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A SURVEY OF BACTERIOLOGICAL QUALITY OF WELL 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 well water supplies within Bosso town. Ten (10) well water samples were aseptically collected from Bosso Town and analyzed using membrane filtration technique. The results obtained showed that all (100.0%) of the water samples from the well sources 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 (24.4%) followed in descending order by *Helicobacter pylori* (13.3%), *Staphylococcus aureus* (10.0%), *Salmonella typhi* (8.9%), *Shigella flexneri* (6.7%), *Streptococcus faecalis* (5.6%), *Streptococcus pyogenes* (5.6%), *Campylobacter jejuni* (4.4%), *Pseudomonas aeruginosa* (4.4%), *Bacillus subtilis* (4.4%), *Proteus mirabilis* (4.4%), *Klebsiella pneumoniae* (3.3%), *Proteus vulgaris* (3.3%) and *Yersinia enterocolitica* (1.1%). This study reveals that well water samples were contaminated. 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: Water; Wells; Coliforms; Unhygienic practices; Water-borne disease

INTRODUCTION

Water is the most valuable and basic natural resources and all lives, especially humans, depend on 70% water to survive. Water is an essential commodity that is regarded as an important life sustaining drink to humans (Wolfe, 2001). Water fit for human consumption is called drinking or portable water (Oyedum, 2010) and such water can be used for various purposes without any risk of acquiring any water borne disease. Also, when water is distributed to the end users, in a condition in which it is produced with required treatments, the microbial load would be

reduced to a safe level (Nwachukwu *et al.*, 2000). Unfortunately, prior to the time water gets to its end users, it is usually prone to various microbial growth, microbiologically-induced chemical changes and contamination with pathogenic microorganisms, which constitute serious threat to public health (Stender *et al.*, 2001). Many people, especially in the developing world, depend on untreated surface and ground water sources for their daily water needs, and water from these sources are often faecally contaminated (Jorge *et al.*, 2008).

Most water bodies faecally contaminated clearly indicate that the water body contains other opportunistic organisms that are important to humans, which may cause severe illness and subsequently death. Environmental Protection Agency (EPA) (2009) 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 leads to acquisition of the pathogens through various routes of transmission such as: Oral route, Dermal route and as Aerosol (Hailer *et al.*, 1999; APEC 2010).

The faecal pathogens in water supplies are a very diverse group of organisms such as bacteria (e.g. *E. Coli* 0157: H7, *Shigella spp*, *Campylobacter jejuni*, *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) (Jorge *et al.*, 2008). Also, some water borne pathogenic diseases that may coincide with faecal contamination include ear infections, dysentery, typhoid fever, cholera, encephalitis, giardiasis, gastroenteritis and hepatitis (Hailer *et al.*, 1999).

Generally water 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 (Oyedum, 2010). However, the role of contaminated water in the transmission of disease and the importance of water in public health cannot be overemphasized, 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 membrane lauryl sulphate broth using sterile forceps. These steps were repeated for each

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 environs, where the entire general populace depends on it for their daily activities and survival.

MATERIALS and METHOD

Study Areas: The study areas were Bosso central, Bosso low-cost, Bosso estate, Okada Road, El-waziri, Anguwan Tukura, Tudun Fulani, Rafin Yanshi, Federal University of Technology (FUT) Bosso campus and Maikunkele all in Bosso Local Government Area of Minna, Niger State, Nigeria. All the wells sampled were frequently used by the inhabitants around the area for drinking and other domestic purposes. Most of these wells were constructed close to buildings with soaker-ways while some were constructed in the open fields close to refuse dump sites with a depth of 50 meters. The study was carried out from May to August 2015.

Collection of Samples: Ten (10) samples of well water, consisting of two hundred (200ml) were collected aseptically in sterile sampling bottles from the various study areas mentioned above and taken to the laboratory immediately for analysis within 48 hours.

Analyses of Samples: The samples were analyzed using membrane filter technique. Prior to filtration, each 200 mls water sample aseptically collected was divided to obtain two sets of 100 mls 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

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 faecal coliform respectively. The yellow colonies were counted immediately after the incubation before they decolorized.

Identification of Isolates: Isolates from primary cultures incubated at (37°C and 44°C) were aseptically sub cultured on to fresh media (MacConkey agar and Nutrient agar) to obtain pure cultures using the streak plate technique. The resultant pure isolates were sub cultured 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.

RESULT

The result obtained from the various well water sampled revealed faecal coliform counts which ranged from 35.0 to 135.0 cfu/100ml. The result also showed that total coliform count from the well ranged from 100.0 to 360.0 cfu/100ml (Figure 1).

