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The acknowledgment of people, grants or funds should be brief.

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MICROBIAL EVALUATION OF TAP WATER IN DELTA STATE UNIVERSITY, ABRAKA

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ABSTRACT

Water is one of the most abundant resources on which life on earth depends; in some places, the availability of water is critical, limited, and renewable. The study is aimed at a microbial evaluation of the quality of tap water at Delta State University, Abraka. The pour plate method was used to determine the total heterotrophic count and thereafter, bacterial isolates were characterised using standard microbiological methods. The most probable number technique was employed in determining the total coliform count. Findings from the study revealed the heterotrophic count of the various water samples was between 3.0 x 10^4 and 3.4 x 10^5 cfu/ml. The coliform count in the presumptive test ranged from 9 to 240. This research also revealed the presence of bacteria species such as Pseudomonas *spp.*, *Enterobacter spp.*, and *Aeromonas spp. Enterobacter spp.* occurred the most and accounted for 33.33%, while *Pseudomonas spp.* and *Aeromonas spp. accounted* for 16.67% each. *Escherichia coli* was absent in all the water samples analysed, but the presence of the isolated bacteria species in drinking water is of grave importance. The contamination of water samples may be a result of leaking underground pipes or inadequate sanitary conditions in the storage facilities. In order to improve the quality of tap water in the community, storage facilities have to be maintained periodically, and sanitary conditions should be improved.

Keywords: Tap-water, Microbial, Quality, Abraka.

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INTRODUCTION

Water is a unique commodity. It is the most abundant and essential resource among other natural resources useful to all living creatures (1). Water is the most indispensable need for the existence of all living things, for domestic and other purposes. Access to portable water is one of the many goals of the Sustainable Development Goals (SDG), which aim for environmental sustainability (2).

In mammals, water plays an essential role by absorbing a large amount of heat and then dissolving the waste products generated as a result of metabolism. Humans drink water, which provides for normal bodily and cell functions. A reduction in the daily intake of water causes a decrease in the efficiency of cells and other body activities. Humans also use water for agricultural, industrial, and recreational activities, in addition to other purposes (8, 9). Though all these needs are salient, water for human consumption and sanitation are regarded as having a significant social and economic impact on the health of the entire population.

Most of our water supplies are from surface water, which includes rivers, streams, lakes, oceans, seas, and other water bodies. In developing countries, water pollution and its shortage are prevalent (3). This may be due to poor domestic and personal hygiene and the accumulation of industrial and agricultural waste. As populations increase, the tendency for surface and underground water to be polluted becomes increasingly high. Basically, water-borne infectious diseases are transmitted primarily through water supplies contaminated with human and animal faecal matter. Some microorganisms isolated from water include *Escherichia coli*, *Staphylococcus sp.*, *Bacillus sp.*, *Streptococcus sp.*, *Klebsiella sp.*, *Pseudomonas sp.*, *Flavobacterium sp.*, *Enterobacter sp.*, *Proteus sp.*, *and Pseudomonas sp.* (4). Other human pathogenic organisms that pose a serious risk of

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disease whenever found in drinking water include *Salmonella* spp., *Shigella spp*., *Vibrio cholerae*, *Yersinia entercolitica*, *Campylobacter* spp., various viruses such as hepatitis E and A, rotaviruses, and parasites such as *Entamoeba histolytica* and *Giardia* spp. Previous findings reveal a high mortality rate from diarrheal-related diseases, and a greater percentage are children who are below the age of five (5).

It is important to state that water meant for consumption should not contain any microorganisms known to be pathogenic or any bacteria indicative of faecal pollution (6). Hence, it is absolutely necessary to test portable water to ensure it is safe. Evaluating the quality of portable water depends to a large extent on the examination of indicator organisms such as coliforms. One of such members of the faecal coliform group is *Escherichia coli*. *E. coli* is regarded as a specific indicator of faecal pollution in drinking water because of its prevalence in human and animal faeces as compared to other coliforms (7).

Disease outbreaks and economic losses could result from a shortage of water; hence, water is a necessity. Spores of bacterial and fungal origin may be present in polluted water. These spores may be obtained from the air, dead plants, animal sewage, and organic waste. Almost all microorganisms may be found in water, but bacteria appear to be the major water pollutants. It is important to know that dead, decaying organic matter acts as a substrate for some microorganisms (10). Bacteria are known to be helpful in the digestion of poisons from food and water. The presence of other species could cause various diseases in humans and other animals. It is also a known fact that water from wells, streams, rivers, boreholes, and even rainwater contains dissolved materials from the air as well as suspended dust intermixed with microorganisms (11).

