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Determination of Physicochemical Properties of Some Selected Well and Borehole Water of Nasarawa Area of Zagga Town of Kebbi State, Nigeria

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Abstract
Nowadays, especially in poor resource settings, there is rising infectious and chronic diseases, which most especially can be attributed to poor water quality as one of the causes. Consequently, it becomes imperative to determine the safety of drinking water source. This research is aimed to determine the physicochemical characteristics in well water and borehole water in Nasarawa area of Zagga town of Kebbi state, using standard methods and materials of analytical grade. Results show the pH range of 6.13-6.7, and conductivity is in the range of 3.37-80.1 (ppm). Bicarbonate determined is within the range of 24-84 (ppm). TDS was found in the range of 9-35(ppm), while DO found was 4.7-6.8 (ppm). Chloride was 0.7-11.3 (ppm), and TSS is 7.3-13.3 (ppm). pH, DO, Cl^-, TDS, and bicarbonate are within the World Health Organization (WHO) permissible limits as found in the findings of this study.
Keywords: bicarbonate, borehole water, chloride, pH, semi-arid, water supply, well water

INTRODUCTION

Water refers to a colorless, odorless, tasteless liquid, which boils at 100$°C$ at normal atmospheric pressure; a very vital liquid, a most important liquid, with higher density point than ice with higher melting and boiling points than colleague liquids (Abdulhamid et al., 2013);(Abubakar et al., 2021). Global water indices indicated that freshwater is about 2.5%, while saline water is circa 97.5%, therewith groundwater constitutes about 30.1% of the freshwater resource available (Abubakar et al., 2021). Groundwater as found beneath the earth surface in pores and spaces of the crust or rock formations remains an important parcel of the hydrological cycle preferred for significant number of world's population owing to its reliability, accessibility, freshness, portability, and other charitable idiosyncrasies therewith (Isah et al., 2016); (Abubakar et al., 2021); (Wali et al., 2022). It is the largest water supply to the world potentially available for human consumption, human use in domestic and related activities, especially in places with scarce or polluted surface water or in rural areas. Being the water confined in the ground beneath the surface makes it less amenable to microbial or chemical contaminations in contrast to its counterpart water sources (Isah et al., 2016).

However, nowadays anthropogenic processes such as laundry, agriculture, industrial productions, construction activities, urbanization, municipal waste disposal, and relations have been on the rise and served as culprits in polluting our environment, let alone, the groundwater (Aliyu et al., 2020). Pollution and solvent character of water make groundwater receptive to heavy metals such as lead, iron, cadmium, copper, mercury, aluminum, arsenic, cobalt; therewith some of the metals are toxic at higher levels, some are of these are toxic at any level, interfering with enzymes systems, and metabolic pathways in humans, plants, and other organisms. Many of these heavy metals are deleterious to aquatic system, animals, ecosystem and human health (Aliyu et al., 2020) making access to quality drinking water difficult especially in this region of the country known with low rainfall, short annual rainfall, erratic rainfall, deforestation, and nearness to desert (Uba et al., 2016); (Wali et al., 2022). The situation is of overt concern at this century when United Nations declared free access to clean water as a basic human right and one of the indices of good living; clean water is desirable for social development, justice and welfare. Clean water cannot be overemphasized; it is a known as earth's milk. Accessibility to clean water is becoming a growing challenge as in, an individual requires 20-50 liters of clean quality water every day for drinking and domestic use; but water crises including water diseases and shortage are increasing especially in developing countries (Yahaya et al., 2019).

Invariably, using low quality water for human consumption and agriculture affects human health, plant growth, and pollute soil making it less suitable for agricultural practices and domestic uses (Kasarawa et al., 2017); (Wali et al., 2022). Preventing the burden of water pollution or water diseases requires adequate monitoring of the water (constituents, possible pollutants) to take appropriate remedies (Yahaya et al., 2019); (Wali et al., 2022). Likewise, a step towards monitoring of water quality through the assessment of physicochemical parameters is vital role in assessing the water environment, ecology, and the likes. It is a good ploy to measure water quality as well (Rahamana & Jolly, 2021). Therefore, this research is aimed to determine the physicochemical characteristics in well water and borehole water in Nasarawa area of Zagga town of Kebbi state, Nigeria.

MATERIALS AND METHODS

Sample Collection

The sample was collected from wells and borehole water of Nasarawa area of Zagga town, Kebbi state, Nigeria. The sample was collected from different wells and boreholes in Nasarawa area and the area contained 15 well and 5 bore hole. Before collecting the sample, the area was divided into 2 parts and each part 1 well and bore hole were collected. The sample was labeled A to D.
sample A: sample from borehole
sample B: sample from borehole
sample C: sample from well
sample D: sample from well

Determination of Bicarbonate (CO_3^{2-})

The methyl orange was added into colorless solution and the solution turn to orange and the solution is titrated against 0.05M of H_2SO_4 until the color change to red.

Determination of Chloride (CL^-)

From the solution of carbonate and bicarbonate 1cm^3 of $K_2Cr_2O_7$ was added the solution turn to orange color and titrated against 0.05M $AgNO_3$ until color change to turbid brown.

