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

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ABSTRACT

This study was carried out to determine the coliform contamination of public boreholes and pipe borne water supplies within Bosso town. Ten (10) pipe borne water samples were aseptically collected (according to standard methods) from Bosso town and analyzed using membrane filtration techniques. The results obtained showed that all (100.0%) of the pipe borne water samples had coliform counts above 0 cfu/100ml. The bacteria isolated included species of *Escherichia, Pseudomonas, Streptococcus, Staphylococcus, Salmonella, Shigella, Clostridium, Bacillus, Yersinia, Serratia*. *E.coli* had the highest frequency of occurrence (20%) followed in descending order by *Staphylococcus aureus (*11.7%), *Salmonella spp* (11.7%), *Shigella spp* (11.7%), *Clostridium spp* (8.3), *Streptococcus faecalis* (8.3%), *Pseudomonas aeruginosa* (6.7%), *Bacillus subtilis* (6.7%), *Streptococcus pyrogenes* (5%), *Klebsiella spp* (3.3%), *Proteus vulgaris* (3.3%), *Yersinia spp* (1.7%) *and Serratia spp* (1.7%).This study reveals that pipe borne water samples were contaminated with bacteria. This highlights the need for a continuous assessment of the quality of public water supply and the introduction of intervention measures to prevent outbreak of water-borne diseases.

Keywords: Pipe borne, water, bacteria, water-borne disease
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INTRODUCTION

Water, as one of the basic components of life is important to man, animals and plants [1].It is an essential medium required to sustain the life of all living organisms, due to its unique chemical and physical properties [2]. According to Third World Academy of Science (TWAS as cited in Adabara *et al.* [3]), safe drinking water is a basic human requirement and essential to all and it is essential for sustainable development. 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 [4]. 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 [5]. 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 contaminated by matter of faecal origin [3].

Most water bodies that may be 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. [6] 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 [7, 8].

The faecal pathogens in water supplies are a very diverse group of organisms such as bacteria (including *E.coli* 0157:H7, *Shigella* species, *Campylobacter jejuni*, *Salmonella* species, *Yersinia* species etc), Protozoans (such as, *Entamoeba histolytica*, *Gardia* species, *Cryptosporidium* species etc) and viruses (including Noroviruses, Enteroviruses, Adenoviruses, Rotaviruses and Hepatitis A and E viruses) [9], which are all dangerous pathogens. Also, some water borne diseases that may coincide with faecal contamination include ear infections, dysentery, typhoid fever, cholera, encephalitis, giardiasis, gastroenteritis and hepatitis [7].

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 [10]. 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 that various public water supplies are evaluated/ monitored continuously to enable the detection and prevention of disease causing bacteria. This study is therefore aimed at microbiological evaluation of the quality of pipe borne water supplies to Bosso and its environs, where the entire general populace depends on it for their daily activities and survival.

MATERIALS AND METHODS

Study areas

The study areas were all in Bosso Local Government Area of Minna, Niger State, Nigeria. While samples were collected from 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 the pipe borne water sampled were frequently used by the inhabitants around the area for drinking and other domestic purposes. Most of the pipe borne water sampled was from taps constructed close to buildings with soakaways, while some were constructed close to refuse dump sites. The study was carried out from May to August, 2015.

Collection of samples

Ten (10) samples of pipe borne 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 hr.

Analysis 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, 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^{o}C for 4 hr. One of the Petri dishes was then transferred to an incubator at 37°C for 14 hr to isolate the total coliform, while the second Petri dish was placed in an incubator for 44°C at 14 hr for the isolation of faecal coliform respectively. The yellow colonies were counted immediately after the incubation period before they decolorize.

Identification of isolates

Isolates from primary cultures incubated at (37°C and 44°C) were aseptically subcultured on to fresh media (MacConkey agar and Nutrient agar) to obtain pure isolates 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.

RESULTS

The results obtained showed that faecal coliform count from the taps ranged from 8.0-100.0 cfu/100ml.The result also showed that total coliform count from the taps ranged from 70.0-228.0 cfu/100ml (Fig 1).The total coliform counts (TCC) were on the average six times higher than the faecal coliform counts (FCC).

The result also showed that among all the sample area studied, Bosso Central had the highest percentage of coliform contamination while Federal University of Technology (FUT) Bosso campus had the least coliform contamination (Fig 1).

A total of 60 isolates were identified and characterized in descending order of their frequency of occurrence as *E.coli, Staphylococcus aureus*, *Salmonella* species, *Shigella* species, *Clostridium* species, *Streptococcus faecalis*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes*, *Klebsiella* species,*Proteus vulgaris*, *Yersinia* species, and *Serratia* species (Table 1).

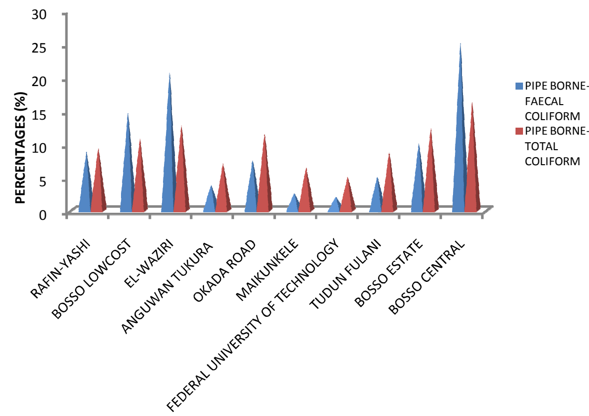

Fig 1: Percentage of occurrence of the coliform in Pipe borne water sample

Table 1 shows a total of 60 isolates identified and characterized in the descending order of their frequency of occurrence as *E.coli, Staphylococcus aureus*, *Salmonella* species, *Shigella* species, *Clostridium* spieces, *Streptococcus faecalis*, *Pseudomonas aeruginosa*, *Bacillus subtilis*, *Streptococcus pyogenes*, *Klebsiella* species, *Proteus vulgaris*, *Yersinia* species, and *Serratia* species.

