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BOREHOLE WATER QUALITY WITHIN THE FEDERAL UNIVERSITY OF TECHNOLOGY, AKURE, NIGERIA

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Abstract
The aim of this study is to determine the quality of borehole water supplied within the Federal University of Technology, Akure, Nigeria in order to ascertain its suitability for drinking purpose. Water samples were procured from 16 boreholes within the Federal University of Technology, Akure. The physico-chemical parameters determined include turbidity, pH, total dissolved solids, chloride, nitrate, total hardness, magnesium and alkalinity while the bacteriological parameters include Total Coliform Bacteria, and E.coli (Faecal Coliform). pH values ranged from 6.2 to 7.7, only BH10 did not fall within the WHO recommended range of 6.5 to 8.5. The chloride content of BH10 exceeded the WHO maximum permissible limit by 0.6 mg/L. BH01 and BH13 exceeded the WHO maximum permissible limit of 100 mg/L for total hardness with values of 119.7 and 128.1 mg /L respectively. Magnesium content of the water samples ranged from 0.98 to 3.3 mg/L with BH02, BH03, BH05, BH10, BH13, BH14 and BH15 exceeding the WHO maximum permissible limit of 2 mg/L with values of 2.1, 2.7, 2.9, 2.7, 3.3, 2.3 and 2.9 mg/L respectively. Most of the borehole water samples analyzed fell within WHO standards for potable water. However, because of the pH, chloride, total hardness and magnesium contamination reported in some of the water samples analyzed, it is recommended that the water be subjected to treatment before distribution to the consumers in order to make it safe for drinking purpose.

Keywords*: Water quality, borehole, bacteriological, physico-chemical, maximum permissible limit*

Introduction

Increase in human population has exerted enormous pressure on the provision of safe drinking water especially in developing countries (Umeh *et al*., 2005). Freshwater quality remain one of the most critical environmental and sustainability issues of the twenty-first century (UNEP, 2002). Cuo, (2016) identified surface and underground water as two main sources of water and opined that the primary usage of water is for domestic, industrial and agricultural purposes. While surface water is found in streams and rivers, underground water is found below the surface of the ground and can be extracted through wells and boreholes. Borehole water can be described as ground water available in aquifers and obtainable by installing a pump to extract the water for easy access by the consumers (Adeyemi, 2020). According to Emeka *et al.* (2020), the quality of borehole water cannot be visually ascertained unless it is analyzed in the laboratory and compared with relevant standards like World Health Organization (WHO).

Unwholesome water is a global public health threat, placing persons at risk for a host of diarrheal and other diseases (Hughes and Koplan, 2005; WHO, 2011a). Annually, more than 2 million persons, mostly children less than 5 years of age, die of diarrheal disease (Kosek *et al*., 2003). Approximately 90% of diarrheal-related deaths have been attributed to unsafe supplies and sanitation conditions (WHO, 2004). The suitability of water for its intended purpose is assessed based on the water quality characteristics (Ojo *et al*., 2022).

Groundwater is a remarkably important source of water and sole input to coastal waters (Kim *et al*., 2003). Groundwater contains a variety of constituents such as microorganisms, gases, inorganic and organic materials at different concentrations (Sundaram *et al*., 2009). Water contamination with trace metals can be related to polluted water infiltrating through soil, rock and eventually reaching the groundwater (Oladipo *et al*., 2011). The aim of municipal water supply is the production and the distribution of safe water that is fit for human consumption (Okonko *et al.,* 2008). Conformity of potable water with water quality standards is of utmost importance because of the ability of unwholesome water to spread diseases within a given population (Ojo and Obiora-Okeke, 2022).

The Department of Works and Services of the Federal University of Technology Akure (FUTA) is in charge of supplying water for various uses in the institution's hostels, administrative offices, academic buildings, staff quarters and other buildings. FUTA witnessed an increase in population of 4,127 staff and students from 24,292 in 2013 to 28,419 in 2019 (FUTA Directorate of Works, 2019). Periodic examination of all water sources is essential in order to determine its continued suitability for the intended use and to detect any deterioration in the quality of the water (Ojo, 2022). According to Agbaire (2014), the two major water problems man has to contend with in any habitat are water quantity and water quality. Akeju *et al*., (2021) addressed the problem of water quantity from boreholes in the Federal University of Technology, Akure. This study aims at determining the quality of the borehole water supplied within the Federal University of Technology, Akure in order to determine its suitability for drinking purpose.

