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A SURVEY OF BACTERIOLOGICAL QUALITY OF BOREHOLES WATER FROM VARIOUS LOCATIONS IN BOSSO TOWN, NORTH CENTRAL, NIGERIA.

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Abstract

The importance of water cannot be over emphasised as it serves a vital role in sustaining the lives of living organisms especially human but is also a major route in the transmission of human diseases since certain pathogens which are capable of causing life-threatening disease survive in water. This study was carried out to determine the coliform contamination of public boreholes water supplies within Bosso town. Ten (10) water samples of borehole were aseptically collected from Bosso Town and analyzed using membrane filtration technique, to isolate both faecal and total coliform. The results obtained showed that most (60.0%) of the water samples from the boreholes sources except the samples from Bosso Lowcost, Anguwan Tukura, Okada Road, Bosso Estate, contained 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 (20%) followed in descending order by Salmonella typhi (14.2%), Staphylococcus aureus (12.8%), Shigella flexneri (11.4%), Clostridium difficile (8.5), Streptococcus feacalis (7.1%), Pseudomonas aeruginosa (7.1%), Klebsiella pneumoniae(5.7%), Streptococcus pyrogenes (4.2%), Bacillus subtilis (2.8%), Proteus vulgaris (2.8%), Yersinia spp (1.4%) and Serratia spp (1.4%). This study reveals that borehole water samples were contaminated, with the highest percentage of faecal and total coliform contamination observed as 25.9%(Bosso Central) and 0.56%(Maikunkele) respectively. This therefore highlights the need for a continuous assessment of the quality of public water supply and intervention measures to prevent outbreak of water-borne diseases.

1.0 Introduction

Water as one of the basic media that is essentially needed for the survival of all living organisms especially humans. 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].

However when water is distributed to its end users, in the condition in which it is produced following treatments, the microbial load would be reduced to a safe level [2]. Unfortunately, prior to the time water gets to its end users, water is usually prone to various microbial growth, microbiologically induced chemical changes and contamination with pathogenic microorganisms, which constitutes a serious threat to public health [3]. Many people especially in the third world like Nigeria, depend on untreated surface and ground water sources for their daily domestic purposes and water from these sources are often faecally contaminated [1].

However, most water bodies faecally contaminated clearly indicates that the water body contains other opportunistic organisms that are important to humans, which may cause severe illness and in turn death. [4] reported that high pathogens in water bodies may result from inadequately treated sewage discharged from various septic tanks, and use of such water by the general populace lead to the acquisition of the pathogens through various routes of transmission, such as; Oral route, Dermal route and as Aerosol [5;6]. [7] Jorge *et al.* 2008, in a report affirmed that most faecal pathogens in the water supplies are of diverse group of organisms, which consist of bacteria (such as. *E. Coli* 0157: H7, *Shigella spp*, *Campylobacter jejuni*, *Proteus* species, *Streptococcus* species, *Klebsiella* species, *Salmonella* species, *Yersinia* specie etc), protozoa (for example, *Entamoeba histolytica*, *Gardia* species, *Cryptosporidium* species etc) and viruses (e.g. Noroviruses, Enteroviruses, Adenoviruses, Rotaviruses and Hepatitis A and E viruses). In most cases, these pathogens give rise to some water borne pathogenic diseases such as ear infections, dysentery, typhoid fever, cholera, encephalitis, giardiasis, gastroenteritis and hepatitis [5].

Water generally is expected to be a life supporting medium but studies have shown that water does not only improve the standard of life but can also serve as a carrier of dangerous pathogens [8]. However, the role of contaminated water in the transmission of disease of public health importance cannot be over emphasized, based on the fact that it is difficult for the general public to distinguish between safe water and portable water, thereby increasing their vulnerability to illness that normally arises from the consumption of contaminated water. Therefore it is imperative that various public water supplies are evaluated continuously to enable the detection and prevention of disease outbreaks. This study is therefore aimed at evaluating the quality of various public water supplies to Bosso and its envions, where the entire general populace depends on it for their daily activities and survival.

2.0 Materials and method

2.1 Study Areas

The study areas were 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 all boreholes sampled were frequently used by the inhabitants around the area for drinking and other domestic purposes. All the boreholes constructed were of adequate standard with depth and were constructed close to buildings with soakaways and refuse dump sites.

2.2 Collection of Samples

Ten samples of 200mls each were collected aseptically in sterile sampling bottles and taken to the laboratory immediately for analysis within 48 hours.

