



Original Article

Bacteriological Analysis of Sachet Water in Maiduguri Metropolis

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ABSTRACT

Potable drinking water serve as an important pillar for primary prevention of diseases and it continues to be the foundation for the prevention and control of water borne diseases. This study aims to determine bacteriological analysis of five (5) brands of sachet water (A to E) in Maiduguri metropolis, using multiple tube fermentation method (most probable number) for enumeration of both total coliform count and fecal coliform count. Lauryl Tryptose Broth (LTB) along with fermentation tubes (Durham tubes) was used. The total bacterial counts for all the water samples were generally high exceeding the limit recommended by both Environmental Protection Agency (EPA) and World Health Organization (WHO) (1.0×10^2 cfu/ml), which is the standard limit of heterotrophic count for drinking water. Also, the sachet water found contaminates with pathogenic bacteria such as *Klebsiella species*, *Escherichia coli*, *Pseudomonas species* and *Enterobacter species*. Therefore, appropriate treatment processes should, therefore be utilized for production of quality and safe packaged drinking waters.

Keywords: Bacteriological, Sachet, Water, Coliform.

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INTRODUCTION

Fresh drinking water is one of the natural resource which is necessary for existence and survival of all human being (Abdullahi *et al.*, 2010). Potable drinking water serve as an important pillar for primary prevention of diseases and it continues to be the foundation for the prevention and control of water borne diseases (WHO, 2010; Isa *et al.*, 2013). The importance of potable water supply in the socio-economic life of communities cannot be overemphasized. Often, source and potability of water supply reflects on the health conditions of communities as microbiological contamination of water is the primary cause of disease outbreaks in many communities particularly in many developing countries. The transmission of disease through drinking water is, therefore, one of the primary concerns for safe water supply (Ahmed *et al.*, 2004; Popoola *et al.*, 2007). Contaminated water is a global public

health threat placing people at risk of a host of diarrhoeal and other illness as well as chemical intoxication (Okonko *et al.*, 200; Isa *et al.*, 2013). In many developing countries, availability of potable water becomes a problem when supply is interrupted frequently and shortages become the order of the day (Popoola *et al.*, 2007).

The danger that unsafe drinking water poses to health is enormous (Njoku and Osinlu, 2007; Oparaocha *et al.*, 2010). Unsatisfactory water supplies and unwholesome sanitary conditions can result in poor human health (Chukwu, 2008; Oparaocha *et al.*, 2010). The ensuring of good quality drinking water is a basic factor in guaranteeing public health, the protection of the environment and sustainable development. Thus, many infectious diseases are transmitted by water through faecal oral contamination. Diseases due to drinking of contaminated water leads to the death of five million children annually and make 1/6 of the world population sick (Shittu *et al.*, 2008; Isa *et al.*, 2013).

Safe drinking water is a basic need for human development, health and well-being; it is an internationally accepted human right (WHO, 2001). The consumption of unsafe water has been implicated as one of the major causes of diarrhea and deaths. According to World Health Organization, there were estimated 4 billion cases of diarrhoea and 2.2 million deaths annually (Essien and Olisah, 2010). The Federal Ministry of Health and various State Ministries of Health in Nigeria are reporting increased number of cases of gastroenteritis, diarrhea, typhoid and cholera which are indicative of poor drinking water quality. The gradual deterioration of water quality is a result of the increase in human populations and urbanization (Edema *et al.*, 2001; Essien and Olisah, 2010). As an alternative, private sector participation has lead to the idea of packaged drinking water popularly referred to as "pure water.". This product is 500ml of water in clear nylon square sachets which have been electrically heated and sealed at both ends and widely patronized by both low and middle income earners (Addo *et al.*, 2009).

