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Microbiological Analysis of Drinking Water in Maiduguri Metropolis, Nigeria

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ABSTRACT

Good quality drinking water is one of the major natural resources which is necessary for existence and survival of all living things. This study was aimed to determine the microbiological analysis of drinking water in Maiduguri Metropolis, Nigeria. Six(6) samples were collected from different geographical zones within the studied area, these include; Jajeri (A), Gwange (B), London Ciki (C), Hausari (D), Maduganari (E) and Umarari (F). The microbiological analysis was examined using Most Probable Number (Multiple Tube Fermentation Method) for enumeration of both total coliform and differential Escherichia coli count. The results of the analysis shows that total coliform count ranges from 30-60 cfu/ml, with sample D had the highest coliform count and while the water sample from point F had the lowest coliform count, although, the entire water sample exceeded the standard limit of 0 cfu/ml established by World Health Organization (WHO) and 10cfu/100ml set by Nigeria Standard of Drinking Water Quality(NSDWQ). Also further characterization of the isolates revealed that the samples were contaminated with different pathogenic bacteria such asEscherichia coli, Pseudomonas species, Enterobacterspecies, and Klebsiellaspecies. Therefore, there is need to enlighten the general public about the need for water purification to ensure potability before consumption.

INTRODUCTION

Water plays indispensable role for sustenance of life, without which no life could survive on earth. Maintaining the standard of water is very important for human being since it is directly linked with his daily life (Bello *et al.*, 2013). Water is one of the essentials that support all forms of plant and animal life. Although, source and portability of drinking water determine the health conditions of the peoplein a society as microbiological contaminant of water is the major cause of disease outbreak in societies particularly in many developing countries. The transmission of contaminant through drinking water is therefore, one of the basic needs to safe water supply (Ahmed *et al.*, 2004; Popoola*et al.*, 2007; Bukar*et al.*, 2015). Water contamination is a globalpublic health threat placing people at a peak risk of a diseases such as dysentery and other illness as well as chemical intoxication (Okonko*et al*., 2000; Isa *et al*., 2013). In third world countries, the availability of standard drinking water becomes a problem when supply is impeded (Popoola*et al*., 2007).Unsafe drinking waterpose several threat to human health (Oparaocha*et al.*,2010). Contaminated water supply and

unidentified sanitation situation can result in poor human health (Oparaocha*et al.*,2010). The ensuring of standard drinking water is a basic factor that ensures public health, the protection of environment and sustainable development. However, many infectious pathogens are transmitted throughfecal oral contamination. Diseases due to the drinking water of contaminated water results to death of five million children annually and make 1/6 of the world population ill (Shittu*et al.*, 2010; Isa *at al*., 2013; Bukar*et al.*, 2015).The supply of contaminated water has been traced to be the major causes of diarrhea and which leads to deaths. World Health Organization (WHO) stated that, there were about four billion cases of gastroenteritiswhich leads to death of about 2.2 million people annually (Essien and Olisah, 2010). The Ministry of Health under the Federal Government and various State Ministries of Health in Nigeria are reporting increase number of cases gastroenteritis, diarrhea, dysentery, typhoid and cholera are indication of fecal oral contamination and poor quality drinking water. The gradualdeterioration of water quality leads to the increase in human population and urbanization (Edema *et al.*, 2001; Essein and Olisah, 2010).Microbial deterioration of drinking water by human and animal excretion is the most common reason for water to be considered unsafe for drinking because of the high percentage of pathogenic organisms. Some of these indicator organisms *include E. coli, Clostridium perfringes, E. faecalis, and Klebsiella species*which serves as fecal coliform for the indication of pathogenic organisms such as *Salmonella typhi, Vibrio cholerea and pseudomon as aeruginosa*. Therefore, the primary goal of this research is to assess the suitability of the water for drinking and other domestic use by assessing the microbiological quality of drinking water in Maiduguri metropolis, Nigeria.

MATERIALS AND METHODS

Study Area

Maiduguri metropolis is a capital city ofBorno State located Northeastern part of Nigeria. Maiduguri metropolis is one of the twenty seven Local Government Area that constitute the Borno.It covers more than 3000 km^2 of different land units. Maiduguri and its immediate environs is known for its dryness, with semi-arid climate, savannah or tropical grasslands vegetation, light annual rainfall of about 300 to 500 mm and the average daily temperature ranging from 22 to 35°C, with mean of the daily maximum temperature exceeding 40°C between March and June before the onset of the rains in July to September. It has mainly sandy loam soils (Bello*et al.*, 2013; Isa *et al.*, 2013; Arku*et al.*, 2011).Maiduguri is located in 11.85 latitude and 13.16 longitudes and is situated at elevation of 325 meters above sea level. Maiduguri has a population of 1,112,449 according to 2007 population census, making it the biggest city in Borno. Its residents are mostly Muslim including Kanuri, Hausa, Shuwa, Bura, Marghi, and Fulani ethic groups. There is also a considerable Christian population and people from Southern states such as the Igbo, Ijaw, and Yoruba. In this study, six geographical zone where randomly selected these include; Jajeri (A), Gwange (B), London Ciki (C), Hausari (D), Maduganari(E) and Umarari (F). All samples were collected from the sampling site within the Maiduguri metropolis and taken to the Department of Microbiology, laboratory for analysis.

