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Microbial Quality of Drinking Water in Public-water Services within Sudan University of Science and Technology

Eltayib Hassan Ahmed[1,*], Nadrin Tawfig[2], Nour-Eldeen M Ali[3], Mohammed Ahmed Ibrahim[1]

[1]Faculty of Medical Laboratory Science, AlzaiemAlazhari University. P.O. Box 1432, Khartoum Bahri 13311, Sudan
[2]Faculty of Medical Laboratory Science, Sudan University of Science and Technology, Khartoum State, Sudan
[3]Medical Laboratories Administration, Ministry of health, Khartoum State, Sudan

Abstract The present research was case studycarried out in Sudan University of Science and Technology (SUST) from April to September 2011 to assess bacterial contamination of drinking water using presence absence technique. SUST provides drinking water through three forms of cooling systems; non-electrical local made coolers, classical electrical coolers and hot-cool refrigerators. Fifty water samples were collected;9 (18%) samples from non-electrical local made coolers, 13(26%) samples from classical electrical coolers and 28(56%) samples from hot – cool refrigerator. The results showed that all water samples were contaminated by coliform bacteria. Samples collected from non-electrical local made cooler showed (88.9%) coliform, (77.8%) thermo-tolerant, (66.7%) presumptive test positive and (55.6%) confirmed E.coli. Samples collected from classical electrical coolers showed (23%) coliform, (23%) thermo-tolerant, (23%) presumptive test positive, and (7.8%) confirmed E.coli. Water samples collected from electrical hot-cool refrigerators showed (82.1%) coliform, (64.3%) thermo tolerant, (28.6%) presumptive test positive and (25%) confirmed E.coli.The study highlights the need for regular bacteriological enumeration along with setting up regime for cleaning and maintaining of water cooling system and regular medical check-upfor people who handling water service.

Keywords Presence Absences Method, Coliform, Thermo Tolerant, E.Coli

1. Introduction

Water is essential to sustain life and satisfactory supply must be available (adequate, safe, and assessable). Improving access to safe drinking water can result in tangible benefits to health; safe drinking water is suitable for all usual domestic purpose including personal hygiene[1].

The World Health Organization reported that every year more than 5 million people die as a result of water related diseases, 10 times the number of people killed in war, which makes it the leading cause of disease and death around the world[2].

Improving access to clean water and sanitation would dramatically reduce illness and death in poor countries,a clean water supply reduces diarrhoea-related death by up to 25%, while improved sanitation reduces it by 32%. Adequate water and sanitation would help vulnerable groups – especially women and girls. It would also provide significant economic benefit. The annual value of time saved globally would amount to $63.5 billion in 2015, while the health-related costs avoided would reach $7.3 billion per year worldwide in 2015[3].

However, several methods were used to assess the bacterial contamination of water. Recently, a simple and very sensitive alternative to the classical Membrane Filtration Technique and Multiple Tube Method has been developed; presence absence (P-A) coliform test. The P-A test is a modification of the MPN procedure in which large water sample (100 ml) is incubated in single culture bottle with triple-strength broth containing lactose, sodium lauryl sulfate and bromcresol purple indicator. The P-A test is based on the assumption that no coliforms should be present in 100 ml of drinking water. Sodium lauryl sulfate inhibits many bacteria, but not coliform. A positive test results in the production of acid from lactose fermentation (bromcresol purple changes from purple to yellow) and constitutes a positive presumptive test. As with the MPN test, it requires confirmation. If there is no colour change, the results are negative for coliform in 100 ml water sample[4].

The present study was undertaken to evaluate the microbial quality of drinking water of cooling system in Sudan University of Science and Technology (SUST), Sudan.Investing in these supplies will reduce waterborne disease outbreaks and overall costsdrinking water.

* Corresponding author:
eltayib1974@yahoo.com (Eltayib Hassan Ahmed)
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2. Material and Methods

2.1. Study Design: this Research was Case Study

2.1.1. Study Area

This study carried out at Western and Sothern Campuses of SUST, according to Centro de CienciasHumanasySociales, Madrid, the university ranked 4,220 in the world, second in Sudan in 2011.

2.1.2. Study Population

SUST provides drinking water through three forms of cooling systems; non-electrical local coolers, which are public drinking fountain, based on circulation of water into the fixed circled pipes within baked bricks (100×150-200CM), it directly connected to water circulation, the users gain the water fromtap at the top of this fountain where the surface have pores to return the access water into drainage system. Non-electrical local made cooling system was established in SUST since 2000. Hot-cool refrigerators are electrical refrigerators provide hot and cool water according to operating options, do not fixed directly to water circulation, it have plastic bottles containers which refilled by workers. The last system was classical electrical cooler which provide only cool water and connected directly to water circulation.

2.2. Sample Collection

The main sources of water supply were subjected to chemical and bacteriological investigation prior to water samples collected from different location. Fifty water samples were collected into sterile containers; 9 (18%) samples from non-electrical local made coolers, 13 (26%) samples from classical electrical coolers and 28 (56%) samples from hot – cool refrigerators.

Water samples were collected aseptically into sterile containers at fifty designated pints (as mentioned above) within SUST. The water samples were immediately subjected to both chemical and microbiological analysis in order to evaluate the microbial quality of cool drinking systemusing the presence absence technique (P-A).