Table 1. Frequency of Occurrence of bacterial isolates

Organisms	Frequency	Percentage frequency (%)
E.coli	12	20.0
Staphylococcus aureus	7	11.7
Salmonella spp	7	11.7
Shigella spp	7	11.7
Clostridium spp	5	8.3
Streptococcus feacalis	5	8.3
Pseudomonas spp	4	6.7
Bacillus substilis	4	6.7
Streptococcus pyrogenes	3	5
Klebsiella spp	2	3.3
Proteus vulgaris	2	3.3
Yersinia spp	1	1.7
Serratia spp	1	1.7
Total	60	100

DISCUSSION

The results shown in Table 1 revealed that all the public pipe borne water analysed within the study area were contaminated with faecal matter. However, the entire pipe borne water sampled had coliform counts above 0 coliform organisms /100ml of water [11]. The pipe borne water contamination observed in this study maybe due to the fact that the most water distributors pay less attention in flushing the head pumps and pipes of these pipes borne- water adequately to prevent the accumulation of microorganisms. Also, in most cases the head pumps and the pipes are not protected adequately from bacteria, based on this most people tend to suck water from the pump outlets by applying pressure with their mouths, thereby introducing different bacteria into the pipe borne water system. This in turn, makes the head pumps and the pipes serve as habitats for various coliforms which give rise to the development of biofilms and this constantly contaminates the water that flows out, for the populace to use. This result is similar with the result of Okoko & Idise [12], who reported that the presence of biofilms in the various tap water could be attributed to defective joints on the pipes, rusted pipes crossing over the sewage or low/ high pressure in sewage pipes.

In addition to this, the observation of coliform counts exceeding above the WHO recommended standard [11], in the pipe borne water in this study, is an indication that the pipes used in the construction of these taps serve as habitat to various contaminants in the environment due to improper joining process of various fittings and valves, handling during their production and the lack of adequate maintenance of these pipes, prior its usage in the supply of water enhances the contamination level of the water that passes through them. According to the report of WHO [13], the level of contamination measured by bacteriological analysis may be a risk especially during an outbreak of diseases like cholera or typhoid. Similarly, the contamination of these tap water is also based on the fact that, the source of the water that is channeled through the pipes, are heavily contaminated with coliforms and in most cases such pipe borne water lack adequate chlorination treatment (which is the application of chlorine residual of 1mg/l or greater for at least 30min) [14] to eradicate these coliforms before the water is supplied.

All the sampled areas except 40% of them had higher percentages of faecal coliform (Figure 1). The result could be attributed to the fact that the populace in these areas ignorantly engage themselves in various unhygienic practices such as, inappropriate defecation and construction of soakaways, septic tanks and pit latrines around the areas where the pipes are located. In addition to this, the most populace in these areas also engages in inappropriate farming activities with the use of human faeces as a source of manure. The farming and construction activities lead to destruction of the pipelines and this in turn could lead to the penetration of various coliforms into these various sources of water. This result agrees with the findings of Bala [15] and Mashi [16] who reported that damage on the pipelines in the environment where they are laid give way for the contamination of the tap water by sewage which easily seep into the broken pipes, 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 Okoko & Idise [12] and Geldreich [17].

Organisms isolated from these water samples in this study were species of *Escherichia, Pseudomonas, Streptococcus Staphylococcus, Salmonella, Shigella, Clostridium, Bacillus, Yersinia* and *Serratia.* These findings agree with the results of Benka-Coker & O' limani [18], Edema *et al.* [19] and Ukpong [20], which states that these organisms are basically regarded as water resident organisms. *E.coli* had the highest frequency of occurrence (20%) followed in descending order by *Staphylococcus aureus* (11.7%), *Salmonella* spp (11.7%), *Shigella* spp (11.7%), *Clostridium* spp (8.3), *Streptococcus feacalis* (8.3%), *Pseudomonas aeruginosa* (6.7%), *Bacillus subtilis* (6.7%), *Streptococcus pyrogenes* (5%), *Klebsiella* spp (3.3%), *Proteus vulgaris* (3.3%), *Yersinia* spp (1.7%) and *Serratia* spp (1.7%). *E. coli* with the highest frequency in this study indicates that the water sampled from these various sources were recently contaminated because *E.coli* is an indicator of recent faecal contamination. This result obtained from this study agrees with the findings of Bala [15], 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 pipe borne water is basically due to inadequate attention given to the various water sources and their construction so as to obtain a portable water supply which is an essential part of human life. It is therefore, recommended that environmental health workers should help in carrying out efficient surveillance on the various public water sources on regular basis so as to easily help detect any lapses on the pipelines or boreholes and immediately give suggestions on how to solve the problem to avoid an outbreak of waterborne disease. In addition, the pipelines should be adequately constructed with standard valves and fittings to avoid damage of these pipelines, which brings about repairs and thus contamination of these pipelines. Effective and sufficient chlorination treatment should be carried out on various water bodies before they are channeled to various pipelines for usage.

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