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At Delta State University, the topography of the land is flat, and the ground water level is between 6 and 8 meters. It is of utmost importance that drinking water from the source has to be tested and regularly monitored by the authorities to ensure that it is pure and germ-free. In this study, the bacteriological quality of the water being supplied to the DELSU community was microbiologically evaluated.

EXPERIMENTAL

Study area

Delta State University, Abraka, is located in Delta State, Nigeria. It is a typical rural setting, although gradually transforming into a semi-urban area with the establishment of Delta State University. Abraka has an estimated population of 50,000. The major occupation of the indigenes is farming. Civil servants also abound in the community because of the presence of the University and public schools.

Sample collection, transport, and storage

The water samples were collected from taps at different locations at Delta State University, while aseptic conditions were maintained during the collection of samples. Samples from the taps were taken after allowing the taps to run for about five minutes. Approximately 200 ml of water was collected from each tap location coded as A, B, C, D, E and F. The samples were kept in an ice pack to prevent any changes in the microbial flora of the samples during transport. The water samples were transported to the laboratory in a vertical position, maintaining a temperature of 1–4 ^{o}C with ice pack-enclosed conditions. Samples were analysed immediately after collection.

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Total heterotrophic bacteria count

The total bacterial count was carried out by the pour-plate method. In a sterile petri dish, one millilitre of each water sample was transferred aseptically and mixed with 19 ml of melted nutrient agar. The experiment was done in triplicate. The medium was allowed to solidify, and the plates were incubated at 37^{o}C for 24 hours. The number of colonies in each plate was counted and the number of bacteria/ml of each sample, calculated.

Isolation and Identification of Bacteria

Each water sample was subjected to serial dilution and 0.1 ml of the 10^{-5} dilution was plated in MacConkey agar, blood agar, Mannitol salt agar, Salmonella-Shigella agar and Simmon Citrate agar. Incubation of the plates was done at37^{0}C for 24 hours. Afterwards, the cultural appearance of the bacterial colonies were studied. This was followed by the Gram staining of the colonies. The biochemical tests performed on the bacterial isolates are indole, citrate utilization, oxidase, hydrogen sulphide, catalase, urease, MR-VP and carbohydrate fermentation.

ENUMERATION OF COLIFORM BACTERIA

Most probable number test

This is a 3 step test comprising of the Presumptive test, confirmed test and the completed test. The multiple tube fermentation technique was performed as a presumptive test for total coliform using a total of 9 tubes containing 5ml of MacConkey broth and inverted Durham tubes. To the first 3 tubes containing double-strength MacConkey broth, 10 ml of the original sample was added. Then to second set of 3 tubes containing single-strength MacConkey broth, 1 ml of the original sample was added. The last set of 3 tubes containing single-strength MacConkeybroth, had 0.1 ml of the original sample added to them. All tubes were incubated at 37ºC for 48 hours for the observation

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of gas production. First reading was taken after 24 hours to record positive tubes, and the negative ones were incubated for another 24 hours.

Confirmed test: A loopful of inoculum was taken from tubes that were gas positive for the presumptive test and was inoculated into a tube containing 10 ml Brilliant green lactose broth medium. All tubes were incubated at 37ºC for 48 hours for the observation of gas production.

Completed test (Fecal coliform test)

At least 3 loopful of each confirmed positive tube were subcultured into EC (Escherichia coli) broth medium and then incubated at 44.5ºC for 24 hours. Tubes showing any amount of gas production were considered as positive and the most probable number was recorded (the results were compared with the most probable number table) (12).

RESULT AND DISCUSSION

The heterotrophic count of the various water samples was between 3.0×10^4 and 3.4×10^5 cfu/ml (Table 1). A previous study reported the mean total bacterial counts of 2.0×10^4 cfu/ml in borehole water (13). However, in a similar study surface water had a higher bacterial count compared to ground water (22). These counts clearly exceed the World Health Organization standard limit for drinking water (14) and therefore not acceptable. High bacterial counts is indicative of elevated level of the pollution of water, this could be attributed to both human and animal activities. Surface water can be contaminated by human waste such as sewage and bacteria along the flow paths of water (5). Other sources of contamination may include animal waste deposition, pasture and surface runoff. Of the six borehole water samples evaluated, two samples had zero coliform count (Table 2.0) thereby complying with the WHO standard for coliform in water (14).

