**Assessment of microbiological quality of water in Federal University, Ndufu-Alieke, Ikwo**

**Mbah et al.**

ASSESSMENT OF MICROBIOLOGICAL QUALITY OF SURFACE AND UNDERGROUND WATER IN FEDERAL UNIVERSITY, NDUFU-ALIKE, IKWO

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Abstract

The study used two comparative double-blind methods. Water analysis was performed using estimation of total coliforms and quantitative bacteriological analysis. A total of 126 water specimens from surface and underground water, FUNAI’s sachet and bottled water were analyzed over two seasons, rainy and dry seasons. Among the samples studied, 47 (37.30%) were positive for coliforms. The bacteria isolates observed as contaminants in the water include: *E. coli*, *Salmonella spp.*, *Shigella spp.*, *Proteus vulgaris*, *Morganella morganii*, *Klebsiella oxytoca*, *Enterobacter spp.*, *Citrobacter freundii*. There was higher prevalence of contamination of the water specimens studied during the rainy season than during the dry season period. The presence of *E. coli*, *Salmonella spp.*, and *Shigella spp.* in the water consumed in the University is of immense public health importance and calls for concerted efforts to prevent disease epidemic due to food poisoning. Our finding is a strong call for all producers of commercial water to ensure that standards practices are adhered to in their production. It also buttresses the fact that boiling water for domestic use remains a salient control measure because drinking only bottled water may be exorbitant beyond the reach of the average student in FUNAI.

**Keywords:** FUNAI, sachet water, bottled water, streams and fecal coliforms

1. Introduction

The consumption of quality water is a necessity in the maintenance of normal functioning of various parts of the body for humans (Izah and Ineyougba, 2015). Potable water quality is evaluated based on the general appearance (turbidity), taste, colour, and odour but these do not indicate that the water is free from contaminants. Water quality is usually monitored with regard to the physicochemical, heavy metal and microbial characteristics (Majumder *et al.*, 2011). Drinking water is essential for survival hence its biological and chemical contamination is a serious problem that may have severe health effects (Bashir and Aish, 2013). The risk of contamination of drinking water supplies with microbial pathogens is minimized by modern approaches to water management, but continues to be of major public health concern. Environmental issues such as increasing salinity and global warming are likely to affect the sustainability of our current drinking water supplies and increase the threat of waterborne disease outbreaks (Leder *et al.*, 2002). Microbiologically contaminated water contributes to the heavy burden of disease associated with cholera, typhoid, *paratyphoid*, *hepatitis* and gastroenteritis. Ideally, drinking water should not contain any microorganisms known to be pathogenic or any bacteria indicative of fecal pollution since the presence of these microorganisms has been traditionally seen as indicator of fecal contamination. Tests are useful for monitoring the microbial quality of water meant for human consumption (Nguendo-Yongsi, 2010).

Water borne diseases continue to be one of the major health problems especially in developing nations. The high prevalence of diseases such as diarrhea, typhoid, cholera and bacillary dysentery among the populace has been traced to the consumption of unsafe water and unhygienic drinking water (Oyedeji *et al.*, 2010). The most dangerous form of water pollution occurs when faecal contaminants enter the water supply. Pathogens such as *Salmonella species*, *Shigella species*, *Vibrio cholera* and *E. coli* being shed in human and animal faeces ultimately find their way into water supply through seepage of improperly treated sewage into ground water. The contamination of natural water with faecal material, domestic and industrial sewage and agricultural and pasture runoff may result in increased risk of disease transmission (Geldreich, 1991).

Federal University, Ndufu-Alieke, Ikwo (FUNAI) is located in Ikwo Local Government Area of Ebonyi State. It is one of the newly established universities and has attracted people from across the country that now dwell in the university in close association with the natives.
Underground water pumped by boreholes positioned at strategic locations around the university community is the major source of water supply. Also, sachet and bottled water which are closed underground water produced by the University management is the main source of water consumed by the University community. This study was aimed at evaluating the microbiological quality of the underground, surface, sachet and bottled water used and consumed within the University community.

2. Materials and Methods

2.1 Study area

The study was carried out in Federal University, Ndufu-Alike, Ikwo, Ebonyi State. The study area is located between Latitude 06°4’N and Longitude 08°5’E. Rainfall pattern is bimodal (April – July), September – November with a short spell sometimes in August. The annual rainfall is between 1000 – 1500mm (Ogbodo, 2013). The vegetation of the area is predominantly derived savannah (Ogbodo, 2013). The mean annual temperature is about 24°C and the relative humidity is between 60 – 80% (Ogbodo, 2013).

