MICROBIOLOGICAL QUALITY OF WATER FROM DISPENSERS SITUATED AT CSIR - FOOD RESEARCH INSTITUTE

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ABSTRACT:

Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. This work aimed at determining the microbial quality of water supplied to CSIR-Food Research Institute. Water samples were collected from different dispensers situated at different locations of the Institute. Swabs from the inlet and outlet taps as well as the entire dispensers were also taken. The samples were analyzed for aerobic mesophilic organisms, coliforms, *Escherichia coli*, *Enterococcus*, and *Staphylococcus aureus*. The pH levels of the water samples were also determined. The water samples analyzed were microbiologically safe but the microbial populations recorded on the dispensers were quite substantial. The mean pH of all the water samples were in the range of 5.4 - 5.8 which were acidic and did not meet the WHO standard.

INTRODUCTION

Water is a transparent fluid which forms the world's streams, lakes, oceans and rain, and is the major constituent of the fluids of living things. Safe drinking water is essential to humans and other life forms even though it provides no calories or organic nutrients. The human body contains from 55% to 78% water, depending on body size. To function properly, the body requires between one and seven liters of water per day to avoid dehydration; the precise amount depends on the level of activity, temperature, humidity, and other factors. Most of this is ingested through foods or beverages other than drinking straight water. Most specialists agree that approximately 2 liters (6 to 7 glasses) of water daily is the minimum to maintain proper hydration (Annon. 2014). The most important point to address for all water intended for drinking purposes is the quality since this has a direct impact on human health (MaMDG, 2005; IWMI, 1999a; 1999b). The quality of drinking water in developing countries is of grave concern, especially where there are rapid urban expansions and growth in the country's population (IWMI, 2003). It has been reported that many sources of drinking water in Ghana have been contaminated not only with microorganisms of faecal origin but also varied levels of metals, many of which affects the pH of these water sources, posing very serious health risks to the people (Obiri-Danso *et al.*, 2002, 2003; Kyei-Baffour *et al.*, 2005; Edoh *et al.*, 2004). Several risk assessments related to the safety of drinking water have been performed, either in general terms or focused on specific microbial pathogens or parasites (Sekla, 1991; Gale, 2003; Hoornstra and Hartog, 2003; Percival *et al.*, 2004; WHO, 2008; Mena and Gerba, 2009). Drinking water may be re-contaminated with pathogens during distribution. Numerous outbreaks related to enteric pathogens, viruses or parasites have also been reported, (Rooney *et al.*, 2004: Schuster *et al.*, 2005; Karanis *et al.*, 2007; September *et al.*, 2007; La Rosa *et al.*, 2008; and Reynolds *et al.*, 2008).

In Ghana, to ensure the safety of drinking water, most companies treat and package the water into dispensers, bottles and sachets. CSIR-Food Research Institute depends on one of such producers for their source of drinking water. However, contamination of this treated water can occur through transportation, handling, contact, environment, at the point of use etc. Several studies of both recreational and drinking water samples have suggested that *enterococci* are more relevant indicators of faecal contamination than faecal coliforms and *E. coli* (Grammenou *et al.*, 2006; Kinzelman *et al.*, 2003; Davis *et al.*, 2005). The presence of Faecal coliforms and *E.coli* indicates that the water may be contaminated with human or animal wastes. These bacteria can cause short-term effects, such as diarrhea, cramps, nausea, headaches, or other symptoms. They may pose a special health risk for infants, young children, the elderly, and people with severely compromised immune systems (CDC, 2009). For this reason, this work is aimed at determining the microbial quality of water supplied to CSIR-Food Research Institute.

MATERIALS AND METHODS

Sampling

Water samples were collected from each dispenser situated at different locations of the institute. Also swabs from the inlet and outlet taps as well as the entire dispensers were taken. These samples were transported immediately to the laboratory for analysis