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Table 1: Mean Heterotrophic plate count of the various water samples

Water Samples	Heterotrophic Plate Count (Cfu /ml)
A	4.0×10^4
B	3.0×10^4
C	2.3×10^5
D	3.4×10^5
E	3.4×10^5
F	2.9×10^5

The highest coliform count in the presumptive test was 240 while the least was 9 (Table 2.0). These clearly exceeded the WHO standard. However, two out of the six samples had zero coliform count thereby complying with the WHO standard for drinking water. A similar study reported that coliform bacteria were present in all collected samples with MPN values ranging from 14 to 1600 (15) however findings from another study by Muhammad revealed a lower coliform count ranging from 14 to 36 counts (21). The incidence of coliform in water suggests the possible pollution by other infective microorganisms thus rendering such water unsafe for food processing also for consumption (16). The WHO guideline recommends further investigation for any water sample with high coliform counts (14).

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Table 2: Presumptive Test

Water sample	Number of tubes giving positive reactions			
	3 of 10ml	3 of 1ml	3 of 0.1ml	MPN/ml
A	2	0	0	9
B	3	0	0	23
C	3	3	0	240
D	0	0	0	0
E	3	3	0	240
F	0	0	0	0

This research also revealed the presence of three bacteria species namely *Pseudomonas spp*, *Enterobacter spp* and *Aeromonas spp* (Table 3.0). *Enterobacter spp* was most prevalent while *Pseudomonas* and *Aeromonas spp* had the least occurrence. This is clearly in contrast with a previous study done in Riyad, Saudi Arabia where the tap water was of a better quality (23) An earlier study revealed *E. coli* as most prevalent (61 %), *P.aeruginosa* 53%, *Salmonella* 25 % and *S. aureus* was least prevalent with14 % (15). Laboratory investigations of water from River Ethiope in Abraka showed the presence of *E. coli*, *S. aureus*, *Bacillus* spp, *S. epidermidis*, *Actinomyces* and *Enterobacter sp.*(17). The occurrence of these bacterial species in drinking water is of grave importance. *Enterobacter spp*is known to be a fecal coliform which is indicative of faecal contamination of the water. Consumption of such water can result in health hazards (18). Numerous health risks have been associated with the consumption of faecal contaminated water. Immuno-compromised adults and children under the age of 5 are known to be at greater health risk if they consume faecal contaminated water (19). It has been documented that water borne diseases such as diarrhea, cholera dysentery typhoid, and polio amongst others are the major causes of death in underaged children (20) *Pseudomonas spp* on the other hand is capable of giving rise to urinary infections. The pollution of such water may be due to water the presence of sewage tanks around

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the vicinity of the taps. Contamination can also result from underground leaking pipes meant to transport water from one location to another. Inadequate treatment of storage facilities can also give rise to storage tank harbouring some opportunistic pathogens such as *Pseudomonas spp* which can give rise to a number of infections in humans. Appropriate treatment processes must therefore be utilized in order to minimize health hazards resulting from the ingestion of such contaminated water (18).

Table 3: Frequency of Occurrence of Isolates from Water samples

Isolates	A	B	C	D	E	F	Frequency of occurrence (%)
Pseudomonas spp	+	-	-	-	-	-	16.67
Enterobacter spp	-	+	+	-	-	-	33.33
Aeromonas spp	-	-	-	-	+	-	16.67

Conclusion

In conclusion, the presence of microorganisms of various species is in accordance with the fact that microorganisms are ubiquitous, occurring in air, water and also the environment. The water samples assessed had high heterotrophic counts and coliform counts, both of them clearly above the standard limit for drinking water. The presence of a feacal coliform indicates contamination of water with faecal matter. On the other hand *Pseudomonas spp* are capable of causing infection of the urinary tract. All of these microorganisms are harmful to human health. The contamination of water samples may be due to leaking underground pipes, inadequate sanitary conditions with the storage facilities and presence of sewage tanks around the vicinity of the taps and storage facilities.

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In order to improve the quality of tap water in the community the storage facilities have to be maintained periodically, leaking pipes have to be fixed and human and animal waste have to be far from storage facilities and taps. In general, sanitary conditions should be improved in the campus.

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