2.3. Presence Absence Technique

The P-A technique was performed as described by WHO1997,briefly:

- 100ml of water sample was inoculated into a 250 ml P-A culture bottle containing 50 ml of triple strength P-A broth and mixed thoroughly by inverting the bottle several times to achieve even distribution of triple-strength medium throughout the sample and incubated at 35 ± 0.05℃ .

- The P-A culture bottle was inspected after 24 and 48 hours for acid production. Adistinct yellow colour was formed in the medium when lactose fermented (acid conditions).

- culture showed acid production or acid and gas (a positive presumptive test) was transferred to a tube of brilliant green lactose bile (BGLB) broth containing a Durham tube and incubated at 35 ± 0.05℃ for 48 hours.

- Turbidity in the BGLB broth and gas in Durham tube within 48 hours confirmed the presence of coliform bacteria (e.g. Escherichia coli).

- The results were record as presence-absence test positive or negative for coliform in 100 ml of water sample.

General information related to study such as type and interval of maintenance of drinking water services and medical fitness certificate of worker who handling water services were collected through direct interview.

3. Results

The microbiological, pH and of chemical analysis of drinking water at main sources fallen within recommended limits (Data not shown).

The collected data (from interview) revealed that the administrative did not have feedback system of community water supply in term of water purity, regular maintenance of distribution system and satisfaction of students, moreover; the workers who refill the hot-cool refrigerators had no medical fitness certificate.

Samples collected from classical electrical coolers showed 23% coliform, 23% thermotolerant, 23% presumptive test positive, and 7.8% confirmed E.coli positive, while water samples collected from hot- cool refrigerators showed 82.1% coliform, 64.3% thermo tolerant, 28.6% presumptive test positive, and 25% confirmed E.coli positive, whereas water samples collected from non-electrical local made coolers showed 88.9% coliform, 77.8% thermo tolerant, 66.7% presumptive test positive, and 55.6% confirmed E.coli positive.

However, 68% of collected samples (from different cooling water systems) showed coliform, 56% showed thermo tolerant coliform, 34% were presumptive E.coli positive and 26% were confirmed E.coli positive

4. Discussion

High microbial counts in water are undesirable because of the increased likelihood that pathogens may be present, the possibility that these organisms will find access to foods and drink thereby causing spoilage and the adverse effects such organisms may have on pipelines and processing equipment. Presently, public health standards consider water to be safe for human consumption when it contains a maximum of 500 colony forming units per millilitre (CFU/ml), when it is free of E. coli (less than 5 CFU /100ml)[5,6,7].

Several methods were applied for bacteriological examination of water, however these techniques were not recommended for field work and its time consuming; therefore Presence Absence method was chosen for this study. Presence Absence technique, only indicates the presence or absence of indicator sought, do not consumes time, personnel, equipment and media.[8].

Inspite of acceptable water at the main sources in this study, the level of coliform contamination of water services was far exceed the WHO standards, accordingly McGarvey et al.,[9].reported that the problems are often experienced with accessibility to and availability of the supply water despite the availability of cleaner water from tap, tank and borehole. These results might explain the presence of water-borne disease such as dysentery, diarrhea and typhoid fever within the university population. The relation between coliform compliance and outbreak occurrence is well documented byCraun et al.,[10].and by Pruss et al.,[11].

The samples collected from non-electrical local made cooler and hot – cool refrigerators were highly contaminated with faecal pollution indicator whichpointed post treatment contamination.The contamination of drinking water systems in this study could be attributed to several factors such as deficiency of cleaning and maintaining of non-electrical local made coolers, the pores on surface of this system might partially or totally blocked due to accumulation of dust, therefor retained water, moreover the student washed their hand over it before drinking as the hand is mean of drinking which made it suitable environment for bacterial multiplication, thus damage in the pipe distribution system or leakage might be basis of pollution.

The study also revealed that the workers who refill the hot –cool refrigeratorshad no medical fitness certificate. However, Larson[12]reported that human hand are routinely contaminated by bacteria from anterior nose and gastrointestinal as well as environment microorganisms and the hand of worker may serve as reservoir for hand organisms causing infection including infection caused by multidrug resistant strains, also Pratt et al.,[13]concluded that handling contribute to the deteriorating microbiological quality of water. However, Mokgope and Butterwoth[14] reported maintenance as another problem, which influence uses sustainability of such serviceswhereas Momba and Kaleni[15]mentioned that the containers of water might lead to the water at the point of use being of inferior drinking microbiology quality by the time people get it.

Our results were agreement with study carried out by Ojo et al.,[16]at Lagos University to evaluate the quality of water, they found that the coliform contamination was far exceeds the WHO standards.Karthick et al.,[17]reported that the contamination of the water in Kerala State, India, might be due to lack of community hygiene and insufficient treatment.

The present study indicated the failure of different systems of cooling water at SUST to meet WHO standard for drinking water and highlights the need for regular bacteriological enumeration along with setting up stable regime for cleaning and maintaining of water cooling systems and regular medical checkup for people who handling the water services. These results strongly alarming the community of SUST and they being at critical health risks.

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