2.2 Sampling of water specimens

The water samples analyzed include; FUNAI bottled water, FUNAISachet water, (these are underground water that were treated and packaged for sale). Also, surface water from a stream located within the university campus and underground water from borehole obtained from different outlets which are: Male Hostel, Female Hostel, Canteen and Biology Laboratory. Asceptic measures were strictly adhered to in the collection of water samples used for this study to ensure that contaminants were not introduced from either the containers or during sample collection. A triplicate of each specimen was analyzed and only those which had more than two specimens with presence of microorganisms that were higher than the WHO guidelines (2003) were recorded as being positive.

3. Estimation of Total Coliforms

The multiple tube fermentation test was used to assess the microbial quality of the water following standard methods (APHA, 1998). The 5 – tube most probable number (MPN) method was used to estimate the total coliforms. MacConkey broth was used for the presumptive tests. Inoculated tubes of MacConkey broth were incubated at 44°C for 24 hours. Eosine Methylene blue agar was used to confirm positive presumptive tests. Biochemical tests were used to characterize the coliforms that were isolated.

4. Quantitative Analysis

Membrane filtration technique was also employed. One hundred (100ml) of water samples were filtered through the membrane filters, and then the membrane filters were used to inoculate MacConkey agar, Eosine-Methylene blue agar, blood agar and sabouraud’s dextrose agar. The media were incubated for 24 hours at 37°C. Isolates were identified and characterized using colonial morphological characteristics and biochemical tests.

4.1 Statistical analysis

Statistical approaches used were descriptive statistics and student t-test to analyze the data. Data analysis was performed using statistical programme for the social sciences (SPSS) version 18.0.

5. Results

A total of one hundred and twenty six water specimens were collected and analyzed using two comparative double-blind methods. Specimens which were positive by both methods were recorded as being positive while those that were positive for either of the methods were regarded as being false positive. Among the one hundred and twenty six specimens analyzed, a total of 47 (37.30%) were positive for coliforms. The bacteria isolates observed as contaminants in the water are identified based on their phenotypic characteristics the isolates are suspected to include; E. coli, Salmonella spp., Shigella spp., Proteus vulgaris, Morganella morganii, Klebsiella oxytoca, Enterobacter spp., Citrobacter freundii. The frequency of these isolates is presented in table 3. E. coli was detected in 16 (12.70%) of the 126 specimens analyzed, Salmonella spp was detected in 7 (5.55%) while Shigellaspp. was detected in 9 (7.14%). These organisms are of public health importance when found in water. When various water sources were compared, no fecal coliform was isolated from FUNAI bottled water, the highest concentration of contaminants was found in the stream water, the sachet water was found to be contaminated also. Among different locations of the borehole collection points studied,
highest contamination was observed in the stream water in both seasons. There was higher prevalence of contamination in the FUNAISachet water in the dry season (11.11%) than during the rainy season (4.76%). When the difference between the prevalence of water contamination of FUNAISachet water was compared between the rainy and dry seasons, the difference was statistically significant (p<0.05).

Table 1: Occurrence of total coliforms (TC) and faecal coliforms (FC) in the water specimens studied

<table>
<thead>
<tr>
<th>Sample</th>
<th>No. tested</th>
<th>No. contaminated</th>
<th>Indicator bacteria (no/100ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>TC</td>
</tr>
<tr>
<td>A</td>
<td>18</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>18</td>
<td>29</td>
</tr>
<tr>
<td>D</td>
<td>18</td>
<td>4</td>
<td>13</td>
</tr>
<tr>
<td>E</td>
<td>18</td>
<td>6</td>
<td>19</td>
</tr>
<tr>
<td>F</td>
<td>18</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>G</td>
<td>18</td>
<td>3</td>
<td>13</td>
</tr>
</tbody>
</table>

Key: A – FUNAI bottled water  B – FUNAI sachet water  C – Stream surface water  D – Male Hostel borehole  E – Female hostel borehole  F – FUNAI canteen borehole  G – Biology laboratory borehole

Table 2: Comparison of the number of specimens contaminated with coliforms between rainy season and dry season

