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Bacteriological Contamination of Well Water in Makurdi Town, Benue State, Nigeria

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Abstract: Bacteriological contamination of well water in Makurdi town, of Benue State, Nigeria was investigated. A total of 15 water samples were collected from hand dug wells and analyzed for total bacteria count as it affect the quality of drinking water for both wet and dry season. The analysis was done according to standard methods of water examination and as reported in WHO guide limit for drinking water. The investigation revealed that the wells examined were highly contaminated with bacteria. Wells 6 and 7 showed highest total bacteria counts of 7.0×10^5/100 mL and 8. 2×10^5/100 mL in the wet season, while wells 7 and 2 showed highest total bacteria counts of 8.0×10^5/100 mL and 5.5×10^5/100 mL in the dry season. The contamination of all wells could be due to improper construction of wells, refuse dumping sites and various human activities around the wells. Water generally from these wells is not safe for drinking except some form of treatment is carried out.

Key words: Bacteriological, contamination, hand dug wells, water sources, groundwater, nutrient egar, total bacteria count

INTRODUCTION

The inadequate supply of clean drinkable waters and the frequent pollution of existing supplies create very grave health problems for people in developing countries like Nigeria. Water serves as a vehicle for the transmission of diseases like typhoid fever, cholera, rashes, diarrhea, dysentery, Gastro-enteritis etc which have contributed immensely to the stagnation of the economic development of some of these nations (Okoufu *et al*., 1990).

In Nigeria, several studies have been carried out in urban areas on ground water contamination (Awalla, 2002; Akpabio and Ebong, 2004; Egbulem, 2003; Ahmed, 2003; Adebayo and Bashire, 2002). The uniform findings from these studies is that groundwater is highly contaminated and clinically unsafe for human consumption. With increasing population densities of urban areas and the corresponding increase in demand for social amenities, it has become increasingly difficult to meet all the water requirements in quantity, regularity and quality. The public water supply is generally inadequate and in most cases inaccessible, the supply is intermittent and unreliable thus resulting into high degree of population densities and concentration of socio-economic activities, it has become increasingly difficult to meet all the water requirements.

The public water supply is generally inadequate and in most cases inaccessible, the supply is intermittent and unreliable, thus resulting into high dependency on unsafe supplementary sources such as streams, hand dug wells and ponds (Kakulu and Osibanjo, 1992; Olajire and Imeppeoria, 2001; Nnodu and Ilo, 2002; Owuama and Uzoije, 2005; Ocheri, 2006; Maxwell *et al*., 2010). Concern over the quality of water harnessed especially from the hand dug wells have received wide attention among researchers (Ovrawah and Hymore, 2001; Ehinola and Coker, 2002; Nnodu and Ilo, 2002; Ogunbadewa, 2002; Omofonmwam and Eseigbe, 2009). Consistent in their findings is that water from hand dug wells are polluted through physical processes, geochemistry of the environment and anthropogenic activities. Consequently consumers of such waters are exposed to series of health risks. This study investigated the bacteriological characteristics of well water in the study area.

MATERIALS AND METHODS

The study is Makurdi town, the capital city of Benue State in north central Nigeria. Makurdi lies between Lat. 7°44N and Long 8°54N. It is located within the flood plain of lower River Benue Valley. The physiographic characteristics span between 73-167 m above sea level. Due to the general low relief sizeable portions of Makurdi is water logged and flooded during heavy rainstorm. This is reflected in the general rise in the level of groundwater in wells during raining season. The drainage system is dominated by River Benue which traverses the town into Makurdi North and South banks. Temperatures are generally high throughout the year due to constancy in isolation with the maximum of 32°C and a mean minimum

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of 26°C. The hottest months are March and April. The rainfall here is convective and occurs mostly between the months of April and October and is derived from the moist and unstable Southwest trade wind from St, Helena subtropical Anticyclones (STA). Mean annual rainfall total is 1190 mm and ranges from 775-1792 mm. Rainfall distribution is controlled by the annual movement and prevalence of Inter-Tropical Discontinuity (ITD). The mean monthly relative humidity varies from 43% in January to 81% in July-August period (Tyubee, 2009).The geology is of cretaceous sediments of fluvio-deltaic origin with well bedded sandstones of hydro geological significance in terms of groundwater yield and exploitation (Kogbe *et al*., 1978). Makurdi town which started as a small river port in 1920 has grown to a population of 297, 393 people (NPC, 2006).

This study relied on the analyses of water samples collected from hand dug wells across the residential area of Makurdi town. Two sets of water samples were collected from 15 hand dug wells in the months of September for wet seasons and March for the dry season. The essence is to assess the effect of bacteria loading in well waters. To ensure quality assurance adequate measures such as the use of sterilized containers in water sample collection, proper preservation and storage at temperature of 4°C before laboratory analysis. The analysis of the water samples collected was done according to standard methods of water examination using the nutrient egar method which is the most recognized method for total bacteria count (APHA, AWWA and WPCF, 1985). Bacteriological content of well water as it affects the quality of drinking water is based on the WHO prescribed limit.

