Microbiological Assessment of Drinking Water Quality in Omdurman City

Hanan B. Alkhiry[a*], Elnasri M. Mutwali[b], Nagat A. Alrofaei[c], Elsir A. Salih[d]

[a,b,d]*Department of Biology, Faculty of Education, Alzaiem Alazhari University, Khartoum*

[c]*Biotechnology Department, Faculty of Science and Technology, Omdurman Islamic University*

Abstract

A study was conducted to evaluate the drinking water of Omdurman city, by looking into the microbiological aspect. Ten samples were taken randomly from different parts of Omdurman city during three seasons (winter, summer and autumn) for two successive years. Results indicated that most of the samples were contaminated by bacteria, including *Coliform, Escherichia coli* and *Fecal streptococcus*. The contamination percentage was higher in the rainy season and summer, while in winter was the least.

Keywords: Microbiology; Drinking water; Quality; Omdurman city.

1. Introduction

Sudan is one of the largest countries in Africa and lies mostly in the arid region where water is a scarce commodity. Water used in Sudan derives almost from surface water resources, as ground water is used in only limited areas. Surface water is provided mainly by the Nile River. The main part of the Nile is formed by the confluence of the Blue Nile and the White Nile in the capital of Khartoum. In recent years, there has been a large movement of displaced groups into the peripheral areas of the city of Omdurman. These communities live in localities characterized by crowding, poor housing and in adequate water and sanitation, although great attempts are being made by the government to improve the infra-structure[1]. In many countries around the world, including Sudan, some drinking water supplies have become contaminated, which has impacted on the health and economic status of the population.

----

* Corresponding author.

The contamination of natural water with fecal material from sewage and agricultural run-off may result in an increased risk of disease transmission to humans[2]. Fecal Coli form have been seen as an indicator of fecal contamination and are commonly used to express microbiological quality of water and as a parameter to estimate disease risk [3]. A number of authors have reported a statistically significant deterioration in the microbiological quality of water between the source and point of use in the home (4 ,5 , 6). The present study was undertaken to investigate water quality and determine the microbiological quality of water samples collected from ten different sites of Omdurman city during two season years (2014 and 2015).

2. Materials and Methods

a) Sample collection

The water samples from different sources and sites in Omdurman city were collected during three seasons (winter, summer and autumn) and for two successive years. The samples were collected during the day in sterile screw-cap bottles bottles and examined in the laboratory immediately after arrival.

b) Microbiological examination

Total viable bacterial count was carried out using the pour plate technique according [7].. the presumptive Coliform test, confirmed Coliform test and the most probable number (MPN) and the fecal Coliform test were carried according to methods prescribed by [8 and 9].

3. Results and Discussion

Table (1 and 2) showed the mean value of total count bacteria of water samples collected from Omdurman city in the years 2014 and 2015. The highest total viable count during the year 2014 and 2015 was found in sample No. 10. This sample was taken directly from River Nile (untreated sample). On the other hand samples No. 3 had the lowest count during the two years 2014 and 2015 in the three seasons (winter, summer, autumn). This sample was taken from ground water and it is known that the ground layers work as filters, so water must be free from any organisms. Results from Table (1) indicated that 40, 70 and 70% of Omdurman city water samples showed the presence of the total Coliform, in winter, summer and autumn respectively. The results also showed the presence of *Escherichia coli* in water samples with percentage of 30, 40 and 50% in the first year (2014) in winter, summer and autumn respectively. However, in the second year data (2015), the percentage value was 30, 40 and 60% in winter, summer and autumn respectively. The presence of fecal streptococcus bacteria was detected in some water samples and the percentage was 10, 20 and 30% in both years, in winter, summer and autumn respectively. The present of Coliform, *E. coli* and fecal streptococcus means that these water samples were unfit for drinking according to the Sudanese standards [10] and the international standards [9] for drinking water. These standards stated that *E. coli* or thermotolerant Coliform bacteria must not be detectable in any 100ml sample. The detection of total Coliform, *E. coli* and fecal streptococcus in these samples was an indication that water was exposed to contamination from human or animal faeces. Similar results were reported by [11] in Nigeria [4] and [12 and 13] in Sudan, they reported that some water samples were contaminated by Coliform, *E. coli* and fecal streptococcus bacteria The results coincided with that obtained

by [14] who found that there were either Coliform or fecal coli form in Samples from Nile water . Also [15] in his study found that the drinking water samples from Elhasahisa city were contaminated by Coliform bacteria and *Escherichia coli* .

