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RELATIVE BACTERIOLOGICAL ASSESSMENT OF PUBLIC BOREHOLE AND WELL WATER IN BOSSO TOWN, NORTH-CENTRAL NIGERIA

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Abstract

Background: Water is an essential requirement for the survival of living organisms especially human but is also important in the transmission chain of many human diseases since certain pathogens which are capable of causing life-threatening disease survive in water.**Aim**: This study was carried out to determine the relative bacteriological quality of borehole and well water supplies within Bosso town. **Method**: Twenty (20) water samples comprising of 10 each of borehole and well samples were aseptically collected from Bosso Town and analyzed using membrane filtration technique. **Result**: The results obtained showed that most (60.0%) of the water samples from the boreholes sources except the samples from Rafin-Yashi, Maikunkele, F.U.T Minna, Tudun Fulani, contained coliform counts below 10cfu/100ml while the majority (90.0%) of the well water sampled had coliform counts above 10cfu/100ml. The organisms isolated included species of *Escherichia, Pseudomonas, Streptococcus, Staphylococcus, Salmonella, Shigella, Clostridium, Bacillus, Yersinia, Serratia* e.t.c. *E.coli* had the highest frequency of occurrence (25%) followed in descending order by *Staphylococcus aureus* (8.3%), *Salmonella spp* (8.3%), *Pseudomonas aeruginosa* (8.3%), *Bacillus subtilis* (8.3%),*Clostridium spp* (6.7%),*Streptococcus feacalis* (6.7%), *Shigella spp* (6.7%), *Streptococcus pyogenes* (5%), *Klebsiella spp* (5%), *Proteus vulgaris* (5%), *Yersinia spp* (3.3%) and *Serratia spp* (3.3%). **Conclusion**: This study reveals that well water and borehole water samples were contaminated with greater contamination observed with well water. This highlights the need for a continuous assessment of the quality of public water supply and intervention measures to prevent outbreak of water-borne diseases.

Keywords: Coliform; Water-borne; Illnesses; Outbreak; Quality

1. Introduction

Water, as a medium that sustains life is essential to all living organisms. The third world academy of science (TWAS) reported that safe drinking water is a basic human requirement and essential to all and it is essential for sustainable development[1]. Many people especially in the developing world depend on untreated surface and ground water sources for their daily water supply and water from these sources is often faecally contaminated[1]. Water pollution caused by faecal contamination is a serious problem due to the potential for contracting diseases from pathogens[2]. Most faecally contaminated water, contain animal faeces which also carry a large number of opportunistic pathogens, capable of inflicting debilitating illnesses and in some cases, death[2, 3]. Ingestion of water contaminated with feces is responsible for a variety of diseases important to humans via what is known as the fecal-oral route of transmission. Pathogens from water contaminated by fecal matter get into humans via the

following route: Oral route, Dermal route and as Aerosol[4, 5].

The fecal pathogens in the water supplies are a very diverse group of organisms such as bacteria (e.g. *E. coli* 0157: H7, *Shigella sp, Campylobacter jejuni, Salmonella sp, Yersinia sp* etc), protozoa (e.g. *Entamoeba histolytica, Gardia sp, Cryptosporidium sp* etc) and viruses (e.g. Noroviruses, Enteroviruses, Adenoviruses, Rotaviruses and Hepatitis A and E viruses).

The role of contaminated water in the transmission of disease of public health importance cannot be over emphasized. Unfortunately however it is difficult for the general public some times to physically distinguish between safe water and potable water, thereby increasing their vulnerability to illness that normally arises from the consumption of contaminated water. There is therefore the need for continuous evaluation of public water supply to avoid the outbreak of epidemics. This study was aimed at evaluating the quality of public water supply to Bosso and its environs where the population density is quite high due to the presence of the Federal University of Technology, Minna.

