbles from forming at the membrane-medium interface.

Coliforms were detected as rose-pink colonies on the HA plate whiles *E. coli* were detected as blue-green colonies on the HA agar plate. The total numbers of colonies appearing on each plate were counted and recorded.

Faecal Coliform Determination

The membrane filter was removed with the aid of a sterile forceps and incubated on media-faecal coliform (m-FC: Acumedia, USA) at 44°C for 24 h. Faecal coliforms were detected as blue colonies on the m-FC agar plate. The total numbers of colonies appearing on each plate were counted and their mean recorded.

Total Viable Count Determination

The viable bacteria count were determined using modifications of standard pour plate method with plate count agar (PCA; Oxoid Limited, Basingstoke, UK) as medium as previously described by Wohlsen *et al.* (2006). Briefly, 1 ml portions of the water samples were transferred into an empty sterile plates and 15 ml of molten PCA which has been cooled to 45°C was added and swirled to mix well. The mixture was allowed

to cool undisturbed to solidify on a flat table top. The media were incubated at 37°C for 24 h. All bacteria colonies appearing on the media surface and embedded in the media were counted with the aid of a magnifying lens and identified using various biochemical, serological tests, and the results recorded.

Statistical analysis

Descriptive statistics such as means and percentages were used in the analysis of the results. Also, the student's t-test was used to find out significant differences between the parameters studied. P-values >0.05 were taken as statistically insignificant difference.

III. Results

Many bacterial infections are transmitted by water through the faecal-oral route. In the present investigations, a total of five hostels were selected and 120 questionnaires were completed by residents of the selected hostels. Water samples were collected twice from 10 water poly tanks in these selected hostels. Table 1 shows the use of poly tank water by the residents of the hostels. From the table it can be observed that 31 (26%) of

the students use the poly tank water for drinking purposes, 83 (70%) also use it for cooking purposes while all of residents in the hostels use the water for both bathing and washing purposes.

Table I. Various uses of the tank water among 120 respondents in the students hostels at KBTH, Accra

Uses	Frequency	Percentage (%)
Drinking	31	26
Cooking	83	70
Bathing	120	100
Washing	120	100

The comparative means of the indicator bacteria among the surveyed household poly tanks water samples in selected student hostels in KBTH, Accra Metropolis are presented in Table 2.

Table II. The comparative means (\log_{10} CFU/100 ml) of the indicator bacteria among the surveyed tanks water samples

Tank	TC	FC	EC	TVC
A		2.9	2.6	3.5
B	3.1	0.5	0	3.3
C	2.5	2.1	2.0	2.8
D		0.7	0	2.5
E	3.0	0	0	2.6
F	2.5		2.4	3.5
G		2.8	2.6	3.5
H	2.3	2.9	2.2	2.9
I			2.2	2.6
J	2.9	2.7	2.1	3.4
	3.2	2.6		
	3.1	2.6		
	2.9			
	2.9			

TC, Total coliform; FC, Faecal coliform; EC, *Escherichia coli*

TVC, Total viable count; CFU/ml, colony forming units per milliliter

It can be observed from the table that all the water samples were contaminated with two or more bacterial faecal indicators. The total viable count ranged 2.5-3.5 \log_{10} CFU/100 ml of the

water samples. Similarly, the total coliforms counts ranged 2.3-3.2 log₁₀ CFU/100 ml while *E. coli* counts ranged 2.1-2.6 log₁₀ CFU/100 ml of the analysed poly tank water samples. Also, faecal coliform counts ranged 0.5-2.9 log₁₀ CFU/100 ml in the study. The highest percentage bacterial counts of the household poly tank water samples was observed for total viable counts (32%) followed by total coliform (30%), faecal coliform (21%), and *E. coli* (17%) as presented in Fig. 1.

