MICROBIOLOGICAL ASSESSMENT OF WELL-WATER SOURCES IN MINNA, NIGER STATE

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ABSTRACT

The microbiological properties of well waters used for domestic purposes was evaluated in this study. The physicochemical parameters evaluated include the pH of the water samples which ranged from 6.68 to 7.95, while the total hardness ranged from 13 to 150 mg/l. and the total hardness ranged from 13 to 150mg/l. The total heterotrophic bacterial counts of the bottled water ranged from 3.1×10^4 to 5.4×10^4, the MPN ranged from 26-150ml per 100ml, the bacteria isolates include *E. coli*, Streptococcus sp., *Enterobacter aerogenes,* Bacillus sp, Klebsiella sp. Etc. The presence of indicator organism indicates fecal contamination of the well water. It is therefore recommended that provision of hand dug wells and boreholes in this area should not be in proximity with the pit-latrines, septic and dump sites, which occurs in some households in Minna.

1. INTRODUCTION

Water is one of the most important elements for all forms of life. It is indispensable in the maintenance of life on earth. It is also essential for the composition and renewal of cells (Ethiopian Federal MOH, 2004; WHO, 2008). Water is an inorganic, transparent, tasteless, odorless and almost colorless chemical substance that's the principle part of the earth's hydrosphere and the fluid of maximum living organisms (Oboh and Olotu, 2023). Groundwater is any fresh water that lies beneath the earth's surface in soil pore spaces and in the fractures of rock formations. Groundwater is usually regarded as great sources of water because it looks clear and clean. This is because it runs through so many layers of rocks and sediments which serve as a sort of natural filtration system. The quality of groundwater can however deteriorate due to inadequate source protection and poor resource management resulting in groundwater contamination (Pedley and Howard, 1997). The use of contaminated groundwater has been responsible for water borne diseases including gastroenteritis, cholera, typhoid, giardiasis, stomach cramps and aches, vomiting, (caused by bacterial and viral pathogens and also protozoan parasites (Pedley and Howard, 1997) respiratory infections, liver damage and even cancer (due to DNA damage) caused by a series of chemical such as CFCs, MTBE etc (Bitton, 1999). The World Health Organization (WHO) estimated that 1.1 billion of the world's population has no access to safe water. In addition, 80% of diseases and one third of death in developing countries are due to consumption of contaminated water (WHO, 2011). In Nigeria, it is reported that the incidence of acute diarrhoea is approximately 4.9 episodes per year and there are approximately 200,000 diarhoea related deaths of children aged below five years with an average of 300 deaths per day (United nation, 2012). Consumption of these contaminated waters lead to Several water-borne diseases like cholera, typhoid, hepatitis A and E (Ghosh *et al.,* 2019). Diseases related to contamination of drinking-water constitute a major burden on human health. Up to 80% of all sicknesses and diseases in the world are caused by inadequate sanitation, polluted water or unavailability of water. Bacteriological quality of drinking water is primarily determined by using "indicator organisms" whose presence indicates faecal contamination (Dunling and Fiessel, 2008) and greater risk of contracting disease when these indicator bacteria are present at higher levels (Alonso *et al.,* 1996). Coliforms especially *E. coli* is thr recommended indicator. The most dangerous water pollutants are pathogenic microorganisms including Salmonella sp, Shigella sp, Vibro cholerae and E. coli. Naturally occurring opportunistic pathogens commonly found in water include *Pseudomonas aeruginosa*, Klebsiella sp, Aeromonas sp and might cause diseases in human mostly the debilitated and immunocompromised (Cunningham, 2005; Adamu *et al.,* 2016). Because coliform bacteria are most commonly associated with sewage, or surface and groundwater they are used as indicator group to determine the sanitary quality of drinking water (Casanova, 2001). Though most Coliform bacteria do not cause illness, their presence in a water system is a public health concern because it suggests that other disease causing organisms may exist in the water (Aydin, 2007). Coliform bacteria are commonly found in the soil, on vegetation and in water. They are also found in the intestine of warm blooded animals (Ramirez *et al*., 2010; Al-Khatib and Arafat, 2009). Coliform from animals wastes can enter directly into water supplies and contaminate the groundwater source thereby rendering it defective. The contamination of the wells can be caused by both point-source e.g. accidental spills, washings, leakages, dumping of animal wastes etc. and nonpoint-source e.g. runoff from roads, chemicals used in agriculture such as fertilizers, pesticides and herbicides. These sources of pollution may also contribute to the total and fecal coliform contamination thereby raising concerns about its safety; especially concerns about its potential for disease transmission (Ali *et al.,* 2012). In order to assess the risk of using water from these wells, information about the quality of the water is needed. Therefore, the objectives of this study are to measure: the physicochemical and bacteriological quality of selected well water used in Minna.

2. MATERIALS AND METHODS

Collection of water samples

Water samples from five different locations were collected following the method described by Idowu et al., (2011). Water sample from each well was aseptically collected into a sterile 200 ml plastic bottle tied with a strong string to a piece of metal of about 500g. The bottle cap was removed and bottle immersed into the well to a depth of 2 metres. The bottle was then brought up to the surface without touching the sides of the well and was immediately covered. The bottles were placed in cool boxes and transported to the laboratory within 4 hours for analysis.