Collection of Sample

Water samples from different boreholes were collected using sterilized bottle, and transported in a cool container to the Microbiology laboratory,

Faculty of Science, University of Maiduguri, for Microbiological analysis.

Bacteriological Analysis

Determination of Total Coliform Count and Fecal Coliform Count: Bacteriological characteristics of water samples were examined using Most Probable Number(Multiple Tube Fermentation Method) for enumeration of both total coliform and fecal coliform count. Lauryl Tryptose Broth (LTB) along with fermentation tubes (Durham tube) was used. A serial dilution of the water samples to be tested was made and incubated at 35°C for 20-24 hours for total coliform count. The positive result tubes where transferred to Brilliant Green Lactose Bile Broth and incubated for 48 hours at 35°C, the growth or production of gas confirmed the presences of coliform (Isa *et al.*, 2013; Bello*et al.*, 2013; Nollet 2007).

Heterotrophic Plate Count

Serial dilution of water samples were prepared with sterile distilled water. The 10^5dilution was used. 1ml of the water sample was aseptically transferred in to the center of the sterile petri disc containing the suitable media.The water sample was spread uniformly using sterilized glass rod and the media was incubated at 37˚C for 24 hour as described by Bukar *et al.* (2015).

RESULTS AND DISCUSSION

Table1: Total Heterotrophic Count and Coliform Count of 6 Sachet Water Samples

Sample	Total Heterotrophic Count(CFU/F)	Total Coliform Count MPN/mml	Fecal Coliform Count	Isolates
A	$1.65X10^5$	50	0	*Enterobacter* species
B	$1.55X10^5$	35	0	*Pseudomonas* Species
C	$1.75X10^5$	55	1	*Klebsiella* species, *Pseudomonas* species and *E. coli*
D	$1.80X10^5$	60	0	*Klebsiella* species, *Pseudomonas* species
E	$1.50X10^5$	40	0	*Pseudomonas* species
F	$1.40X10^5$	30	0	*Pseudomonas* species
WHO	$1.00x10^2$	0 per 100ml	0	Zero
NSDWQ	-	10 per 100ml	0	Zero
EPA	$1.00x10^2$	-	0	Zero

The results of the microbiological analysis of drinking water from different geographical location in Maiduguri metropolis shows that total coliform count ranges from 30-60 cfu/ml, with sample D had the highest coliform count and while the water sample from point F had the lowest coliform count,

although, all the water sample exceeded the standard limit of 0cfu/ml established by WHO and 10cfu/100ml set by NSDWQ. However with the exception of water sample from C which have fecal coliform count of 1cfu/ml, the remaining water sampleshad zero fecal coliform count which shows that the samples are safe from fecal coliform contamination. The presence of fecal coliform may indicate a higher risk of pathogens being present in the water which may leads to waterborne diseases such as dysentery, typhoid fever, viral and bacterial gastroenteritis and hepatitis A (Table 1) (Isa *et al.*, 2013; Bello*et al.*, 2013; Bukar *et al.*, 2015).The result of the water samples collectedfrom different geographical zones in Maiduguri metropolis shows the samples contaminated with pathogenic bacteria whichinclude *Escherichia coli, Klebsiella species, Enterobacter species, and Pseudomonasspecies*. The result of this study agree with Bukar *et al.*,(2015)in Maiduguri metropolis, Nigeria, who reported that drinking sachet water is contaminated with *pseudomonas species,Klebsiella*species and *Enterobacteria species*. It is also similar to the finding of Mgbakor*et al.*, (2011) in Owerri metropolis that showed drinking water contained*Klebsiella species* and *Pseudomonas species*. The finding of this study is also similar to the work of Kalpana*et al.*, (2011) in Kebbi state, Nigeria, who showed drinking water contained *Staphylococcus aureusand Escherichia coli*. The presence of these pathogens in such water could leads to the incidence of diarrhea, food poisoning and gastroenteritis especially among school children.

CONCLUSION

The results of this study shows the microbiological analysis of water samples collected within Maiduguri metropolis using Multiple Tube Fermentation Method (Most Probable Number) and Serial Dilution Method for isolation and identification of both total coliform count and fecal coliform count. The heterotrophic bacterial counts and the total coliform count of all the water samples exceeded the standard set by Environmental Protection Agency (EPA), World Health Organization (WHO) and Nigeria Standard of Drinking Water Quality (NSDWQ). Manypathogens were also found from the drinking water such as *Klebsiella species, Escherichia coli, Pseudomonas species and Enterobacter species.*Therefore, there is need to enlighten the general public about the need for water purification to ensure potability before consumption.

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