Microbial analysis

For all samples, 1 ml were homogenized in 9 ml sterile diluents (0.1 % peptone, 0.8 % NaCl, pH 7.2) by use of a stomacher (Lab Blender, Model 4001, Seward Medical, London, England.) for 30 s at normal speed. From appropriate ten-fold dilutions, pour and spread plate counts were carried out. Aerobic mesophiles were enumerated by pour plate on Plate Count Agar (Oxoid CM325; Oxoid Ltd., Basingstoke, Hampshire, UK), incubated at 30 °C for 72 h in accordance with NMKL No. 86, 2006. Total coliforms and *E. coli* were enumerated by pour plate on Tryptone Soy Agar (Oxoid CM131), pH 7.3 overlaid with Violet Red Bile Agar (Oxoid CM107), pH 7.4 and incubated at 37 °C for 24 h for total coliforms and at 44 °C for 24 h for *E. coli*. Colonies for total coliforms were confirmed on Brilliant Green Bile Broth (Oxoid CM31), pH 7.4 incubated at 37 °C for 24 h according to NMKL No. 44 (2004) and *E. coli* using EC Broth (Oxoid CM853), pH 6.9, followed by Trypton Water (Oxoid CM87), pH 7.5, all incubated at 44 °C for 24 h as described by (NMKL. No. 125, 2005). Enterococcus was dertermined according to NMKL No 68,5th Ed. 2011.*Staphylococcus aureus* was determined by the spread plate method using Baird-Parker Agar (BP, CM 275 Oxoid Ltd, Hampshire, England.) with Egg Yolk Tellurite Emulsion (SR54) added and Blood Agar Base (BAB, CM 55 Oxoid Ltd, Hampshire, England.). Both media were incubated at 37 ^{o}C for 48 h according to NMKL Method No. 66, 4th Ed., 2003.

Chemical Analysis

pH

The pH of the water samples were determined directly using a pH meter (Radiometer PHM 92, Bagsvaerd, Denmark) after it was calibrated using two standard buffers 4.00 and 7.01.

RESULTS AND DISCUSSION

Table 1: Mean microbial population in CFU/mls.

Isolates		Dispensers			
		Water	Container	Inlet	Outlet
A. Mesophils	D1	8.4×10^2	9.0×10^2	<10	7×10^1
	D2	4.8×10^2	2.3×10^3	1.0×10^2	5×10^1
	D3	5.2×10^2	3.4×10^3	6×10^1	8×10^1
	D4	4.3×10^2	7.8×10^3	9×10^1	1.2×10^2
	D5	4.5×10^2	8.6×10^2	<10	4×10^1
	D6	8×10^1	1.9×10^2	<10	<10
Coliforms	D1	<10	2×10^1	<10	<10
	D2	<10	<10	<10	<10
	D3	<10	9×10^1	2×10^1	7×10^1
	D4	<10	2×10^1	<10	<10
	D5	<10	<10	<10	<10
	D6	<10	<10	<10	<10
E.coli	D1	<10	<10	<10	<10
	D2	<10	<10	<10	<10
	D3	<10	<10	<10	<10
	D4	<10	<10	<10	<10
	D5	<10	<10	<10	<10
	D6	<10	<10	<10	<10
Enterococcus	D1	<10	<10	<10	<10
	D2	<10	<10	<10	<10
	D3	<10	<10	<10	<10
	D4	<10	<10	<10	<10
	D5	<10	<10	<10	<10
	D6	<10	<10	<10	<10
Staph.aureus	D1	<10	<10	<10	<10
	D2	<10	<10	<10	<10
	D3	<10	<10	<10	<10
	D4	<10	<10	<10	<10
	D5	<10	<10	<10	<10
	D6	<10	<10	<10	<10

D: Dispenser.