The result also showed that among all the sample areas studied, Bosso Central had the highest percentage of coliform contamination while Tudun Fulani had the least coliform contamination (Fig 1)

A total of 100 isolates were identified and characterized in the descending order of their frequency of occurrence as *E.coli*, *Helicobacter pylori*, *Staphylococcus aureus*, *Salmonella typhi*, *Shigella flexneri*, *Streptococcus faecalis*, *Streptococcus pyogenes*, *Campylobacter jejuni*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Proteus mirabilis*, *Klebsiella pneumoniae*, *Proteus vulgaris*, and *Yersinia enterocolitica* (Table 1).

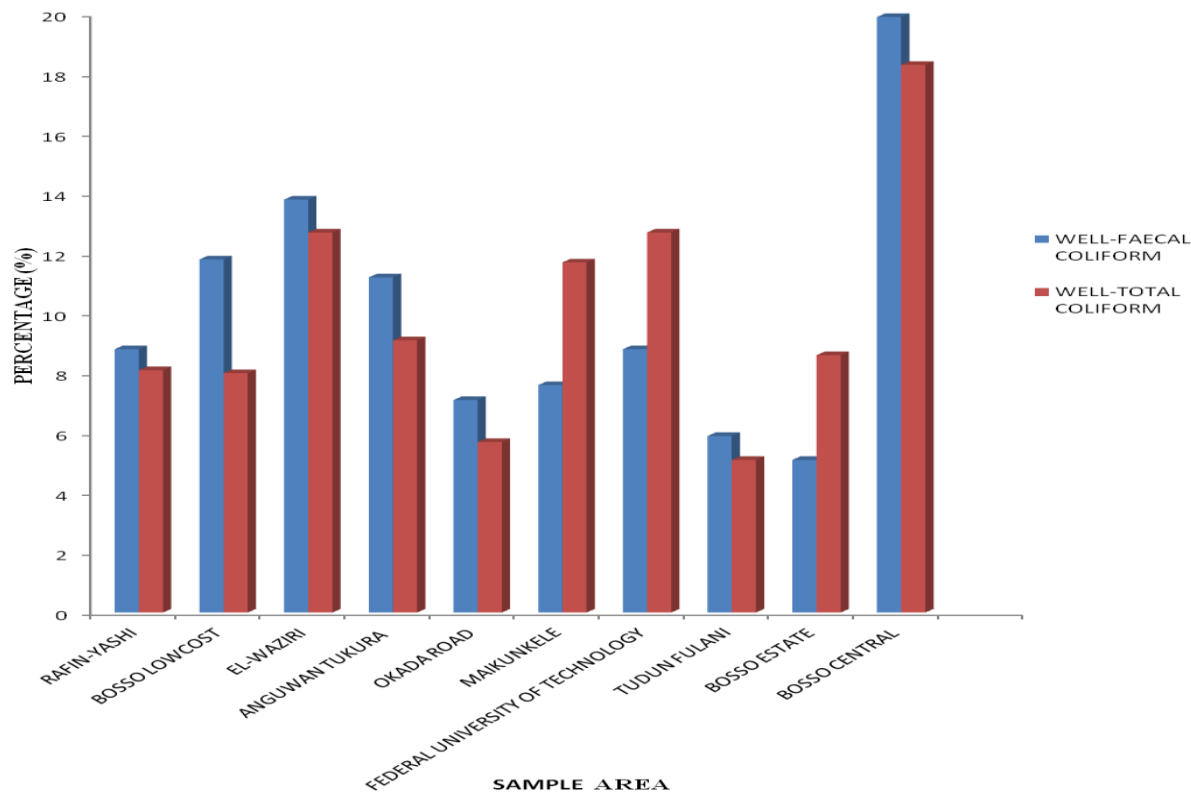


Fig 1: Percentage of occurrence of the coliform in well water sample
 Values represent mean ± deviation of replicate readings

Table 1. Frequency of Occurrence of bacterial isolates

Organisms	Frequency	Percentage frequency (%)
<i>E.coli</i>	22	24.4
<i>Helicobacter pylori</i>	12	13.3
<i>Staphylococcus aureus</i>	9	10.0
<i>Salmonella typhi</i>	8	8.9
<i>Shigella flexneri</i>	6	6.7
<i>Streptococcus faecalis</i>	5	5.6
<i>Streptococcus pyogenes</i>	5	5.6
<i>Campylobacter jejuni</i>	4	4.4
<i>Pseudomonas aeruginosa</i>	4	4.4
<i>Bacillus substilis</i>	4	4.4
<i>Proteus mirabilis</i>	4	4.4
<i>Klebsiella pneumoniae</i>	3	3.3
<i>Proteus vulgaris</i>	3	3.3
<i>Yersinia enterocolitica</i>	1	1.1
Total	100	100

DISCUSSION

The results obtained from this study, revealed that the public well water analysed within the study area were contaminated. All the well water samples had coliform counts above the World Health Organization (WHO) recommended standard, of not more than 10 coliform organisms / 100ml of water (WHO, 2003). This result could be attributed to the fact that, well water is generally used, based on the fact that it is regarded as one of underground sources of water that is easily constructed and affordable. In addition to this, in order to satisfy the increasing demand for water by the increasing populace, little or no attention is given to the adequate construction of wells. For this reason, most of these wells sampled in the study area lacked adequate concrete lining and were inadequately elevated, thereby collecting the runoff of surface water that may be containing coliforms. This result agrees with the findings of Bala (2006), Oyedum (2010) who reported that most of the wells sampled were not lined with concrete and were lowly elevated.

