EKETE International Journal of Advanced Research
ISSN 3027-2513 (ONLINE)
ISSN 3027-169X (PRINT)

EKETE: International Journal of Advanced Research
Volume 2 Number 4, July 2024
url: https://journals.journalsplace.org/index.php/EKETE
Email: eketejournal@gmail.com

ANALYSIS OF PHYSICOCHEMICAL PARAMETERS IN WELL WATER FROM UNWANA COMMUNITY, SOUTHEASTERN NIGERIA

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Abstract

This research seeks to employ analysis in order to analyse the potability of some well water located in Unwana community. Four samples of well water from Unwana community were analysed. The samples were subjected to standard methods of test approved by World Health Organization (WHO). The results obtained were compared with the World Health Organization standard. Findings showed that the Unwana well water showed some level of hardness (27.00-34.67mg/l), slightly acidic, contained high level of iron (0.81mg/l). The iron contents of the well did not meet the recommended value of WHO (0.3mg/l). Also, the pH values (5.89-.6.34) were not within the range of WHO recommended value of 6.5-8.5. Total alkalinity ranged between 20.90-57.00mg/l. Finally the values obtained for nitrite was between 0.002-0.05mg/l which met the WHO recommended range (0.002-0.006mg/l).

Keywords*:* Physicochemical, well water, water quality, potability, Unwana community.

Introduction

Water is a transparent liquid found in the world's rivers, lakes, oceans, and as precipitation. The quality of water in these aquatic environments is shaped by a range of physical, chemical, and biological interactions (Gielchinsky et al., 2017). Before water can be deemed potable, it must meet specific physical, chemical, and microbiological standards. These criteria are established to guarantee that the water is not only safe for consumption but also palatable to drink (Adekunle et al., 2013). Physical standards might include parameters such as turbidity, colour, and temperature, which affect the water's appearance and sensory qualities. Chemical standards assess the presence of various substances, including minerals, metals, and contaminants, ensuring that harmful levels of these components are not present. Microbiological standards are crucial as they evaluate the presence of harmful microorganisms, such as bacteria, viruses, and parasites, which can pose serious health risks. The adherence to these comprehensive standards is essential for confirming that water is safe and enjoyable to consume, thereby protecting public health and enhancing the overall drinking experience. (Haq et al., 2021).

It has been observed that the indigenous people of Unwana choose their source of drinking water based on the proximity of the water source rather than on the potability. In view of this fact and bearing in mind the possible health hazards associated with chemical pollutants it is understandable that physicochemical characteristics of the water sources have become imperative (Adebayo et al, 2022).

Ajiwe and Ijindu (1996) worked on characteristics of Idah well water (close to Unwana community). They found that Idah well water is acidic, turbid and has high iron content. Furthermore, Uzohuo et al (2011) reported a low nitrite content of spring water found in Afikpo community (0.002-0.018mg/l) while Emmanuel (2022) worked on the distribution of nitrite in drinking water in Kwara state. Their work indicated that there were differences in nitrate in water and these differences were related to the difference in geological structure of the area. Water analysis is a major global concern which requires ongoing evaluation and revision of water resource policy at all levels. This is understandable since availability of potable water is a critical factor for socio-economic development (Adebola, 2019).

This study seeks to analyse well water samples from Unwana community and compare them with World Health Organization (WHO) standards for domestic water.

Experimental

Collection of Samples

Four well water samples were collected from Ihere, Ochighaighai, Omere and Akpuruakpu all in Unwana community. The water samples were collected with sterilized plastic containers. The containers were rinsed with distilled water and a second time with the well water samples from the different sources. The water samples Ihere, Ochighaighai, Akpurukpu, and Omere were labelled samples 1, 2, 3 and 4 respectively. Standard methods by WHO was used for the various water samples.

Determination of pH

The pH levels of the water samples were determined using the Lovibond Raw Water Kit, Model AF 355 (413550). This kit is specifically designed for precise pH testing and is commonly used in water quality evaluations. By utilizing this dependable tool, researchers can obtain accurate measurements of the water's acidity or alkalinity, which are crucial for assessing its suitability for different applications, such as drinking, agricultural use, and supporting aquatic life.

Determination of Iron

The lovibond raw water kit was used to determine the amount of iron present. The compartment of the comparator cell was allowed to stand for one minute for the colour to match, the comparator was held up to the sunlight and revolving the disc until the correct match is found. The iron value was given at right hand corner of the comparator.

Determination of Water Hardness

Complexometric titration was employed for the determination of the water hardness. 50ml of the sample was placed in a conical flask. 2ml of pH 10 buffer solution as added and 0.2 of solochrome black and sodium chloride was added as an indicator. The colour change to pink indicates the end point of the filtration.

Determination of Alkalinity

100ml of the sample under test was transferred into the calibrated shaked bottle. One alkalinity. M-tablet was added after crushed with a glass stirring rod. The content was shaken vigorously to disintegrate. On addition of the alkalinity tablet, a bright pink colour was observed. Determination of Nitrite 50ml Nessler tube containing the sample only was placed at the left-hand compartment of Nessler 50. A second Nessler 50 was filled to the 50ml mark with the sample under test. One nitricol acidifying tablet was added. This tablet was crushed with clean stirring rod and mixed to dissolve. The tube was placed right hand compartment of the Nessler 50 and it was allowed to stand for 30 minutes. A figure was shown in the bottom right corner of the comparator, which represents the nitrite in terms of nitrogen present in the sample (mg/l).

