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EVALUATION OF DRINKING WATER COLLECTED FROM DIFFERENT SOURCES IN MINNA METROPOLIS NIGER STATE

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Abstract

The assessment of the physico-chemical parameters and bacteriological quality of drinking water from selected sources in Minna Metropolis were evaluated for a period of six weeks. Four different sources: well, dam, borehole and tap water used for drinking and domestic purposes were sampled and analyzed based on standard procedures. Water temperature, pH, Electrical conductivity, Total Dissolved solids, Dissolved Oxygen and Biochemical Oxygen Demand with the mean values 27.58±0.17^0 c, 9.5±0.04, 268.75±40.92µs/cm, 672.92±95.02ppm, 2.53±0.07 Mg/l and 0.83±0.08 Mg/l respectively. All the physicochemical parameters obtained from all the stations fell within the permissible level except pH. The Total Dissolved solids from the well water was highest ranged from 1,057 to 1,435 ppm and not within the permissible levels of National and International standards for drinking water. The bacteria encountered in the study include: *Klebsiella pneumonia* (28.57%), *Serretia marcescens* (14.29%), *Staphylococcus aureus* (7.14%), *Bacillus subtilis* (14.29%), *Micrococcus leteus* (7.14%), *Bascillus megaterium* (14.29%), *Streptococcus* spp (7.14%) and *Escherichia coli* (7.14%). *Klebsiella pneumoniae* was prevalent in all the samples analyzed and had the highest percentage of occurrence (28.57%) among the eight bacteria species isolated from the water samples. The well water was highly contaminated with bacteria with seven species out of the eight bacteria species isolated. There is therefore, the need for standard treatment of water before consumption to prevent water related diseases.

Keywords: Drinking water, Physico-chemical parameters, Bacteriological quality and Minna Metropolis

INTRODUCTION

Water plays an essential role in human life without which life cease to exist. Water occurs in abundance in nature covering about 75% of the earth surface (Chandra *et al*, 2012). It occurs as surface water such as lakes, streams, rivers, ponds, shallow aquifers, oceans, seas, ice caps, glaciers and as ground water (when it accumulates in the ground) which is obtained as spring water, well water, and borehole water (Chandra *et al*, 2012). The public health significance of water quality cannot be over emphasized. According to the World Health Organisation (W.H.O) 2009, water is vital to our existence in life and its importance in our daily life makes it crucial for thorough microbiological and physicochemical examinations to be conducted before consumption. Drinking safe water has several health benefits like regulating appetite, increase metabolism, boost energy levels, reduce blood pressure, maintain the internal body temperature and constant fluid balance. (APEC Water, 2016). Microbes are integral part of water that is not only responsible for

nutrient recycling in marine and fresh water environment but can also contribute to variety of water borne diseases (National Academy of Sciences, 2016). Molecular techniques have been successfully used for the detection of pathogens in Drinking Water Distribution Systems (DWDS) especially in systems with biofilms (Giao, 2011). The quality of water is also determined by its physical, chemical and microbiological characteristics (Agwu *et al* 2013).

The most common and widespread health risk associated with drinking water is either direct or indirect contamination by human and animal excreta, the microorganism contained in faeces contaminating drinking water and pathogens in water stored within the home are the most important issues of interest in this area and it is also the cause of outbreaks of diseases including dysentery, cholera and hepatitis (Charles, 2006). Bacteria are water borne micro-organisms often composed of single cell rods, spherical or spiral in shape. Bacteria associated with drinking water such as *Vibro cholera, Shigella* spp, *Salmonella* spp, *E. coli and Campylobacter jejuni,* causing serious diseases such as typhoid fever, bacillary, dysentery and many others are mostly encountered in water bacteriological quality test (Amira *et al*, 2012; Siyum and Woyessa, 2013). Therefore, the present study was carried out to investigate the physicochemical and bacteriological qualities of drinking water from different sources in Minna Metropolis.

MATERIALS AND METHODS

Experimental Site: The study was conducted at the Biology and Microbiology Laboratories of the School of Life Sciences, Bosso Campus, Federal University of Technology, Minna. Niger State.

Collection of Water Samples: Four water samples were collected from different sources including tap, borehole, well and dam at Anguwan-Biri, Tudun-fulani, Randa-ruwa and Tunga respectively; within Minna metropolis in sterile plastic bottle/containers, labeled and transported to the laboratories with ice block in black polythene bag for a period of six weeks.