RESULTS AND DISCUSSION

The results of bacteriological analysis for both rainy and dry season are presented in Table 1. All the wells were grossly contaminated with bacteria colonies above the WHO prescribed limit of less than 0 Bacteria Colony count/100 mL for untreated water (Wagner and Lanoix, 1958; WHO, 1971).

The study revealed that, all wells were contaminated with an average of 3.9×10^5 mg L^{-1} in the wet season and 3.5×10^5 mg L^{-1} in dry season. This is in agreement with Ayeni (1989) in his study of physiochemical and bacteriological qualities of some well waters in Samaru, Zaria where it was concluded that these wells were polluted and pose a risk to human consumption. Again, Abdullahi (1989) conducted a study on the isolation and identification of salmonella typhi and vibro-cholerae from wells in Zaria. The results revealed the isolation rate of 16.7% for salmonella and absence of vibro-cholerae. It was noted that three well sites in A.B.U. Samaru Campus had no bacteria while the other three located in Samaru village had bacteria. It was then concluded that sanitation was the factor responsible for the differences. The result of this research is in complete agreement with these authors as most of the wells were located in slums that are not kept clean.

The point to be emphasized here is that potable water should be completely devoid of bacteria organisms. The total bacteria counts in all the wells range from between 1.6×10^5 to 8.2×10^5 in both seasons.

The confirmation of the presence of these micro organisms in well-water calls for urgent decisive steps to be taken against further consumption of these sources of water particularly for drinking and cooking. In comparison with the water quality standard for domestic and potable water supplies, none of the wells met the WHO (1971) drinking water standard of zero total colony count per 100 mL g^{-1}.

The presence of bacteria in wells sampled can be attributed to the closeness of these wells to septic tanks and sucker wells, as seen in wells 1, 2, 3, 6 and 7 with 4.9, 4.5, 5, 3.9 and 3.5 m, respectively. The mean distance of wells form soak away is 6.95 m.

Table 1: Bacteriological content of well water in Makurdi town

Well code	Well dept (m)	Dept of water (m)	Location of wells from soak away (m)	Total bacteria count (mg L^{-1}) rainy seasons count	Total bacteria count (mg L^{-1}) dry season count
W1	2.30	1.30	4.90	5.1×10^5	3.5×10^5
W2	2.70	1.45	4.50	6.1×10^5	5.5×10^5
W3	2.70	1.45	5.00	5.2×10^5	5.3×10^5
W4	7.30	1.00	8.00	1.6×10^5	2.0×10^5
W5	5.20	1.60	9.00	1.8×10^5	2.1×10^5
W6	4.33	4.30	3.90	7.0×10^5	5.3×10^5
W7	5.80	3.40	3.50	8.2×10^5	8.0×10^5
W8	3.77	2.33	7.00	3.4×10^5	3.0×10^5
W9	1.87	1.80	10.00	1.7×10^5	2.0×10^5
W10	2.93	1.35	8.00	2.9×10^5	3.0×10^5
W11	3.70	3.50	12.00	1.8×10^5	1.5×10^5
W12	9.50	7.50	8.00	2.0×10^5	2.3×10^5
W13	2.90	2.00	6.00	4.5×10^5	4.0×10^5
W14	1.00	1.60	8.30	2.9×10^5	1.8×10^5
W15	1.00	1.00	6.20	3.8×10^5	2.9×10^5
Mean	3.80	2.33	6.95	3.9×10^5	3.5×10^5

The correlation between the ingestion of polluted/contaminated water and the incidence of diseases such as gastro-enteritis and some helminthic diseases, has long been established (Feachem *et al*., 1983; Gibbs, 1987). Thus the continued consumption of such water, mainly out of ignorance should be discouraged or legally prohibited.

CONCLUSION AND RECOMMENDATION

This study has been expository, revealing data that would have ordinarily been neglected or taken for granted. The need to reduce contamination has a direct relationship with transmission of pathogens with regards to the construction of wells near potential source of contamination like septic tanks and soak-away pits. To achieve this:

- Soak-away pits, latrines and other potential sources of ground water pollution must be situated at least 100 m away from the site of shallow wells
- Enactment and enforcement of laws and regulations be employed to prohibit the indiscriminate construction of hand dug wells which have proliferated most parts of Makurdi town. If the wells must be sited and well-water utilized for domestic purpose, because of the erratic nature of public piped-supply from the State Water Board, then there is need to educate the inhabitants of Makurdi town on the danger of drinking micro bialy contaminated water
- Well water should be treated before use, either by boiling and filtration or by chemical sterilization or a combination of both
- Methods of extraction of well water should be done aseptically, they should be protected with parapet wells and provided with facilities for the extraction of water from the pit
- The containers used for collection of water should be kept in clean conditions to avoid introduction of contaminants

Since, it has been ascertained from the study that the patronage of well water by the inhabitants stemmed from the grossly inadequate public water supply; the state Government should hasten work on the Greater Makurdi Water Works to improve the quantity, quality and regularity of water supply to the public.

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