Sachet- water or pure water is classified as food and is regulated and screened by National Agency for Food and Drug Administration and control in Nigeria, whose bacteriological standards are as recommended by World Health Organization (Afiukwa *et al.*, 2010). Many people in rural and urban communities rely on sachet water as the source(s) of their drinking water supply. The integrity of these sachet waters before is doubtful, in fact, unconfirmed report abounds that most of the vendors do not treat their sachet waters before selling to the public (Oladipo *et al.*, 2009). Although there is lack of documented data on incidence rates, it has been clearly observed that the appearance of pure water has tremendously increased the case of gastroenteritis such as salmonellosis and typhoid fever in recent years. Water pollution has continued to generate unpleasant implications for health and economic development in Nigeria (Adelegan, 2004). Earlier investigation conducted on the safety of drinking water has show that water on the market is of good microbiological quality while the quality of some factory bagged sachet and hand-filled polythene bagged drinking water was noted to be doubtful (Obiri *et al.*, 2003; Oladipo *et al.*, 2009). Therefore, the objective of this study is to determine bacteriological analysis of sachet water in Maiduguri metropolis, Nigeria.

MATERIALS AND METHODS

Collection of Sample

Five (5) brands of sachet water (A to E) with NAFDAC certification were randomly collected in different parts of Maiduguri metropolis Northeastern, Nigeria in bags within 48hours of production and stored in a room at ambient temperature. All samples were bought from the vendors in Maiduguri and taken to the Department of Science Laboratory Technology, laboratory for analysis.

Bacteriological Analysis

Determination of Total Coliform Count and Fecal Coliform Count

Bacteriological characteristics of the water samples were determined using multiple tube fermentation method (most probable number) for enumeration of both total coliform count and fecal coliform count. Lauryl Tryptose Broth (LTB) along with fermentation tubes (Durham tubes) was used. A serial dilution of the water sample to be tested was made and inoculated into LTB growth media. Samples were then incubated at 35°C for 48 h for the presumptive test for total coliform count. After the positive tubes were transferred to Brilliant green lactose bile broth (confirmation test) and incubated for 48 h at 35°C, the growth or gas production confirmed the presences of coliform (Nollet, 2007).

Heterotrophic Plate Count

Ten fold serials dilutions of water samples were prepared in sterile distilled water. The 10² and 10⁶ dilution was used. From this 0.1ml of the sample was aseptically transferred onto the centre of a prepared plate agar (Oxoid) a sterile glass rod was used to spread the water sample evenly on the surface of media. The plate was made in duplicate and incubated at 37°C for 24hours.

RESULTS AND DISCUSSION

Bacteriological analysis of Sachet water collected from five different sites in Maiduguri metropolis showed that all the water samples contained high levels of total heterotrophic bacteria counts; with sample B had the highest total heterotrophic bacteria counts and sample C having the lowest total heterotrophic count as shown in Table 1. Heterotrophic count (HPC) measures a range of bacteria that are naturally present in the environment (Shittu *et al.*, 2008; EPA, 2002). The total bacterial counts for all the water samples were generally high exceeding the limit recommended by both EPA and WHO (of 1.0×10²cfu/ml), which is the standard limit of heterotrophic count for drinking water. The high total heterotrophic count is indicative of the presence of high organic and dissolved salts in the water. According to World Health Organization (2002) report, a high heterotrophic count concentration does not itself present a risk to human health. Nevertheless, heterotrophic counts are used as good indicators of the overall quality of production (Obiri *et al.*, 2003). These may therefore, be used in assessing the cleanliness of the different brands of sachet drinking waters sold in the selected areas of study.

The most probable number for presumptive total coliform count of the water samples ranged from 0 and 2 MPN per 100 ml. Water sample from Point A and D had the highest coliform count of 2 MPN per 100 ml, followed by point B, C and E with 1, 0 and 0 MPN per 100 ml, respectively. However, lowest coliform count of 0 MPN per 100 ml was recorded in water sample from point C and E as shown in the Table 1. Bacteriological analysis of the sachet water of common use within Maiduguri metropolis indicates that most of the sachet water did not meet the requirement of both EPA and WHO standard for potable water. This could be attributed to the bacterial contaminants which could have been introduced during the processing, packaging and distribution stages. The total plate count was observed above the specified range of EPA or WHO. The data obtained from coliforms count underlines the unsuitability of the brands for human consumption. Ajayi *et al.*, (2008) had reported an earlier study of packaged drinking waters in Ibadan, Nigeria in which larger proportions of sachet water were found to show positive coliforms count compared to bottled waters. Ineffectiveness or malfunctioning of the treatment process employed could also result in the presence of coliform bacteria in the samples of water. According to Edberg (1996), no treatment process or method used in mass production of drinking water yields a sterile product; it only produces a safe product devoid of pathogenic organisms.