2.3 Analyses of Samples: The samples were analyzed using membrane filter technique. Prior to filtration, each 200ml water sample aseptically collected was divided to obtain two sets of 100ml of the water sample, which were filtered simultaneously using 0.45µm pore sized membrane filter with 47mm diameter. The filter papers for each sample were then aseptically transferred onto two Petri dishes containing absorbent pads soaked previously in membrane lauryl sulphate broth using sterile forceps. These steps were repeated for each sample. The two Petri dishes for each sample were inverted and incubated at 30°C for 4 hours. One of the Petri dishes was then transferred to an incubator at 37°C for 14 hours, to isolate the total coliform, while the second Petri dish was placed in an incubator for 44°C for 14 hours for the isolation of 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, Oxidase, Mannitol salt and Starch hydrolysis.

3.0 Result and discussion

The result obtained from the various borehole water sampled revealed faecal coliform counts which ranged from 6.0 to 27.0 cfu/100ml.The result also showed that total coliform count from the boreholes ranged from 24.0 to 85.0 cfu/100ml (Fig. 1).

Table 1 shows a total of 70 isolates identified and characterized in the descending order of their frequency of occurrence as *E.coli, Staphylococcus aureus*, *Salmonella typhi*, *Shigella flexneri, Clostridium difficile, Streptococcus faecalis*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes*, *Klebsiella sp, Proteus vulgaris*, *Yersinia sp,* and *Serratia sp*.

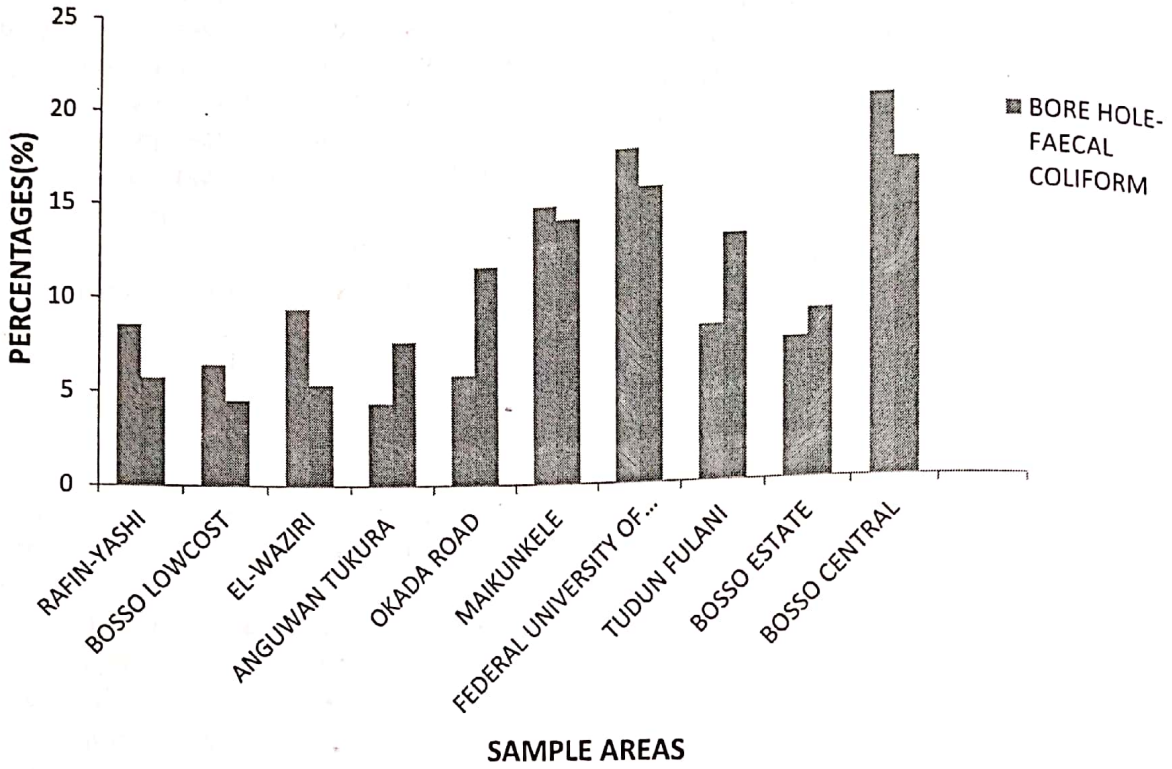

Fig 1: Percentage of occurrence of the coliform in Borehole water sample.