Determination of Physico-chemical Parameters: Water temperature, Hydrogen Ion Concentration (pH), Total Dissolved Solids (TDS), Electrical Conductivity, Dissolved Oxygen concentration and Biochemical Oxygen Demand (BOD) of water samples from the four different sources were determined weekly based on standard methods as described by Adebowale *et al*, 2008, Shyamala *et al*, 2008; Guptas, 2009, Navneet *et. al*, 2010 and Premlata, 2009 respectively.

Bacteriological Examination: Media, Serial dilution, Presumptive Test, Confirmed Test Completed Test, Characterization and Identification of Isolates, Gram staining; Microscopic Observation and Biochemical characterization of the bacteria isolated from water samples from the four different sources were determined weekly based on standard methods as described by Manga and Oyeleke, 2008 and Reiner, 2010. The experiment was conducted for a period of six weeks before termination.

Data Analysis of The Experiment: The data collected were analysed for significant differences ($P < 0.05$) by the analysis of variance (ANOVA)

using a Computer Statistical Package for Social Sciences (SPSS). Duncan Multiple Range Test (Duncan, 1955) method was used to separate the means where there were statistically significant differences ($P < 0.05$)

RESULTS AND DISCUSSION

The results of mean physicochemical parameters of drinking water collected from four different sources in Minna metropolis for a period of six weeks is presented in Table 1. There was no significant difference ($P>0.05$) in the temperature of drinking water ranging from the dam (27.32 ± 0.36^0 c) to 27.73 ± 0.41^0 c from the tap water source respectively. Similarly the D.O concentration of drinking water from different sources in Minna Metropolis was also not significantly different ($P>0.05$) ranging from 2.43±0.16Mg/l from tap water to 2.6±0.12Mg/l from the borehole water. Although, there was significant difference ($P<0.05$) in the pH value of the drinking water from all the drinking water sources analyzed but was significantly highest ($P<0.05$) in drinking water from the dam (9.63±0.06) when compared with other sources of drinking water. However, E.C (540±29.10µs/cm) and TDS (1302.33±60.28ppm) of drinking water from well were significantly highest ($P<0.05$) during the study period. Similarly, the BOD concentration (0.62±0.09Mg/l) of drinking water from borehole was significantly lowest ($P<0.05$) during the study period

Bacteriological quality of drinking water collected from different sources in Minna metropolis

The bacteriological quality of drinking water collected from different sources in Minna Metropolis is presented in Table 2. The table showed the bacteria species isolated from different sources of drinking water during the study period. Table 3 indicated the frequency of occurrence of the bacteria species isolated from drinking water from different sources. The result revealed that well water source had the highest number of bacteria species isolated followed by dam and borehole water with the tap water being the least contaminated.

Table 1:Physicochemical Parameters of drinking water collected from Four ferentfrom different sources in Minna metropolis for a period of six weeks

PARAMETER	Well	Dam	Borehole	Tap
Water temperature. (^{0} c)	27.73 ± 0.39^a	27.32 ± 0.36^a	27.55 ± 0.36^a	27.73 ± 0.41^a
pH	9.52 ± 0.11^b	9.63 ± 0.06^c	9.4 ± 0.06^a	9.58 ± 0.05^b
Electrical Conductivity (µs/cm)	540 ± 29.10^d	95 ± 3.42^b	363.33 ± 4.94^c	76.67 ± 2.11^a
Total Dissolved Solids (ppm)	1302.33 ± 60.28^c	257.53 ± 20.07^a	877.5 ± 30.18^b	258.5 ± 68.43^a
Dissolved Oxygen (Mg/l)	2.55 ± 0.15^a	2.52 ± 0.16^a	2.6 ± 0.12^a	2.43 ± 0.16^a
Biochemical Oxygen Demand (Mg/l)	1.02 ± 0.16^b	0.8 ± 0.15^b	0.62 ± 0.09^a	0.9 ± 0.23^b

Values are Mean ± Standard error, Values followed by the same superscript(s), in the same row, are not significantly different at ($P>0.05$) tested by DMRT

Table 2 : Bacteria species isolated from drinking water collected from different sources in Minna metropolis during the period of six weeks

Organisms	Well	Dam	Borehole	Tap
Klebsiella pseudomonas	+	+	+	+
Serretia marcescens	+	+	-	-
Staphylococcus aureus	+	-	-	-
Bascillus subtilis	+	-	+	-
Strptococcus spp	+	-	-	-
Micrococcus leteus	+	-	-	-
Bascillus megaterium	-	+	+	-
Escherichia coli	+	-	-	-