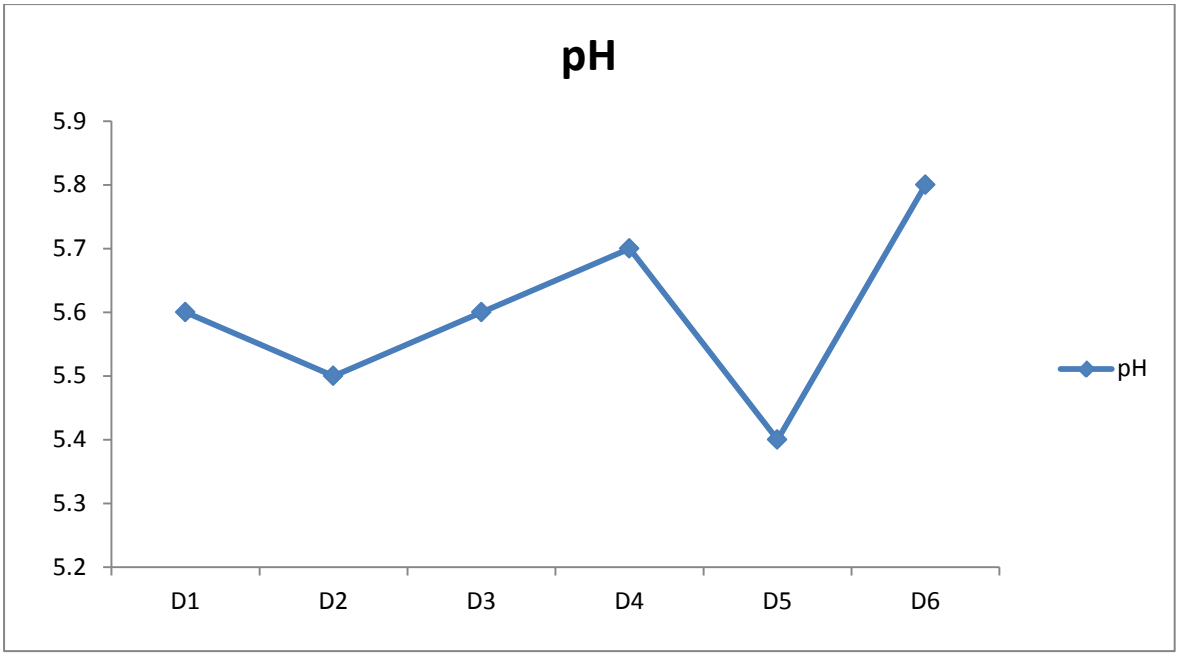

Fig 1: A graph of the mean pH values of Water.

Result of the water samples and of the containers, the inlet and outlet taps of the dispensers is shown in Table1. Pathogenic bacteria such as *E.coli*, *Staph. aureaus*, *Enterococcus faecallis*, were absent in all the samples analyzed. However, aerobic mesophiles were in the range of 10-10^2 CFU/ml for the water sample. The aerobic mesophilic counts on the outside of the water containers/dispensers ranged from 10^2-10^3 CFU/ml whiles three out of the six containers recorded coliform counts all in 10 folds. The inlet sections of the dispenser surprisingly also recorded aerobic mesophiles in the range of 10-10^2 CFU/ml with only one recording coliforms but in low numbers. A total of 83 % (5 out of 6) of the outlet sections recorded aerobic mesophiles with only one recording coliforms. The results obtained is in conformity with microbiological guidelines and standards for drinking water which suggest zero colony count/100 ml of water sample for *E. coli*, *P. aerugnosa* and *E. faecalis* (The Natural Mineral Water, Spring Water and Bottled Drinking Water Regulations, 1999). Relatively high aerobic mesophilic counts are indicative of poor, unhygienic handling and processing. The population of aerobic mesophiles recorded provided an idea of the overall

bacteria load of the water, outer section of the bottles, inlet and outlet taps of the dispensers. Bacterial growth in water may be unnoticed even in transparent packaged water bottles/containers and the presence of some of these microorganisms may pose a potential risk to consumers as it multipliers over time. Even though the microbial population recorded in the water samples were low those on the bottles were quite substantial. It has been established that deterioration of water quality occurs during transport and storage (Clasen & Cairncross, 2004; Wright et al. 2004; Gundry et al. 2006) and may be attributed to this result as the water is sometimes stored over a period before usage. The inlet and the outlet taps of the dispensers also recorded some counts due to the dust from the environment as well as contacts from hands, receptacles etc. These microorganisms can gain entry into the dispensed water and re-contaminate it thereby increasing the microbial load and making the water unsafe for drinking. The mean pH of all the water samples were in the range of 5.4 - 5.8 (fig. 1) which were acidic and did not meet the WHO standard (WHO, 1997). The U.S. Environmental Protection Agency, which classifies pH as a secondary drinking water standard, recommends a pH between 6.5 and 8.5 for drinking water. WHO warns that extreme pH levels can worsen existing skin conditions. Also other than the unpleasant aspect of foul-tasting water, low pH values generally have few negative health effects and can cause serious problems to consumers (Anon., 2014). Regular monitoring of the water dispensers for pathogens and indicator organisms as well as pH should be carried out on regular basis. A preventative maintenance plan must also be developed to prevent contamination of the water and this should be paramount to the Institute by ensuring that the dispenser (inlet and outlet tap) is cleaned properly and sanitised on daily or weekly basis.

CONCLUSION

The water samples analyzed were microbiologically safe. It is, however, disturbing that the water samples, containers and the inlet and outlet taps of the dispensers were contaminated with bacteria. Efforts should be made to minimise these microbial contamination by periodic examining the water from these water dispensers for their safety. The supplier/producer should also be informed to improve the pH level of the water in order to prevent any health risk.

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