Table 1. Frequency of Occurrence of bacterial isolates

Organisms	Frequency	Percentage frequency (%)
E.coli	14	20.0
Salmonella typhi	10	14.2
Staphylococcus aureus	9	12.8
Shigella flexneri	8	11.4
Clostridium difficile	6	8.5
Streptococcus feacalis	5	7.1
Pseudomonas aeruginosa	5	7.1
Klebsiella pneumoniae	4	5.7
Streptococcus pyrogenes	3	4.2
Bacillus subtilis	2	2.8
Proteus vulgaris	2	2.8
Yersinia spp	1	1.4
Serratia spp	1	1.4
Total	70	100

The results shown in Figure 1 revealed that the public borehole water analysed within the stud y areas were all contaminated. The borehole water contamination observed in this study maybe due to the fact that the boreholes sampled

were shallow, and in most cases they served as an environment for supporting the growth of most coliforms that are water dependent. In addition, due to the inadequate fortification of the boreholes and improper usage by the general public continuously, nuts and bolts often loosen, and in the process of repairing them they get exposed to contaminants. This result agrees with the earlier findings of Bala [9], in Adamawa state of Nigeria who reported that borehole water were contaminated with coliform organisms above 0cfu/ml [10] which is the recommended standard of coliform organisms in a portable water. All the boreholes samples were faecally contaminated with coliform counts ranging from 6.0 – 27.0 cfu /100ml. This result is contrary to the result of Adabara [11], who stated that all the boreholes samples except four had coliform counts within the World Health Organization (WHO) recommended standard of not more than 10 coliform organisms/100 ml of water [12]. This is basically due to the overpopulation of the sample areas. The influx of people to these areas, in order to satisfy their quest for portable water supply encourages them to practice life styles such as overgrazing with animals around borehole, these animals would in turn pass out faeces around the boreholes. In addition to this, the process of irrigation, which involves the farming activities with animal and human wastes, carried out with the aid of these boreholes supports leaching and this process could lead to the penetration of various coliforms into these various sources of water. This result agrees with the findings of Bala [9] and Oyedum, [8] who reported that the contamination of these boreholes may also be due to leaching that occurs around the borehole sites, washing away various chemicals (especially agricultural chemicals) into the soil; this serves as substrate that produces energy to ensure the survival of the microbe, thus increasing the population of coliforms or microorganisms in the borehole. The result obtained from this study revealed that the coliform contamination is thrice as high as the study of Adabara [11]. The highest faecal and total coliform contamination was in Bosso Central. This basically is attributed to poor hygienic practice of the populace in regards to the disposal of their wastes and house refuse. Based on the fact that the University is located close to this area, an abnormal increase in the populace is observed with limited number of infrastructures to satisfy their needs. This in turn leads to competition for basic needs such as portable water supply for their domestic purposes and in order to satisfy their needs they tend to contaminate this borehole water source with coliform bacteria. The observation of 60% of the boreholes in the sample areas (as seen in Fig 1), being faecally contaminated is an indication that the populace around this borehole sites lack adequate toilet facilities, thereby they dispose their wastes around irregularly. Most of the houses constructed around these boreholes have improper placement of pit latrines, which are shallowly dug. In most times, these latrines get filled up and their contents seep into the soils around the borehole sites. In addition to this, the irregular construction of houses in this area has supported the proximity of various soakaways, septic tanks and sewage runoff around the sites were the boreholes are located. This result agrees with the findings of other authors who reported that sewage containing human excreta is the most dangerous material that pollutes water and due to inadequate sanitation can lead to the cause and spread of 80% of waterborne infections, such as typhoid fever, amoebic dysentery, bacillary dysentery, cholera, poliomyelitis and hepatitis [13; 14; 15] in the developing countries. However the isolated organisms are in conformity with

the findings of Benka-Coker and Olimani [16]; Edema *et al.*[17] and Ukpong [18] which states that these organisms are basically regarded as water resident organisms. *E. coli* having the highest frequency of occurrence in this study indicates that the water sampled was faecally contaminated recently. This is based on the fact that, *E.coli* is an indicator of recent faecal contamination. The result obtained from this study also agrees with the findings of Bala [9], who isolated various organisms from the water samples from various areas in Jimeta, Yola, Adamawa State with *E.coli* having the highest frequency of occurrence. However, unlike the study of Bala [9], this study reveals the presence of *Clostridium difficile* [19], which is an entero pathogen, considered to be harmful to human health, based on the fact that it is a major cause of a health condition known as *Clostridium difficile* colitis, which affect both children and adults severely and in some cases, could result to death [20; 21].

4.0 Conclusion

In time past, studies on boreholes had presented it as one of the safest source of water but this study has brought to limelight present situation of water from certain boreholes in Bosso town, in North central, Nigeria, especially the one located in Federal University of Technology, Minna, which is usually used by the students, near-by dwellers and the entire public for their domestic purposes. The high percentage of faecal contaminations observed in these sampled water clearly reveals that such water are potential sources of various health problems and deaths associated with the populace within the sample area, and as such requires urgent attention.

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