Table 1: The microbial quality of the water sample from Omdurman city in the year 2014

Season	Sample number	1	2	3	4	5	6	7	8	9	10
Winter	Total viable count (cfu/ml)	$8. \times 10^3$	7.0×10^4	3.5×10^2	4.0×10^3	3.6×10^4	3.8×10^3	4.5×10^2	5.6×10^2	4.8×10^3	7.5×10^5
	Coliform (MPN) total coliform	20	10	0	13	0	0	0	0	12	200
	E. coli	5	3	0	0	0	0	0	0	0	50
	Fecal streptococcus (MP/mL)	0	0	0	0	0	0	0	0	0	0
Summer	Total viable count (cfu/ml)	4.3×10^3	5.4×10^3	4.8910^2	6.0×10^3	5.8×10^4	1.8×10^3	2.4×10^4	5.9×10^4	5.6×10^3	3.6×10^5
	Coliform (MPN) total Coliform	30	15	0	35	20	0	0	12	15	260
	E. coli	25	8	0	20	0	0	0	0	0	65
	Fecal streptococcus (MP/mL)	10	0	0	01	0	0	0	0	0	48
Autumn	Total viable count (cfu/ml)	4.0×10^4	3.0×10^4	8.5×10^3	4.2×10^4	3.8×10^4	6.5×10^3	5.2×10^3	5.7×10^3	5.6×10^3	7.0×10^4
	Coliform (MPN) total coliform	45	20	0	40	28	0	0	18	20	300
	E. coli	30	12	0	26	0	0	0	0	0	180
	Fecal streptococcus (MP/mL)	3	0	0	6	0	0	0	0	0	70

Table 2: The microbial quality of the water sample from Omdurman city in the year 2015

Sample number	Winter T.V.C. (cfu/ml)	Winter Coliform total Coliform	Winter E. coli	Winter Fecal streptococcus (MP/ml)	Summer T.V.C. (cfu/ml)	Summer Coliform total	Summer E. coli	Summer Fecal streptococcus (MP/ml)	Autumn T.V.C. (cfu/ml)	Autumn Coliform total	Autumn E. coli	Autumn Fecal streptococcus (MP/ml)
1	$3,0\times10^3$	30	25	0	$4.^{6103}$	30	25	0	2.5×10^3	36	28	0
2	$^{o}.0\times10^3$	15	8	0	1.5×10^3	15	8	0	5.4×10^3	18	23	2
3	5.7×10^2	0	0	0	3.8×10^3	0	0	0	4.9×10^2	0	0	0
4	4.5×10^3	13	20	0	2.8×10^4	35	20	01	6.0×10^3	40	28	6
5	6.0×10^4	0	0	0	1.7×10^4	0	20	0	5.8×10^4	27	8	0
6	3.5×10^3	0	0	0	4.3×10^4	0	0	0	1.8×10^4	0	0	0
7	4.0×10^3	0	0	0	2.4×10^4	0	0	0	2.4×10^4	8	0	0
8	3.5×10^4	0	0	0	1.5×10^4	12	0	0	5.9×10^4	18	0	0
9	6.8×10^4	12	0	0	3.7×10^2	15	0	0	5.6×10^3	7	6	0
10	5.0×10^5	180	50	30	5.7×10^2	240	70	60	5.6×10^3	280	175	67

In this respect [4] working with microbiological assessment of drinking water quality in Khartoum State , found that Khartoum surface water was contaminated with coli form , fecal coli form and fecal strepto cocci. It is worth mentioning that the presence of the total Coliform, E. coli and fecal streptococcus decreased in winter and summer in both years, that because the environmental conditions were not favourable for microorganism growth, on the contrary, in autumn, the rainy season the high percentage of water samples contamination may be

attributed to the high turbidity of Nile water in autumn which can protect the pathogenic micro-organism from the effects of disinfectants and stimulate the growth of bacteria during storage. The high contamination in the rainy season may be attributable to the influx through runoff of microorganisms originating from different municipal sewage, garbage, domestic and fecal waste [16].