Table 1: Total heterotrophic bacteria and coliform counts of 5 sachet water samples

S/N	Samples	Total heterotrophic Count (cfu/ml)	Total coliform count MPN/100ml	Fecal coliform count	Isolates
1	A	1.64×10^4	2	0	<i>Klebsiella</i> species, <i>Pseudomonas</i> species
2	B	1.96×10^4	1	0	<i>Enterobacteria</i> species,
3	C	1.40×10^4	0	0	<i>Pseudomonas</i> species,
4	D	1.70×10^4	2	0	<i>Klebsiella</i> species, <i>Enterobacteria</i> species, <i>Pseudomonas</i> species
5	E	1.54×10^4	0	0	<i>Pseudomonas</i> species,
6	WHO	1.00×10^2	0	0	Zero
8	EPA	1.00×10^2	0	0	Zero

Results obtained in this study showed that the sachet water sold at different site in Maiduguri metropolis contaminant with pathogenic bacteria such as *Klebsiella species*, *Escherichia coli*, *Pseudomonas species* and *Enterobacter species*. The result of this study is similar to the finding of Adewoye and Adewoye (2013) in Ogbomoso, South-western, Nigeria, who reported that sachet water was contaminated with *Pseudomonas species* and *Enterobacteriace species*, it also similar to the finding of Mgbakor et al., (2011) in Owerri metropolis who showed that sachet water contained *Klebsiella species* and *Pseudomonas species*. The finding of this study is also similar to the work of Kalpana et al., (2011) in Kebbi state, Nigeria, who showed that sachet water contained *Staphylococcus aureus* and *E. coli*. In a similar study of sachet water samples tested fielded bacteria growth with organisms such as *Klebsiella*, *Streptococcus* and *Pseudomonas* (Adekunle et al., 2004). The presence of these pathogens in such water could account for the incidence of diarrhea, food poisoning and gastroenteritis especially, among the students. Also, presence of this pathogens raise public health concerns that need to be addressed. The need for microbial assessment of water for production of drinks should also be emphasized to reduce possible contamination. In this study, the microbiological analysis of sachet drinking water sold in some part of Maiduguri showed the presence of total coliforms and *E. coli* in concentrations that make the products unfit for human consumption going by WHO and NAFDAC recommendations and guidelines. There is, therefore, need for NAFDAC to intensify efforts in the routine monitoring of activities in the packaged drinking water industry. The safety of sachet drinking water should be ensured through comprehensive regulatory programs at both the federal and state levels. NAFDAC regulations for packaged waters should be protective of public health and there should be continuous adoption of packaged water quality standards. Testing of market samples will be a good way of detecting if the water is actually pure as claimed by these producing companies. The hunt for quick money has resulted in “pure water” business and the associated inability to follow the specified treatment process. Sachet water, inspite of being sealed, is thus observed to contribute to health risk. Therefore, packaging has to be supervised carefully and any sanitary deficiencies discovered should be corrected immediately. The presence of pathogenic organisms including bacteria in the studied sachet water samples are further indications that the originating source of water is doubtful and this water do not undergo appropriate sterilization techniques. Appropriate treatment processes should, therefore be utilized for production of quality and safe packaged drinking waters.

CONCLUSION

The results of this study shows the bacteriological analysis of five (5) brands of sachet water (A to E) in Maiduguri metropolis, using multiple tube fermentation method (most probable number) for enumeration of both total coliform count and fecal coliform count. Lauryl Tryptose Broth (LTB) along with fermentation tubes (Durham tubes) was used. The total bacterial counts for all the water samples were generally high exceeding the limit recommended by both Environmental Protection Agency (EPA) and World Health

Organization (WHO) (of 1.0×10^2 cfu/ml), which is the standard limit of heterotrophic count for drinking water. Also, the sachet water found contaminates with pathogenic bacteria such as *Klebsiella species*, *Escherichia coli*, *Pseudomonas species* and *Enterobacter species*. Therefore, appropriate treatment processes should, therefore be utilized for production of quality and safe packaged drinking waters.

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