Materials and Methods

Study Area

The study was carried out in the Federal University of Technology, Akure (FUTA). FUTA is located Ondo State, Nigeria. It lies between longitude 5°06'E to 5°38'E and between latitude 7°07'N to 7°37'N. The climate is characterized by distinct wet and dry seasons. The onset of rainfall is usually during the month of March with decline during the month of November. The annual rainfall varies between 1500 mm and 3500 mm with mean annual temperature range of 24°C - 27°C. FUTA's topography is composed of mostly lowlands and few rugged hills. FUTA has a population of 28,419 comprising of staff and student as at 2019. The major source of water in FUTA is from boreholes which are drilled at different points on the University campus. The satellite imagery of FUTA with the location of the boreholes is shown in Figure 1.

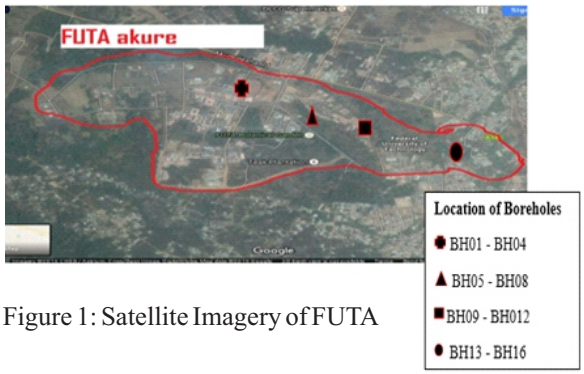

Figure 1: Satellite Imagery of FUTA

Sample Collection

Water samples were procured from 16 functioning boreholes in different locations within FUTA. Samples for physio-chemical analysis were collected in 1 Litre plastic containers while samples for bacteriological analysis were collected in sterile bottles provided by the laboratory. The bottles were rinsed twice with the borehole water before filling with the samples. In order to preserve the integrity of the water samples, the samples were transported within four hours of collection to the laboratory

Water Quality Analysis

The physico-chemical parameters determined include turbidity, pH, total dissolved solid (TDS), chloride, nitrate, total hardness, magnesium and alkalinity while the bacteriological parameters include total coliform bacteria and E.coli (faecal coliform). The tests were carried out at the Microbiology and Chemistry Departmental laboratories of FUTA. The pH of the water samples was determined using the pH meter while the turbidity was determined using the digital turbidity meter. Other water analyses were done using methods specified in APHA (2005). The containers used in the analysis were acid washed and rinsed with distilled water while all equipment used were adequately calibrated. Sigma Analar reagents were used in the preparation of solutions. The analysis carried out on each sample was done in triplicate and the mean was recorded. The results obtained were compared with World Health Organization (WHO, 2011b) standard for potable water.