BACTERIOLOGICAL COUNTS OF WELL WATER SAMPLE

The heterotrophic bacterial count was determined using standard plate count (SPC). Nutrient agar was used for the cultivation of bacteria (Fawole and Oso, 2007).

The total coliform count was determined using the 3-3-3 regime of multiple tube fermentation. MacConkey broth was used for the cultivation. After incubation, the number of positive tube with acid and gas production were noted and reference was made to MPN index table in order to obtain the most probable number (MPN) of coliform per 100ml of the water sample. Eosin methylene blue (EMB) agar was used to determine the faecal coliform (*E. coli*) of the water samples using spread plate technique. The number of typical colonies of *E. coli* were counted and expressed in cfu/ml (Aneja, 2014).

Characterization and identification of bacterial isolates

The bacterial isolates were identified based on their colonial morphology, cellular characteristics and biochemical reactions (Collins and Lyne, 1970; Cowan and Steel, 1985).

All colonies isolated were sub-cultured from the mixed culture to obtain pure culture of the isolates. The pure isolates were then transferred into sterile nutrient agar slants and stored in the refrigerator as stock cultures (Fawole and Oso, 2007).

Determination of physicochemical parameters

Determination of temperature

The temperature reading of the samples were taken immediately after sample collection, a thermometer was dipped into the samples and allowed to stay for 3-5 minutes, the reading was taken after the mercury had become stable and thereafter recorded.

Determination of pH

The pH reading was taken immediately the samples were brought to the laboratory. It was done using a glass electrode pH meter, the pH reading was carried out by dipping the glass electrode pH meter into the water samples, the readings were then recorded.

Determination of Total Hardness

The total hardness was determined by complexometric titration using 0.1 N EDTA to titrate 100 ml of the water sample with Erichrome black-T as indicator. Ten drops of 25% ammonia was initially added to the water sample before the commencement of titration. The initial purple colour changed to light blue at end point.

3. RESULTS

Physicochemical Properties

The pH of the water samples ranged from 6.68 to 7.95 while the total hardness ranged from 13 to 150 mg/l. The values of chloride content and total hardness ranged from 13 to 150mg/l as shown in table 1.

Table 1: Physicochemical Properties of water

Bottled Water Samples	pH	Temperature(^{0}C)	Total Hardness (g/100ml)
A	7.34	27.6	13
B	6.89	25.5	43
C	7.95	26.8	150
D	7.75	27.8	100
E	6.68	28.5	20

Bacteriological Counts and Isolates

Table 2 indicates, the total heterotrophic bacterial counts of the bottled water ranged from 3.1 x 104 to 5.4 x 104, the MPN ranged from 26-150ml per 100ml, the water samples are labelled TW, TU, TX, TY and TZ.

Table 2: Total Bacteria Count

Bottled Water Samples	Heterotrophic Bacteria Count (cfu/ml)	Total Coliform (MPN/100ml)
TW	3.1×10^4	26
TU	4.3×10^4	65
TX	4.1×10^4	48
TY	4.6×10^4	55
TZ	5.4×10^4	150

Bacteria Isolated from well water Samples

The bacteria species isolated are E. coli, Streptococcus sp., Enterobacter aerogenes, Bacillus sp. etc as shown in table 3.

Table 3: Distribution of isolates in the well water

Bacterial Isolates	WELL WATER SAMPLES				
	TU	TW	TX	TY	TZ
E. coli	+	-	-	-	+
Streptococcus sp.,	-	-	+	+	+
Staphylococcus aureus,	+	+	+	-	+
Enterobacter aerogenes	+	+	-	_	+
Bacillus sp.	-	-	-	+	-
Klebsiella sp.	+	+	-	+	+

4. DISCUSSION

The total heterotrophic bacterial counts of the bottled water ranged from 3.1×10^4 to 5.4×10^4, the MPN ranged from 26-150ml per 100ml as shown in table 1, this range is similar to the work reported by Paul (2011). The bacteria species isolated are *E. coli*, Streptococcus sp., *Enterobacter aerogenes,* Bacillus sp., Klebsiella, this is similar to the work reported by Idowu *et al.,* 2011. The pH of the water samples ranged from 6.68 to 7.95, the pH range is similar to that reported by Iman and Abdulkadir, (2012) while the total hardness ranged from 13 to 150 mg/l this is similar to the work by Paul (2011) on well water in Niger State. The total hardness ranged from 13 to 150mg/l as shown in table 1. High MPN values was recorded for some of the samples as shown in table 2, which clearly exceeds the limit set by WHO, the isolation of *E. coli* in some of the well water sample indicates fecal contamination of the water. The reason for the gross contamination of well waters be due to poor sanitary condition around the areas where such wells are located or drawing water from the wells with contaminated containers, a practice that is common among the users since individuals bring along their own water containers.

5. CONCLUSION

To reduce the widespread incidence of contamination of well water, it is advocated that wells dug must be deep and covered adequately, also good and proper personal and environmental sanitary practices must be maintained in and around the wells. Boiling well water before being used for drinking purposes would also go a long way to prevent incidence of waterborne diseases.

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