The result obtained revealed that 70% of the wells sampled were contaminated with faecal coliforms (Fig 1) which exceeded 10-25 coliforms per 100 ml. This result agrees with the result of Freedman (1977), and it could be based on the location of most of these wells sampled. Due to the ignorance of the populace, most of these wells sampled were located 20 meters away from various pit latrines and soakaways. Based on the unhygienic practices exhibited in these study areas, most people tend to defecate indiscriminately around the well, thereby making the well prone to heavy burden of faecal contamination especially when rain or flood washes the faecal particles into the wells. This result agrees with the result of Kolo *et al.* (2004) ; Cairncross *et al.* (1993) who reported that location of wells too close to pit latrines, soakaways, bathroom

passage or refuse dumps could pollute groundwater.

Furthermore, the heavy coliform contamination of these well sampled is attributed to the fact that most of these wells were observed to lack proper covers/lids. Unfortunately, due to the inappropriate covering of the wells sampled, most of these wells are exposed to animal droppings, dead animals, nasal droplets, rain splash, seepage splash, sewage, formites and wind heavily contaminated with coliforms. This result is similar with the result of Adabara *et al.* (2011). In addition, most of the wells sampled lacked sterile and permanent water drawers to draw water from these wells, due to this practice; these wells are faced with heavy microbial contamination. This result is similar with the result of Bala (2006), who reported that well due to inadequate coverings could be polluted by dirt on different tins or buckets that are lowered into the wells.

The area with the highest percentage of faecal coliform contamination is Bosso central (Figure 1). This result could be attributed to the fact that coliforms contamination of these wells occur at the point of digging the wells manually. Basically the nature of the soil in the well is usually affected, due to the continuous seeping of agricultural chemicals such as; pesticides, herbicides or fertilizers that occur in these wells during localize and mechanize farming to preserve and prevent food losses. The penetration of these organic substances into the well enhance the occurrence of certain coliforms which use these chemicals as substrates thereby contaminating the water consequently leading to the cause and spread of waterborne infections, such as typhoid fever, amoebic dysentery, bacillary dysentery, cholera, poliomyelitis and hepatitis as reported by Geldreich (2005); Okoko and Idise (2014).

Organisms isolated from these water samples in this study were species of *Escherichia*, *Helicobacter*, *Staphylococcus*, *Salmonella*, *Shigella*, *Streptococcus*, *Campylobacter*, *Pseudomonas*, *Bacillus*, *Proteus* and *Yersinia*. This findings agree with result of Benka-Coker and Olimani (1995); Edema *et al.*(2006) and Ukpong (2008) which state that these organisms are basically regarded as water resident organisms. *E.coli* had the highest frequency of occurrence (24.4%) followed in descending order by *Helicobacter pylori* (13.3%), *Staphylococcus aureus* (10.0%), *Salmonella typhi* (8.9 %), *Shigella flexneri* (6.7%), *Streptococcus faecalis* (5.6%), *Streptococcus pyogenes* (5.6%), *Campylobacter jejuni* (4.4%), *Pseudomonas aeruginosa* (4.4%), *Bacillus subtilis* (4.4%), *Proteus mirabilis* (4.4%), *Klebsiella pneumonia* (3.3%), *Proteus vulgaris* (3.3%), and *Yersinia enterocolitica* (1.1%). *E. coli* with the highest frequency in this study indicates that the water sampled from these various sources were faecally contaminated recently because *E.coli* is an indicator of recent faecal contamination. The result obtained from this study also agrees with the findings of Bala (2006), 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.

CONCLUSION

In conclusion, the indication of contamination in well water is basically due to inadequate attention given to the construction and safety of this source of water by the entire populace. It is therefore recommended that environmental health workers should assist in carrying out efficient surveillance on the various water sources on regular basis to enhance the detection of any lapses on wells and immediately give suggestions on how to solve the problem to avoid an outbreak of waterborne disease. In addition, the well

should be constructed mechanically and adequately lined with concrete to prevent seeping of various chemicals into the wells, which could alter the microbial composition of the wells.

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