2. Materials and Methods

2.1 Study Areas: The study area include Bosso central, Bosso low-cost, Bosso estate, Okada Road, El-Waziri, Anguwan Tukura, Tudun Fulani, Rafin Yanshi, FUT Bosso campus and Maikunkele all in Bosso Local Government Area where the wells and boreholes sampled serve as drinking water for the inhabitants. All the well water sampled was located around buildings with septic tanks and garbage collection points. The boreholes were the conventional types with a depth of 50 meters.

2.2 Collection of samples: 200mls each of twenty samples (made up of 10 samples from well and 10 boreholes water) were collected aseptically in sterile sampling bottle and taken to the laboratory immediately for analysis.

2.3 Processing of Sample: The samples were analyzed using membrane filter technique. Briefly, 100ml of each aseptically collected water sample was filtered using 0.45µm pore sized membrane filter with 47mm diameter. The filter paper for each sample was then aseptically transferred onto absorbent pad soaked previously in membrane lauryl sulphate broth using sterile forceps. The steps were repeated for each sample to obtain duplicates. The two petri dishes for each sample were inverted and incubated at 30^0C for 4 hours. The replicates were thereafter incubated at 37^0C for 18 hours and at 44^0C for 18 hours for the isolation of total and fecal coliform respectively. The yellow colonies were counted immediately after the incubation before they decolorized.

2.4 Identification of Isolates: Isolates from primary cultures incubated at (37°Cand 44°C) were aseptically subcultured on to fresh media (MacConkey agar and Nutrient agar) to obtain pure cultures using the streak plate technique. The resultant pure isolates were subcultured into already prepared slant bottles for the purpose of identification and characterization. This was done using cultural characteristics and appropriate biochemical tests such as coagulase, catalase, urease, indole, sugar fermentation, citrate utilization, Mannitol Salt and starch hydrolysis.

3. Result

The result obtained showed that fecal coliform count from the boreholes ranged from 0 .0 to 7.0 cfu/100ml while fecal coliform count from the wells ranged from 8.0 to 132.0 cfu/100ml.The result also showed that total coliform count from the borehole ranged from 7.0 to 56.0 cfu/100ml while total coliform count from the well ranged from 40.0 to 296.0 cfu/100ml (Table 1). The total coliform counts (TCC) were on the average six times higher than the faecal coliform counts (FCC).

A total of 56 isolates were identified and characterized in the descending order of their frequency of occurrence as *E.coli, Staphylococcus aureus, Salmonella sp, Pseudomonas aeruginosa, Bacillus subtilis, Streptococcus faecalis, Shigella sp, Streptococcus pyogenes, Klebsiella sp, Proteus vulgaris, Yersinia sp,* and *Serratia sp* (Table 2).

4. Discussion

The results shown in table 1 revealed that the public water sources within the study area were contaminated. All the boreholes samples except four had coliform count below the World Health Organization (WHO) recommended standard of less than 10 coliform organisms/100 ml of water[6]. All the well water sampled except one had coliform counts above 10 coliforms organisms per 100mls of water. This result agrees with the earlier findings[7] in Adamawa state of Nigeria who reported that borehole water compared to well water is relatively safer because borehole coliform counts usually falls within the WHO recommended standard. Borehole water contamination observed in this study maybe due to the fact that the boreholes sampled were shallow, and in most cases serve as conducive environment for supporting the growth of most coliform that are water dependent. These boreholes are mechanically powered as a result of which they break down easily thus requiring repair and in the process of repairing them, contamination may occur. The presence of coliform counts in boreholes could be due to poor fortification of the boreholes. On the other hand, all the water samples from the well had coliform count above the WHO recommendation level. This result showed that the water samples from the wells were heavily contaminated with coliform because the coliform counts were found to exceed WHO recommendation and agrees with the earlier results[8] which reported that most well water contain coliform counts that exceed 10-25 coliform per 100 ml . The contamination of water from wells might be due to the fact that the wells were elevated lowly, thereby accommodating the run off of surface water that may be containing coliform. Also, in most cases the well water is not properly covered, and is located near soak away pits and refuse dumps which may therefore increase the contamination of well water. Contamination may also be due to the absence of concrete lining which in addition to the indiscriminate drawing of water from these wells expose them to contamination. It was observed that well water is highly contaminated with coliform than borehole water. Above all, the higher level of contamination observed in well water compared to borehole water seen in this study agrees with the result of a study[9] carried out in Minna, Nigeria. The water from these wells was observed to be contaminated because most of these wells were constructed near septic tank, pit latrines, bathroom passages, sewage, and refuse dumps. In the same view, it was reported[10] that location of wells too close to pit latrines, soak ways or refuse dumps could pollute groundwater.