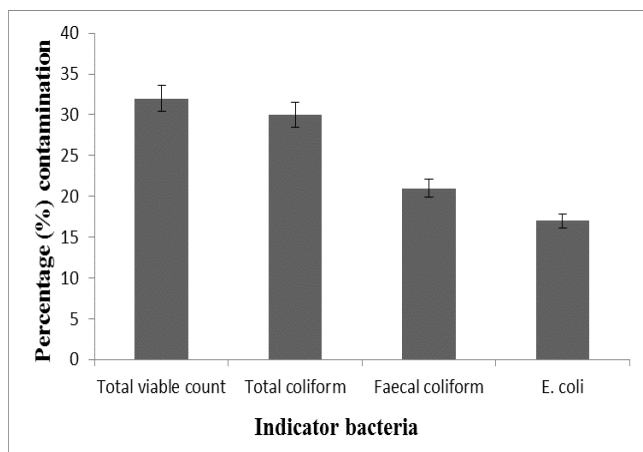


Fig. 1. Percentage (%) bacterial contamination of the surveyed household polytank water samples against the various indicator bacteria monitored.

IV. Discussion

Potable water is the water that is free from disease producing microorganisms and chemical substances that are dangerous to human health

(Shittu *et al.*, 2008). From the study it was observed that more than half of the residents in the selected student hostels use the water in the household poly tanks for cooking and drinking purposes. Three of the poly tanks (B, D, and E) were cleaned recently. Therefore it is possible that cleaning of the 3 poly tanks (emptied and cleaned) might have lowered their total coliform and faecal coliform counts (Table 2). In a similar related work in Bermuda, it was reported that emptying and cleaning is a procedure which can significantly lower poly tank water contamination (Levesque *et al.*, 2008). However it must be noted that a build-up of sediment in water tanks can serve as sources of the supply of suitable nutrients on which bacteria can grow and multiply as previously proposed by House and Reed (1997). Topping up of two of the recently cleaned storage tanks (I and J) a week before the second sampling with water from the Ghana National Fire Service water tankers might have increased the faecal coliform and *E. coli* counts of these storage water poly tanks (Table 2). It is therefore possible that these water tankers for commercial purposes may

contain faecal bacteria that contaminated the water samples.

All the household storage poly tanks water samples analysed had their water testing positive for total viable count (32%), total coliforms (30%), faecal coliforms (21%), and *E. coli* (17%) as presented in Fig. 1. Also, the mean counts of the indicator bacteria were all found out to be above the recommended Environmental Protection Agency (EPA) and World Health Organization (WHO) standards of concentration of faecal coliforms must be zero in good drinking water which raises a public health concern. It has been proposed by other research workers that the use of *E. coli* as a unique indicator of microbial water contamination is questionable because the sources of this water supplied by commercial operated water tankers in the Accra Metropolis are unknown and may contain multiples of microorganisms as previously proposed by Lévesque *et al.* (2008). However the presence of faecal coliforms and *E. coli* in particular gives an indication of faecal contamination of the water in these household storage poly tanks. In Nigeria,

Sule *et al.* (2011) reported that 10% of their samples studied were devoid of coliforms. In a similar related study in Peshawar, Pakistan, it has been reported that about 90% of the drinking water samples and the distribution system studied testing positive for total coliforms (Roohul *et al.*, 2012). Also *E. coli* was isolated from only 20% of the samples analyzed and reported that the water contamination may be due to leakage in pipes and cross contamination from waste waters (Roohul *et al.*, 2012). The present study have therefore proposed that the bacteriological quality of water in a household water storage poly tank might depend on the source from which it was drawn and also the handling of the water in the tank by the users.

V. Conclusion

From the study it was observed that a higher proportion of the residents in the selected student hostels use the household storage poly tanks water for drinking and cooking purposes. Therefore contamination of the storage poly tanks water with coliform bacteria and most importantly faecal coliform and *E. coli* raise a public health concern.

The presence of *E. coli* in the water indicates the tank water has been faecally polluted. Drinking water polluted with faeces can expose the human body to various water borne diseases and therefore the water needs to be treated before using for any domestic purpose. Further studies are also recommended to be done to understand the effect of type of water storage tank (i.e. plastic, concrete, etc) on the water contamination.

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Declaration of Conflict of Interest: None

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