<table>
<thead>
<tr>
<th>Sample</th>
<th>No. tested</th>
<th>Dry season</th>
<th>Rainy season</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>18</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>B</td>
<td>18</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>18</td>
<td>12</td>
<td>6</td>
<td>18</td>
</tr>
<tr>
<td>D</td>
<td>18</td>
<td>3</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>E</td>
<td>18</td>
<td>3</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>F</td>
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<td>6</td>
</tr>
<tr>
<td>G</td>
<td>18</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>126</td>
<td>31</td>
<td>16</td>
<td>47</td>
</tr>
</tbody>
</table>

6. Discussion
Federal University, Ndofu-Alike, Ikwo is a newly established institution which has attracted persons from different parts of the world. Within the University community, there is almost an exclusive consumption of FUNAI sachet water. Also, the students reside in the campus and consume the borehole water. This study became necessary to evaluate the microbiological quality of the water in and around the University community. The presence of E. coli, Salmonella spp., and Shigella spp. in the water consumed in the university is of immense public health importance and calls for concerted efforts to prevent disease epidemic due to food poisoning. E. coli has been used as an indicator organism for faecal contamination of drinking water. The count of faecal coliform and total coliform should be 0 per 100ml according to WHO standard (WHO, 2003). This obvious deviation from the WHO standard indicates contamination of the water and calls for the need to incorporate health education in the orientation of both staff and students and concerted effort to ensure that the quality of both bottle and sachet water sold in the University is not compromised. The observation in this study that boreholes are less polluted than streams is similar to the findings of Malakauskas et al. (2007). FUNAI sachet and bottled water are obtained from borehole and subsequently purified and packaged for distribution. The present study has demonstrated that total coliform count exceeds the standard permitted by the World Health Organization for drinking water. Such results should not to be ignored especially with the fact that several waterborne pathogens like E. coli, Salmonella spp., and Shigella spp. are harmful.
to human health and have high mortality rate. This observation is in line with the findings of Bashir and Aish (2013). The finding of Salmonella spp. and Shigella spp. indicates water contamination from various sources. Pathogens with increased resistance may be transported from animal to human and vice versa through feces or other mechanisms into rivers and ground water (Ibekwe et al., 2011). Infectious diseases caused by pathogenic bacteria, viruses, protozoa and other parasites are the most common and widespread health risk associated with drinking water. Those that pose serious disease risk whenever present in drinking water include Salmonella spp., Shigella spp., Vibrio cholerae etc (Nogueira et al., 2003). This study investigated the water in a university community, most people, mainly students use water directly from available sources without any treatment and as such are exposed to a variety of water – related diseases (Coutinho et al.). Among the total of 126 water specimens analyzed, 47 (37.30%) were found to be contaminated. This implies that there is an increased probability of becoming infected by drinking the water. Also, domestic use of the water increases the chances of acquiring the infection. Source of contamination may be due to carelessness in the production of the sachet water, improper or incomplete treatment of the water. All producers of sachet water should ensure that quality standard practices are adhered to in the production of these water products for commercial purposes. It also buttresses the fact that boiling of water remains a salient control measure because drinking only bottled water is highly expensive. The finding of coliforms in the FUNAI sachet water is comparable to the findings of other studies in developing countries that have found coliforms in sachet and bottled water that are commercially available as well as surface water used in the community (Wright et al., 2004; Vantarakis et al., 2005; Malakauskas et al., 2007; Bernier et al., 2009; Oyedoji et al., 2010; Majumder et al., 2011; Mouzeni et al., 2013; Bashir and Aish, 2013; Shamsiet al., 2015). This study therefore underscores the need to ensure strict adherence to standard practices in the manufacture of commercial drinking water. When the frequency of the samples which were contaminated were compared between seasons, more specimens, both surface and underground water were found to be contaminated during the dry season than during the rainy season (table 2). This may be as a result of surface runoff which carries dirt, feces and decaying organic matter into streams, rivers and open wells.

7. Conclusion
This study investigated the water in a university community, most people, mainly students use water directly from available sources without any treatment and as such are exposed to a variety of water – related diseases. It is commendable that no contaminant was found in the FUNAI bottled water. However, the finding of contaminants in the sachet water is highly significant because as is the practice, sachet water is the affordable drinking water for most people in Nigeria hence its contamination will significantly impact on the health of many residents. This study is the first of its kind in FUNAI and has served to provide baseline data on the microbiological quality of water in the University community. The finding of this study is a clarion call for all the producers of sachet water to ensure that quality standard practices are adhered to in the production of these water products for commercial purposes. It also buttresses the fact that boiling of water remains a salient control measure because drinking only bottled water is highly expensive.

References


Region, Lithuania. *Veterinarija ir Zootekhnija*, 3(28), 50–56.