Result and Discussion

Table 1: Physicochemical Parameters of the Well Water Samples

Parameter	Samples			
	1 (Ihere)	2 (Ochighaighai)	3 (Akpurukpu)	4 (Omere)
pH Value	5.89	5.92	6.17	6.34
Iron (mg/l)	0.81	0.80	0.83	0.81
Water hardness	27.00	33.28	34.67	38.37
Alkalinity (mg/l)	20.90	37.20	57.00	47.81
Nitrite (mg/l)	0.002	0.018	0.005	0.033
Temperature (^{0}C)	26.30	25.60	25.19	27.5

Table 2: World Health Organization (WHO) Standard for Potable Water

Parameter	WHO
pH Value	6.5-8.5
Iron (mg/l)	0.3
Water hardness 200.0	200.0
Alkalinity (mg/l)	Unavailable
Nitrite (mg/l)	3.0
Temperature (^{0}C)	Unavailable

Discussion

The pH values of well water samples were slightly acidic (5.89-.6.34) and these values did not meet the World Health Standard (6.5-8.5). An average value of 0.81mg was obtained for analysis of iron content which did not meet the World Health Standard for the permissible level of iron content in the potable water (0.3mg). The high level of iron contents in these well water gave rise to the slightly brownish colour of the well water. In addition, it has been observed that the presence of iron catalyses the rusting of metallic cooking utensils which is quite undesirable and may pose serious health challenges (Toi Bissang et al., 2024). The average value for the water hardness ranged from 27.00 to 38.37mg/l.

Uzohuo et al. (2011) observed that high alkalinity in certain water sources is often a result of the geological characteristics of the area. The mineral composition of the underlying rocks and soil significantly influences the water's chemical properties, including its alkalinity. For the well water analysed, the alkalinity levels were relatively low, ranging from 20.9 to 57.0 mg/l. The highest recorded alkalinity was 57 mg/l in water from Akpurukpu. Although these levels are on the lower end of the scale, it's important to assess their implications for water quality and human health.

Research shows that water with alkalinity levels between 100 and 200 mg/l is generally regarded as safe for human consumption, as it typically has minimal to no adverse health effects. This range indicates that such water has adequate buffering capacity, which helps to keep pH levels stable and protects against variations that might lead to increased acidity (Wibowo et al., 2024).

In contrast, the alkalinity of the well water in Unwana is notably lower than this recommended range. This lower alkalinity may indicate a reduced ability to buffer pH changes, making the water more prone to acidity. This could potentially impact the taste and overall quality of the water. Moreover, lower buffering capacity could increase the water's susceptibility to contamination, as acidic conditions can enhance the solubility of harmful substances. While the current alkalinity levels in Unwana well water do not pose immediate health risks, they suggest a need for continued monitoring and possible treatment to ensure the water remains safe and pleasant for consumption.

Understanding the effects of low alkalinity is essential for effective water quality management and protecting public health. Low alkalinity can make the water more prone to acidity, which might affect its taste and overall quality. While the current levels do not present immediate health hazards, they highlight the need for ongoing attention to water treatment and management. Ensuring that the water maintains an adequate alkalinity level is crucial for sustaining its safety and palatability over time (Boyd et al., 2016). The geological formations in the region significantly affect the observed alkalinity levels in the well water. The low alkalinity values suggest that while there may not be immediate health risks, it is important to monitor and potentially adjust water management practices to improve water quality and ensure it remains suitable for consumption in the long term.

The water temperatures of the local well water sources ranged from 26.30C to 27.50C. The lowest water temperature was obtained from Omere well water (26.30C) while the highest water temperature as obtained from Ihere well water (27.50C). The temperature differences of the various well may not be unconnected to the various depths of the well (Hannah and Garner, 2015). As expected, Ihere well had the highest depth and lowest water temperature of 26.30C.

Conclusion

The analysis results were compared with the standards set by the World Health Organization (WHO). The findings revealed that the well water in Unwana showed a degree of hardness, with measurements ranging from 27.00 to 34.67 mg/l. Additionally, the water was slightly acidic, with pH values between 5.89 and 6.34, which are below the WHO's recommended range of 6.5 to 8.5, indicating a potential concern regarding water quality and its suitability for drinking.

Furthermore, the water had elevated iron levels, at 0.81 mg/l, exceeding the WHO's acceptable limit of 0.3 mg/l. High iron concentrations can cause undesirable taste and staining, and could pose health risks if consumed over long periods. The water's total alkalinity ranged from 20.90 to 57.00 mg/l, reflecting its ability to neutralize acids and maintain stable pH levels. While this provides some insight into the water's chemical properties, additional context is necessary to fully assess its implications for water quality.

Finally, nitrite levels in the well water were between 0.002 and 0.05 mg/l. These values fall within the WHO's recommended range of 0.002 to 0.006 mg/l, suggesting that nitrite levels are acceptable. However, the higher end of this range indicates a need for continued monitoring to prevent potential health risks. In conclusion, although some aspects of the Unwana well water meet WHO standards, issues such as high iron content and acidity indicate potential health risks that require further investigation and corrective measures to ensure the water is safe for the community.

Recommendation

Future research should expand its focus by integrating microbial analysis and investigating potential contamination sources. This approach will deepen our understanding of the factors affecting water quality in the Unwana Community. Incorporating microbial analysis allows researchers to identify specific microorganisms in the water, which can indicate both ecosystem health and water safety for human use. Examining the types and concentrations of these microorganisms can provide crucial insights into pollution sources such as agricultural runoff, sewage discharge, or industrial waste.

Furthermore, investigating potential sources of contamination is crucial for developing effective management strategies. This may involve evaluating nearby agricultural practices, waste disposal methods, and industrial activities that could affect water quality. By adopting this comprehensive approach, future studies will offer a clearer understanding of current water quality issues in Unwana and guide policy makers and community leaders in implementing necessary interventions to safeguard and enhance water resources. Ultimately, this expanded research can promote more sustainable practices and improve community health outcomes.

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