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Bacteriological Evaluation of the Drinking Water Quality in Khartoum State, Sudan

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ABSTRACT

The aim of this study was aseptically evaluate the Bacterial contamination of drinking tap water from different locations in Khartoum State (Khartoum ,Omdurman and Khartoum North). A total of 150 samples were aseptically obtained for Khartoum bacteriological analysis during the period January November2013. Water samples were analyzed for *E. coli*, and total coli form, total count using membrane filter technique, Multiple-Tube fermentation Techniques a Pour plate count. Most samples obtained from Khartoum state showed presence of total coliform , and fecal coli form, while those obtained from Khartoum North 24.06% ,and 53.61%, East Nile 14.99%,and 0%,Khartoum18.93%,and 21.27%, Jabeel Aeolia3.94%,and 0%, Omdurman12.62%, and 0%, Ombadah14.79%, and 4.68%, karri12.62%, and 20.42%. But water samples in all locations contained high number of total bacteria, Khartoum North 3.38±0 CFU/ ml, East Nile 3.79±0.86 CFU/ ml, Khartoum 3.92±0.48 CFU/ ml, Jabel Awlia 4.12±0.67 CFU/ ml, Omdurman 3.77±0.58 CFU/ ml, Obadiah 3.93±0.49 CFU/ ml, karri3.84±0.39 CFU/ ml. Therefore a need for intervention measures such as in order to reduce the burden of contamination caused by coliform bacteria, in the area of study is contamination is above the normal level?.

Keywords; Khartoum state, Drinking water, Bacterial Contamination

INTRODUCTION

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection. The importance of water, sanitation and hygiene for health and development has been reflected in the outcomes of a series of international policy forums (WHO, 2011). They have also included water -oriented conferences such as the 1977 World Water conference in Mar del Plata, Argentina, which launched the water supply and sanitation decade of(1981–1990) as well as the Millennium Development Goals adopted by the General Assembly of the United Nations 200 and the outcome of The Johannesburg World Summit for Sustainable Development 2002 (WHO, 2008). The UN General Assembly declared the period from 2005 to 2015, as the International Decade for Action, “Water for Life”. Most recently, the UN General Assembly declared safe and clean drinking-water and sanitation a human right essential to the full enjoyment of life and all other human rights (WHO,2011). The contamination of natural water with faecal material, domestic and industrial sewage and agricultural and pasture runoff may result in an increased risk of disease transmission to human who use those waters (Geldreich,1991and Wiggins,1996). Diarrhoeal disease from contaminated water continues to be serious problem in developing countries and a lesser (Grant, 1997, and UNICEF, 2011). The main sources of water contamination are Contamination of drinking water sources by sewage can occur from raw sewage overflow, septic tanks, leaking sewer lines land application of sludge, and partially treated waste water.

Sewage itself is a complex mixture and can contain many types of contaminants, the greatest threats posed to water resources arise from contamination by bacteria, nitrates; trace quantities of toxic materials, and salts (EPA, 1983). Seepage overflow into drinking water sources can cause disease from the ingestion of microorganisms such as disease causes *E coli*, *Giardia*, *Criptosporidium*, *Hepatitis A* virus, and *Helminthes* (EPA, 1983), urban runoff is now recognized as a significant source of contamination to water, suspended sediments are the primary pollutant in urban runoff which also contain oil, grease, pesticides from turf management, road salts, metals, bacteria and viruses, and toxic chemicals from automobiles…etc. (EPA, 1983). Animal production facilities can be a source of drinking water contamination if wastes are not properly managed microorganisms, phosphorus and nitrogen are the prime contaminants from manure, farmers use the lagoon manure (collected liquid manure in catchment ponds where it can be degraded by anaerobic bacteria, sunlight and water) as fertilizer bacteria and other microorganisms are filtered out by the soil, but can enter surface water resources in run-off if waste application rates are high and the soil becomes saturated, Saturation of soil can also contribute to contamination of ground water sources (Abdel Magid and Abdel Magid, 1990). Water of poor quality can cause social and economic damages through water-related epidemics such as cholera which in turn increases medical treatment costs (Pritchard, 2007). Historically, water has played a significant role in the transmission of human disease Typhoid fever, cholera, infectious hepatitis, bacillary and amoebic dysenteries and many varieties of gastrointestinal disease can all be transmitted by water (Rompre´, 2002). For more than a century the presence of Coliform bacteria in drinking and recreational waters has been taken as an indication of faecal contamination, and thus of a health hazard. Total coliform, and thermotolerant, faecal coliform, indicator tests are common public health tests of the safety of water and wastewater which might be contaminated with sewage or fecal material (APHA, 1998). The presence of the indicators is often a key in assessing potential public health risks due to pathogens and is used in drinking water quality regulations and guidelines in many countries (Gauthier and Archibald, 2001). Simple techniques for treating water at home, such as chlorination, filtering, disinfection and storing it in safe containers could save a huge number of lives each year (WHO, 2005). Reducing deaths from waterborne diseases is a major public health goal in developing countries. Many agents are used for disinfection but the most popular are chlorine and chlorine dioxide (Degremont,1979).Residual chlorine provides protection against contamination occurring during subsequent distribution of the water (Salvato,1982). The objectives of this study was to evaluate the drinking water quality in Khartoum state.