4. Conclusion

The microbiological examination of water samples in this study indicated that most of water samples were contaminated by bacteria, including Coliform, *E. coli* and fecal streptococcus as their count exceeded the Sudanese standards (2015) and the International standards (WHO, 2004) .

5. Recommendation

From the results of this study it is recommended to carry out bacteriological examination frequently and regularly for the water entering the distribution system and the water in the distribution system for the control of the hygienic quality of the water supply.

Acknowledgement

References

[1]. Musa, H.A., Shears, P., Kafi, S. and Elsabag, S.K. Water quality and public health in northern Sudan: a study of rural and peri-urban communities. Journal of Applied Microbiology, vol. 87, pp 676-682,1999.

[2]. Geldreich, E.E. and Le Chevallier, M. Microbiological quality control in distribution system. In: Water Supplies, Letterman, R.D. (Ed.) 5th Ed., Mac Graw-Hill, New York 1999.

[3]. WHO (1993). Guidelines for drinking water quality, World Health Organization, Genève, Vol. 1 1993.

[4]. Ell-Amin, Amira, M., Sulieman Abdel Moneim, E. and El Khalifa, Elamin, A. Microbiological assessment of drinking water quality in Wad Medani and Khartoum States. 1th International Water Technology Conference, IWTC. 1802012, Istanbul, Turkey , 2012 .

[5]. Simango , C.,Dindiwe,J., and Rukure, G . Bacterial contamination of food and houes gold stored drinking water in afarm warker community in Zimbalwe , vol.,38[5] pp.143-149,1992.

[6]. Welch,p.,David ,J.,Clarke ,W.,Trinidase , A..Penner,D., Berstein ,S.,Mc Dogall, L. and Adesiyn , A .A.Microbial quality of water in rural com munities of Trinidad.Review of panam Salud publications , vol, 8 (3) , pp.172-180, 2000.

[7]. Harrigan, W.F. Laboratory methods in food microbiology, 3rd edition, printed in Great Britain by WBC book Manufactures, Bridgend, Mid Glam Organ, 1998.

[8]. APHA, AWWA and WPCF Standard methods for the examination of water and waste water. 20th Edition, Published jointly by American Public Health Association, American Water Works Association and Water Pollution Control Federation, Washington D.C. 1999.

[9]. WHO Guidelines for drinking water quality. Third Edition. Incorporating first addendum, Geneva , 2004.

[10]. SSMO Sudanese Standards and Metrology Organization Drinking Water Guidelines Bulletin, Sudan, 2015.

[11]. Oyhakilome, G.I., Aiyesanmi, A.F. and Akharaiyi, F.C. Water quality assessment of Ownea Multi-purpose Dam, Ondo State, Southwest Nigeria Journal of Environmental Protection , vol.3,pp. 14-25,2012.

[12]. Al Khairy, Hanan,B.A. Evaluation of drinking water quality in Althora district. M.Sc. Thesis, Al Zaeim Alazhari Unviesity. Sudan , 2013 .

[13]. Idris, H.A. The microbiological contamination of drinking water in Umbada area in Omdurman city, M.Sc. Thesis, Faculty of Education, Alzaiem Alazhari Unviersity, Sudan 2015.

[14]. EL Hassan , B., Awad elkarim , M.A., Abdel Magid , H . M.,ibrahim , I.s. and Dirar , H . A . On water quantity and quality and their im pact an health in Khartoum Prouince , Sudan . Water Quality Bulletin , vol . 9 (4) pp. 225-230, 1984.

[15]. El bakri , H . K.H Evaluation of drinking water quality from Swface and qround resaurces in Gezira State . M.Sc. Thesic , University of Khartoum 2009.

[16]. Zvikomborero, H. An assessment of water quality of drinking water in rural districts in Zimbabwe, the case of Gokwe south, Nkayi, Lupane and Mwenezi districts, Physics and Chemistry of Earth, vol .3 , pp.856 – 866, 2005 .