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Bacteriological Quality in Some Hand-Dug well Water as Source of Drinking Water in Ban Village, Plateau State, Nigeria

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Abstract: Access to potable water and healthy environment has been a concern worldwide. Developing nation like Nigeria has been facing critical challenge in accessing safe drinking water. Therefore, the people still depend on unsafe water sources such as rivers, streams and hand dug wells. This study examined the bacteriological quality of 16 drinking dug well water in four selected communities (Bantin, Tom, Bator and Rek) in Ban village of Plateau state, Nigeria. Four samples from each of the wells were collected from the communities. Biological contaminations were investigated using standard method (Multiple test tube method). The biological contamination rates were higher (110coliforms/100 mL) in Tom and 108 coliforms/100 mL in Bantin followed by 81.27 coliforms/100 mL in Banton and Rek with 67.78 coliforms/100 mL being the least (Tom>Batin>Bator>Rek), all indicated gross pollution. However, the only well that was found to be fit for human consumption was Bator B. The results suggested that the well water contamination in these areas is largely due to faecal contamination. It is recommended that hand-dug well water be treated prior to consumption in order to curtail infection and distance between latrine and dug well should not be less than 30 m.

Keywords: Hand-Dug Well Water, Water Quality, Faecal Contamination, Coliforms

Introduction

It is commonly said that “water is life,” thus the importance of water to man cannot be overemphasized. However, this essential commodity has to be potable for it to be consumed without causing harm to the consumer. Hand-dug well water is a source of drinking water in rural and semi-urban areas in developing nations like Nigeria. It has been reported that ground water probably carries the largest source of the dug-well water (Tekwa *et al*., 2006). The parameters such as chemical, physical and biological characteristics of ground water are said to determine what it can be used for (Ojo *et al*., 2012). They further reported that what constitute pollution in ground water are a wide spectrum of chemicals, pathogens and physical or sensory changes like high temperature and discoloration. However, the greatest trouble linked with drinking water is contamination resulting from sewage, human and animal excreta (Dufour *et al*., 2012). All these factors can reduce drinking water quality as they also constitute favourable environment for pathogens to thrive .No wonder, it has been reported that people have died due to basic hygiene related diseases such as gastroenteritis, typhoid, diarrhea and dysentery from drinking polluted water (Tambekar *et al*., 2008). When water is in this condition, it is unfit for human consumption.

It has been documented that, in Nigeria, there is a high incidence of child wood diarrhea due to lack of potable water particularly in rural areas as mothers have to obtain water from unhygienic sources for preparing weaning foods (Egwari and Aboaba, 2002). Also, Babaniyi (1991) in reviewing the prevalence of diarrhea in Nigerian children over a period of 12 years discovered that 315,000 children of less than 5 years old died annually of consumption of unpotable water. There has been various cases of outbreak of water-borne diseases in Nigeria with few documented, whereas, majority not reported. Therefore, water that should be consumed must be within tolerable use-limits for human. Due to increasing human activities and climatic change, there is a need to assess the bacteriological quality of drinking water in these communities of Ban village.

Materials and Methods

Water samples were collected randomly from sixteen wells (both covered and uncovered) from the study area in sterile bottles capable of containing 200 mL of water and were then transported to the laboratory for analysis. The depth of the wells and the distance of the wells from latrines were also measured.

Bacteriological Analysis

MacConkey broth was used to determine the number of coliform bacilli per 100 mL of water sample using the multiple tube technique. The MacConkey broth used contained bromocresol purple for indication by its colour change to yellow and the formation of acid from lactose in the broth. Bacteria capable of growth and the production of acid and gas in the broth were assumed to be coliform baclli ("presumptive coliforms"). The samples from positive presumptive tests were sub cultured in both Brilliant greet lactose bile broth and tryptone water and incubated for turbidity, gas formation and positive indole test to obtain confirmed *E. coli* count.

Results

The presumptive test as seen in Table 1 shows that all the water from the wells were unacceptable for consumption except well B in Bator location that was consider fit. Water from the other wells was either at the category of low risk, intermediate risk, high risk or very high risk. Also on the average, all the locations where the well water was analyzed were found to be contaminated with coliform (Table 2). Table 3 shows that water from most of the wells was contaminated with faecal *Escherichia coli* except Bantin A, Tome B, Bator A and Rek C and the Most Probable Number (MPN) ranged from < 1.8 to > 17.

Table 1. Presumptive test for coliform Bacilli

Location of well	Depth(M)	Nature of well	Latrine distance	MPN	No of Coliform Bacilli/ 100ML g^{-1}	Remark
Bantin						
A	6.30	Uncovered	11.00	220.0	22	Intermediate
B	5.10	Covered	29.40	>1600.0	160	High risk
C	5.70	Uncovered	17.00	1600.0	160	High risk
D	6.30	Uncovered	NL	920.0	92	Intermediate
Tom						
A	4.77	Covered	NL	920.0	92	Intermediate
B	4.80	Uncovered	22.00	280.0	28	Intermediate
C	4.95	Uncovered	NL	1600.0	160	High risk
D	3.45	Uncovered	NL	>1600.0	160	High risk
Bator						
A	8.13	Covered	15.00	49.0	05	Low risk
B	7.32	Covered	19.00	<1.8	00	Fit
C	6.60	Covered	20.00	1600.0	160	High risk
D	4.95	Uncovered	12.00	1600.0	160	High risk
Rek						
A	8.49	Covered	10.17	49.0	05	Low risk
B	7.26	Covered	9.00	1600.0	160	High risk
C	5.82	Covered	NL	180.0	13	Low risk
D	6.99	Uncovered	11.50	920.0	92	High risk
Distilled water	-	-	-	<1.8	00	Control