Key: + = positive/present, - = negative/absent

Table 3 : Frequency of occurrence of the bacteria species isolated from different sources of drinking water in Minna metropolis

Organisms Isolated	Well	Dam	Borehole	Tap	N	Frequency (%)
Klebsiella pneumoniae	1	1	1	1	4	28.57
Serretia marcescens	1	1	0	0	2	14.29
Staphylococcus aureus	1	0	0	0	1	7.14
Bascillus subtilis	1	0	1	0	2	14.29
Strptococcus spp	1	0	0	0	1	7.14
Micrococcus leteus	1	0	0	0	1	7.14
Bascillus megaterium	0	1	1	0	2	14.29
Escherichia coli	1	0	0	0	1	7.14
Total	7	3	3	1	14	100

Key: %= percentage, N= no of occurrence of bacteria isolates

The findings of this study revealed that the pH of drinking water from dam was alkaline which might be due to variation in season. This observation was similar to the findings of Lawal and Lohdip (2011) who reported alkalinity in the drinking water during rainy season and acidity in the dry season. The pH values (9.4±0.06-9.63± 0.006) obtained from this study were higher than the set standard by WHO (6.5-8.5). The temperature range (27.32-27.73^0) of the drinking water from different sources were similar during the study period. This may be due to the geographic region and climatic conditions of the study area **(**Oyem ***et al*, 2014)**. This finding was in agreement with the works reported by Chidinma *et al*, (2016) who reported a temperature range of 24-27^0 C from selected borehole water sources in Abakaliki Metropolis, Nigeria. The significant increase in E.C of drinking water from well (540±29.10µs/cm) and borehole (36333±4.94µs/cm) water sources might be attributed to the presence of different dissolved solids (increase in TDS) (Navneet *et al*, 2010)). In contrast, the TDS of drinking water from well (1302.33±60.28ppm) exceeded the W.H.O permissible limit (1000ppm) which was not in consonance with the reports of Shanmugasundaran, *et al*, (2013) who analyzed different drinking water sources (Siruvani, dam, well and borehole) in India and reported the highest value of TDS (652.8ppm) in well water. The bacteria load from the drinking water from different sources were generally high and exceeded the acceptable limit by W.H.O (2009); the viable bacteria counts that were high in different drinking water sources in Minna metropolis could be as a result of human and animal faecal matter contamination from surface water, runoff, broken water pipe line or due to percolation from latrine into the well and borehole water (Panjiar, 2010). This finding was in agreement the works of Saidu (2011) whose least

value of total viable bacteria count was 0.7×10^3 against the WHO standard for drinking water quality. The bacteria species encountered during this study include: *Klebsiella pneumoniae*, *Serretia marcescens*, *Staphylococcus aureus*, *Bascillus subtilis*, *Micrococcus leteus*, *Bacillus megaterium*, *Streptococcus* spp. and *Escherichia coli*. The contamination of these sources of drinking water with the aforementioned bacteria species was due to insanitary activities around the water bodies. The bacteria species isolated were in agreement with the works of Shittu *et al*, (2008) who isolated *Klebsiella* spp., *Staphylococcus aureus* and *Escherichia coli* from well water in Abeokuta, Nigeria. The highest bacterial isolates recorded in drinking water from well was due to unhygienic activities around the water body (Odonkor and Ampofo, 2013). The presence of coliform groups in this water sources suggest that the water might have been contaminated with animals or human faeces and the presence of these organisms in drinking water are indications of poor water quality and could cause a number of diseases such as diarrhoea, dysentery, typhoid fever, gastroenteritis and cholera over time (Hadeep *et al*, 2013).

CONCLUSION

The drinking water collected from different sources in Minna metropolis were generally alkaline but significantly highest in drinking water from the dam. The contamination of the drinking water from different sources in Minna metropolis with bacteria species *Klebsiella pneumoniae*, *Serretia marcescens*, *Staphylococcus aureus*, *Bascillus subtilis*, *Micrococcus leteus*, *Bascillus megaterium*, *Streptococcus* spp and *Escherichia coli* are of public health importance which are responsible for causing microbial-related diseases. Well water had the highest contamination of the bacteria species isolated which is an indication that the water is not safe for drinking without treatment while the tap water had the least contamination.

RECOMMENDATIONS

Good hygienic practices and sanitary conditions around sources of drinking water should be adopted. Boiling of water and other preliminary treatment before consumption and other domestic uses would help reduce water-borne diseases such as cholera, typhoid fever and many others .Analysis should be carried out on water sources used for drinking at regular intervals.

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