Organisms isolated in this study were species of *Escherichia, Pseudomonas, Streptococcus Staphylococcus, Salmonella, Shigella, Clostridium, Bacillus, Yersinia, Serratia* e.t.c. *E.coli* had the highest frequency of occurrence (25%) followed in descending order by *Staphylococcus aureus* (8.3%), *Salmonella spp* (8.3%), *Pseudomonas aeruginosa* (8.3%), *Bacillus subtilis* (8.3%), *Streptococcus feacalis* (6.7%), *Shigella spp* (6.7%), *Streptococcus pyrogenes* (5%), *Klebsiella spp* (5%), *Proteus vulgaris* (5%), *Yersinia spp* (3.3%) and *Serratia spp* (3.3%).This result agrees with the findings[7] in Adamawa State in which similar organisms were isolated from water samples within Jimeta, Yola, with *E.coli* having the highest frequency of occurrence. In this study *E.coli* had the highest frequency and this indicates fecal contamination.

Conclusion

In conclusion, the observed factors causing the contamination of both borehole and well water is the ignorance as people against well informed advices go ahead and construct well and boreholes near sewage collection points, soak away, refuse dump and even sloppy areas where run off do occur. There is therefore the need for intervention measures such as increased enlightenment campaign and the construction of electrically powered boreholes in Nigeria in order to reduce the burden of infection caused by water contamination in the area.

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TABLE 1. Fecal and Total coliform count in samples of borehole and well water from Bosso Town, North Central Nigeria.

Sample	Borehole-FCC x 10^2 (cfu/100ml)	Borehole-TCC x 10^2 (cfu/100ml)	Well-FCC x 10^2 (cfu/100ml)	Well-TCC x 10^2 (cfu/100ml)
Rafin Yashi	0.04x10^2	0.36 x10^2	0.48 x10^2	1.52x10^2
Bosso Low-cost	0.02X10^2	0.07 x10^2	1.32 x 10^2	1.80 x10^2
El-Waziri	0.05X10^2	0.08 x10^2	0.80 x10^2	1.60 x10^2
Anguwan Tukura	0.00X10^2	0.10 x10^2	0.52 x10^2	2.96 x10^2
Okada Road	0.00X10^2	0.04 x10^2	0.24 x10^2	2.12 x10^2
Maikunkele	0.03X10^2	0.56 x10^2	0.72 x10^2	0.84 x10^2
FUT, Minna	0.00X10^2	0.26 x10^2	0.10 x10^2	0.60 x10^2
Tudun Fulani	0.00X10^2	0.50 x 10^2	0.10 x10^2	0.40 x10^2
Bosso Estate	0.06X10^2	0.09 x10^2	0.08 x10^2	0.96 x10^2
Bosso Central	0.07X10^2	0.10 x10^2	0.56 x10^2	1.30 x10^2

Key:
FCC- Faecal Coliform Counts
TCC- Total Coliform Counts

Table 2. Frequency of Occurrence of bacterial isolates in Public boreholes and well water from Bosso Town, North Central Nigeria.

Organisms	Number of Isolates	Percentage frequency
E.coli	15	25.0
Staphylococcus aureus	5	8.3
Salmonella sp	5	8.3
Pseudomonas aeruginosa	5	8.3
Bacillus subtilis	5	8.3
Streptococcus faecalis	4	6.7
Shigella sp	4	6.7
Streptococcus pyogenes	3	5.0
Klebsiella sp	3	5.0
Proteus vulgaris	3	5.0
Yersinia sp	2	3.3
Serratia sp	2	3.3
Total	56	100