MATERIALS AND METHODS

Study area: Khartoum is one of the eighteen states of Sudan. national capital of Sudan. The state lies between longitudes 31.5 to 34 °E and latitudes 15 to 16 °N. Geographically divided into blocks (or clusters), which are further subdivided into localities. There are a total of three blocks and seven localities localities (Khartoum, Jabel Awlia, Khartoum North, East Nile, Omdurman, Ombadah and karari).

Sampling: Total 150 samples of drinking water were collected during the period January November2013 from different localities in Khartoum State these samples were aseptically collected in sterile glass bottles, placed on ice, and sent to Microbiology laboratory in college of Water and Environmental Engineering, Sudan university.

Bacteriology

Colony Count: Total viable count was carried out using the pour plate technique as described by Harrigan (1976). Ten ml of each sample was transferred to nine ml of sterile diluent, as a first dilution, serial dilutions were made up to six and one ml of each dilution was transferred aseptically in duplicate into sterile Petri dishes. ten-fifteen ml of melted plate count agar (45-46°C) was poured into the dishes. The dishes were then thoroughly mixed to facilitate distribution of the sample throughout the medium, and allowed to solidify and plates were incubated at 37°C for forty eight hours. Colony counter (LKB2002.EU) and hand-tally were used for the determination of the total bacterial counts in terms of colony forming units per ml (C.F.U /ml).

Most probable number test: Presumptive test: The multiple tube fermentation technique was performed as a presumptive test for total coliform using tubes containing MaCconkey Broth and inverted Durham tubes. To each of three double-strength MacConkey broth tubes, 10 ml of the original sample added, three single-strength MacConkey broth tubes, 1 ml of the original sample added,and three single-strength MacConkey broth tubes, 0.1 ml of the original sample added. All tubes were incubated at 37°C for forty eight hours for the observation of gas production. First reading was taken after 24 hours to record positive tubes, and the negative ones were incubated for another 24 hours (APHA, 1992).

Membrane Filtration technique: To detect *E. coli,* one hundred ml of drinking water were filtered using membrane filter technique. The filter pad was cultured on a sterile Endo agar plate, incubated at 44.5°C for twenty four hours. After incubation, the number of red colony- forming units was counted to give the number of *E. coli,* per one hundred ml in the water sample. (APHA, 1989)

Statistical analysis: All obtained data were statistically analyzed using SPSS program,(2002) Mean ± standard deviation.

RESULTS AND DISCUSSION

Table1 Shows that the treated water samples in most locations contained high number of total bacteria. However, in general treatment processes leads to decrease number of bacteria at each stations, . But the elimination or complete control of bacteria was not occurred. Regulatory agencies and environmental microbiologists have suggested that the heterotrophic bacterial counts in finished drinking water should not exceed from 500 CFU/ml, mainly to reduce interference with the detection of coliform bacteria, (Environmental Agency, 1989).

Table 1: Mean and standard deviation of Total viable count of bacteria (CFU/ ml) in water at Different locations at Khartoum state

Locality	Number of total viable count of bacteria	Mean ±Std. D of CFU/ ml
Khartoum North	42	3.38±0.73
East Nile	40	3.79±0.86
Khartoum	24	3.92±0.48
Jabel Awlia	66	4.12±0.67
Omdurman	20	3.77±0.58
Ombadah	12	3.93±0.49
Karari	55	3.84±0.39

As it is clear from Table (2) all Khartoum water samples showed the presence of total coliform , and faecal coliform. Khartoum state water samples was significantly different between the locations The highest value of total coliform, was Khartoum North (24.06%)while the lowest one was Jabeel Aeolia (3.94%). The highest value of fecal coliform,was Khartoum North (53.61%) while the lowest one were East Nile,

Jabel Awlia, and Omdurman(0.00%). The presence of total coliform, and fecal coliform, was indicator of pollution of the water .Sudanese standards for drinking water stated that all water intended for drinking must be free from *E.coli,* or total coliform, bacteria in any 100 ml of water. This study reveals that water samples were contaminated with greater total and fecal coliform bacteria. This highlights the need for continuous assessment of the quality of public water supply and intervention measures to prevent outbreak of water by total and fecal coliform bacteria.

Table 2: Percentages of Total coliform and fecal coliform in water at different localities at Khartoum state

No	Locations	Total coliform	*E. coli*
1	Khartoum North	24.06%	53.61%
2	East Nile	14.99%	0.00%
3	Khartoum	18.93%	21.27%
4	Jabel Awlia	3.94%	0.00%
5	Omdurman	12.62%	0.00%
6	Ombadah	14.79%	4.68%
7	Karari	12.62%	20.42%

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