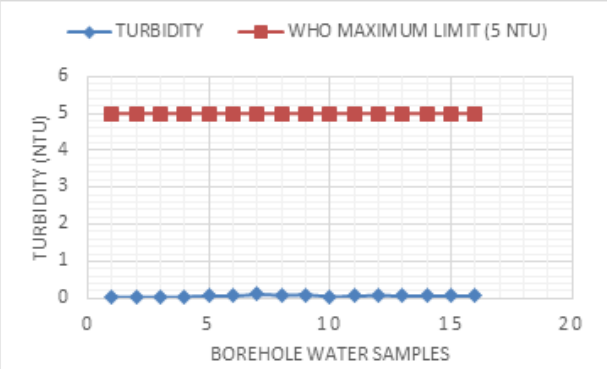

Figure 2: Turbidity values of the water

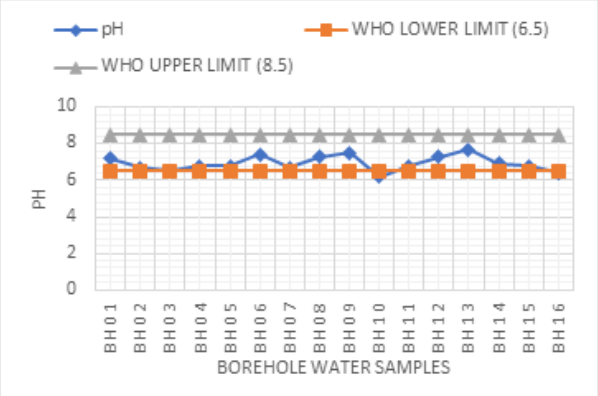

Figure 3: pH values of the water samples

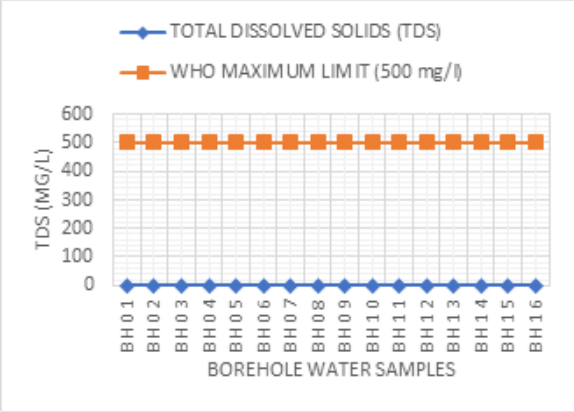

Figure 4: TDS values of the water samples

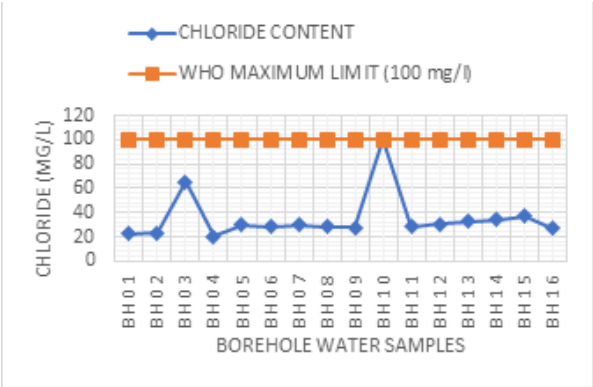

Figure 5: Chloride values of the water samples

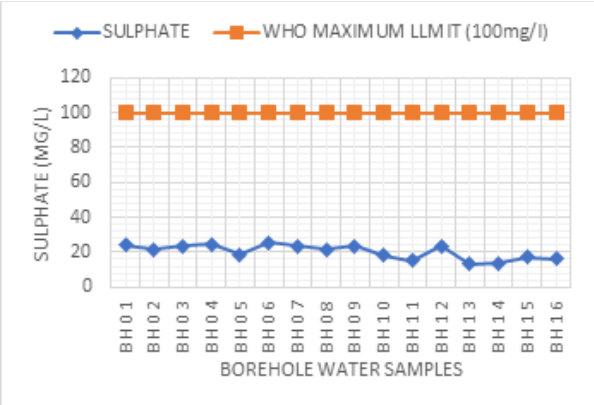

Figure 6: Sulphate values of the water samples

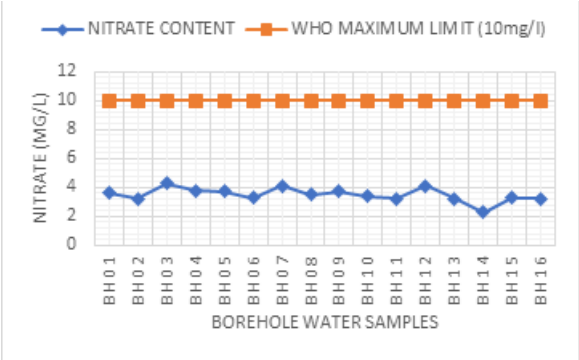

Figure 7: Nitrate values of the water samples

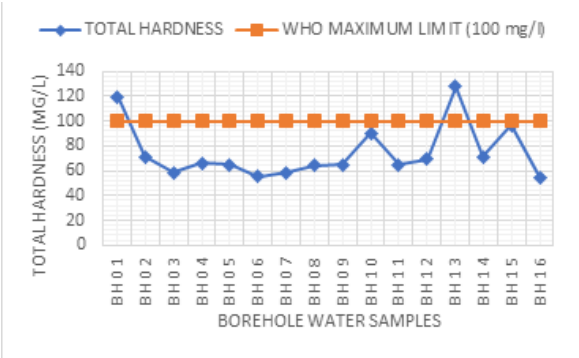

Figure 8: Total hardness values of the water

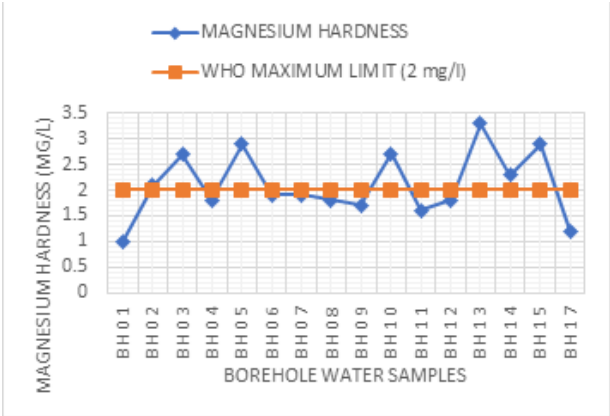

Figure 9: Magnesium hardness of the water samples

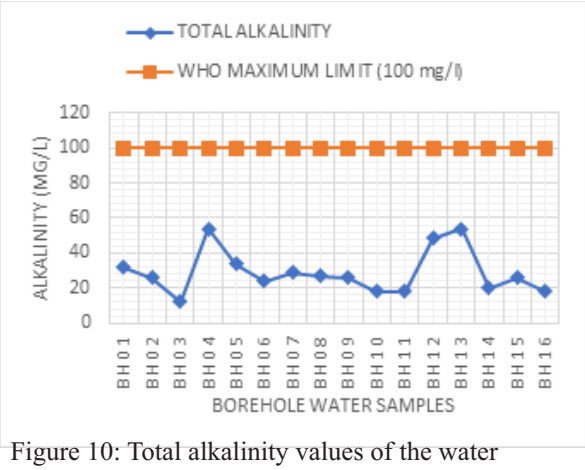

Figure 10: Total alkalinity values of the water samples

Bacteriological analysis

The results presented in Table 1 showed the absence of total coliform bacteria and E-coli while the presence of bacteria fell within WHO maximum permissible limit of 100 cfu/100 mL. However, due to the possibility of contamination that may be introduced during transportation through pipes, the water may become contaminated, therefore, the water may be subjected to post chlorination. Sule *et al*. (2009) affirmed that stressed bacterial cells reactivate faster in dechlorinated water than in chlorinated water.

Table 1: Bacteriological Test results of the borehole water samples

Parameter	Total Plate Count (cfu/100mL)	Total Coliform Bacteria (cfu/100mL)	E-Coli (cfu/100mL)
WHO (2011) LIMITS	100	< 1	< 1
BH01	41	0	0
BH02	47	0	0
BH03	43	0	0
BH04	54	0	0
BH05	28	0	0
BH06	38	0	0
BH07	38	0	0
BH08	40	0	0
BH09	88	0	0
BH10	38	0	0
BH11	48	0	0
BH12	52	0	0
BH13	0	0	0
BH14	6	0	0
BH15	54	0	0
BH16	43	0	0

Conclusion

Most of the borehole water samples analyzed fell within WHO standards for potable water. However, because of undesirable values of pH, chloride, total hardness and magnesium contamination reported in some of the water samples analyzed, it is recommended that the water be subjected to treatment before distribution to the consumers in order to make it safe for drinking purpose.

Acknowledgement

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