According to (WHO, 1997). MPN (Most Probable Number), NL (No Latrine)

Table 2. Average contamination with Coliform in each location

Location of well	Average coliform	Remark
Ban tin	108.50	Gross polluted, necessary repairs, disinfection of well and sanitation check in the location
Tom	110.00	Gross polluted, necessary repairs, disinfection of well and regular sanitation check in the location
Bator	81.27	Grossly polluted, necessary repairs, disinfection of well and sanitation check in the location
Rek	67.48	Grossly polluted, necessary repairs, disinfection of well and regular sanitation check in the location

According to (WHO, 1984)

Table 3. Confirmed *Escherichia coli*

Location of well	MPN	*E. coli* Per 100 mL g^{-1}	Remark
Bantin			
A	4.0	0	Fit
B	11.0	1	Low risk
C	11.0	1	Low risk
D	11.0	1	Low risk
Tome			
A	4.0	1	Low risk
B	11.0	0	Fit
C	4.5	1	Low risk
D	14.0	1	Low risk
Bator			
A	2.0	0	Fit
B	<1.8	0	Fit
C	17.0	2	Low risk
D	11.0	1	Low risk
Rex			
A	4.5	1	Low risk
B	4.5	1	Low risk
C	2.0	0	Fit
D	11.0	1	Low risk
Distilled Water	-	0	Control

According to (WHO, 1997). Most Probable Number (MPN)

Discussion

From the technique used to estimate the Most Probable Number (MPN) of faecal coliform bacteria, it was discovered that both covered and uncovered wells revealed the presence of coli form with the exception of well B in Bator community (representing 6.25% only). However, uncovered wells produced the highest number of coliform in 100mL of its sample (Table 1).The wells that were at high risk and very high risk category of contamination means an immediate action is required (Barthiban *et al*., 2012). Also, on the average results, Tom has the highest coliform of 110 per 100mL with one of its samples producing >160/100mL, followed by Bantin, 108.5/100mL, Bator, 81.27/100 mL and Rek with least average of 67.48/100 mL (Tim>Bantin>Bator >Rek) as shown in Table 2. This shows that water from these locations are grossly polluted. Although water from well of Bantin A, Tome B, Bator A,B and Rex C had zero count of *E. coli* yet are not fit for human consumption because of the presence of more than 3 coliforms/100 mL except well B from Bator location which had less than 3 coliforms/100 mL (WHO, 1984). This result is in line with the general observation that it is very difficult in many villages and small towns in Nigeria to supply regular water with an *E. coli* count of zero per 100 mL. This might due to the fact that most of the residents in these locations do not have toilet facilities and even where these facilities exist they are not well kept.

The contamination of wells could be attributed to the nature, depth and distances of wells from polluted sources like sewage outlet, septic pit and latrine. Most of the positive samples of typical coliform were from uncovered and very shallow wells without water tight linings, hence, there must have been free flow of contamination from open dumps by air and surface water flowing into the wells.

According to Cheesbrough (2000) who stated that, personal wells should be above 10 m deep whereas public or community well should be 20-30 m deep to avoid contamination by faecal organisms from bored-hole latrines which are carried with the ground water flow. But, the unfortunate thing in this study is that almost all the wells analysed fall below those ranges which could prove another source of the coliform organisms observed including hand-dug wells by government agencies.

It is however, clear that in all the households sampled, the latrines were too close to the wells, ranging from only 9-29.4 m, much closer than the minimum of 30 m recommended by the WHO (Araoz and Subrahmanyan, 1970). This could have been responsible for the faecal contamination also.

The isolation of faecal coliforms from samples tested is of great importance as these organisms have been reported as causes of gastroenteritis in human (Ako *et al*., 2009). It is also of importance to note that, finding *E. coli* in water does not only indicate contamination of faecal origin but of itself a major health concern. This is because the type found could be of Verocytotoxin Producing *E. coli* (VTEC) serogroup 0157, being a major cause of hemorrhagic colitis is said to be predominantly water borne disease (Chalmers *et al*., 2000; Isaacson *et al*., 1993).

In order to reduce the level and frequent contamination, individual members of local communities should ensure that hand-dug wells are of desirable depth, far from all sources of pollution especially pit latrines and of good water tight lining and properly covered.

Conclusion

This research showed that hand-dug well water in the study area is unfit for human consumption except Bator B well. This is as a result of high number of coliform organisms present due to the entry of water surface, spillage from contaminated containers and deposition of debris. The extension of water tight lining to 3-6 m below the surface with the well head having a head wall in addition to drainage apron could serve as control measure. Also latrines should be cited at least 30 m away from wells and the wells should be covered after every use.

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Author's Contributions

Dawang Denaan Noel: Supervised and did the write-up.

Aricha Anthony Aduma: Carried out samples collection and analysis.

John Deh Happiness: Collected some of the samples and was involved in identification.

Ethics

This article is original and contains unpublished material. The corresponding author confirms that all of the other authors have read and approved the manuscript and no ethical issues involved.

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