Determination of Acidity (pH)

Fifty 50cm^3 of the water sample was measured using measuring cylinder and transferred into the conical flask and 3 drops of phenolphthalein indicator were added and the solution titrated against 0.04M NaOH until solution turn to pink color.

Determination of Dissolved Oxygen (DO)

Two hundred 200cm^3 of the water sample was measured using measuring cylinder and transferred into the conical flask and 1cm^3 of $MnSO_4$ and 1ml of alkali azide solution were added and were shakes and kept for 1hr until the solution form a residue and 2cm^3 of orthophosphoric acid (HPO^4) was into the residue, the residue turns to dark brown, the dark brown solution titrated against 0.025M $Na_2S_2O_3$ until the solution turn to colorless.

Determination of Total Suspended Solid (TSS)

The filter papers were weighed using weighing balance and recorded,100cm^3 of the water sample were filtered using weighed filter papers and filter papers allowed to dry, after filter papers dried the filter papers reweighed again and recorded.

Total Dissolved Solid (TDS)

A dry empty evaporated dish was weighted and its constant weight was recorded as (W_1)g. Then 100cm^3 of the water sample was poured into the dish. The dish was placed on a water bath and the water allows to evaporate. The was placed in an oven at 100$°C$ for five minutes and transferred to a desiccator were it was left for another five and finally the dish reweighed the weight recorded as (W_2)g.

Determination of conductivity

The conductivity meter was switch on and conductivity meter electrode inserted into the water sample and the value recorded.

Determination of pH

Physicochemical properties of foods are important, water is part of our classes of food we take in everyday (Ardhiyanti & Indrasari, 2020); (Umar et al., 2021). Results for this study was shown by table 1. Therein, pH, DO, Cl^-, TDS, and bicarbonate are within the World Health Organization (WHO) permissible limits as found in the findings of this study. Power of hydrogen ion (pH) in water is of utmost significance to show quality, because other contaminations such as microbial life, solubility, stability of salts etc. changes with pH. Extreme pH affects palatability of water, causing corrosion of pipes and subsequent effects. Slightly acidic pH give room for dissolution of more trace elements which are useful to biological systems (Uba et al., 2016). Based on WHO standard drinking water pH shall range from 6.5-8.5. This study result has shown that the pH range of 6.13-6.7, as within the permissible limit.

Conductivity is the measure of ions concentrations in water. It is a direct index of presence of mineral salts in the water. This finding with a range of 3.37-80.1 (ppm) is below the WHO standard of 1200 (ppm). In turn, low conductivity level shows the water have the potential of low electrolytes or organic matter contamination (Uba et al., 2016). This might be attributed to the desert –like nature of the area known with deep water table, which might make it uneasy for salts to be dissolved therein. Bicarbonate determined is within the range of 24-84 (ppm), which is within the WHO limit of 0-120 (ppm). Bicarbonate level in water might be due to geology. Low level of bicarbonate is associated with pH below 8.5 (Uba et al., 2016).

The low TDS found in this study is a good omen to people with kidney and heart diseases as high levels might affect them (Isah et al., 2016) and low TDS positively influence the density of water by increasing dissolution of useful gases such as oxygen (Isah et al., 2016). DO found in this study is not higher than the permissible limit. This is an indication that the water has low microbial activities (Isah et al., 2016). In this study Cl^- determined was very low, within the WHO accepted limit. Presence of Chloride at accepted level help in ion regulation of enzymes, hormone responses, nerve transmission etc. (Abdulhamid et al., 2013).

TSS is one of the parameters used bin water quality. The results of this study indicated TSS range of 7.3-13.3 (ppm) which is slightly higher than the 7.0 value suggested by WHO. This might also indicate a slight contamination from silt, decaying plants, animal matter, waste, and sewage; which might cause problems for health and aquatic life. Nevertheless, it is important to monitor the water used for drinking from time to time especially in resource poor settings, in semi-arid areas like Kebbi, so as to avoid possible catastrophe and to curtail infectious and foodborne diseases. It would also give the policy makers and researchers the information for taking decisions and making more analysis (Tukura et al., 2014); (Ardhiyanti & Indrasari, 2020); (Sarkingobir et al., 2020);(Umar et al., 2021); (Sarkingobir et al., 2021);(Umar et al., 2022); (Wali et al., 2022).

CONCLUSION

Pertaining the results of physicochemical parameters of well water and borehole water in Nasarawa area Zagga town of Kebbi State, Nigeria; the values of pH, DO, Cl, TDS, and bicarbonate are within the World Health Organization (WHO) permissible limits as found in the findings of this study. Nevertheless, this would not make the water safe, as other parameters were not catered in this study; and water parameters of areas like this that are not always protected can fluctuate, thus, people should take prevention serious.

Based on this research work carried out the following recommendation were made:

1. Routine water quality analysis is needed to make sure the good parameters are maintained, and to take appropriate measure to curtail the hike of unwanted ones.
2. The people who live in this area should purchase better quality water for drinking as a precautionary measure to avoid health impact.

Table 1: Physicochemical properties in some selected wells and boreholes water of Nasarawa area of Zagga town of Kebbi state, Nigeria

Samples	**pH**	**TSS**	**DO**	**Cl**	**Conductivity**	**CO_3^{2-}**	**TDS**
A	6.71	10.7	4.7	11.3	207.0	84	9
B	6.20	13.3	5.7	0.7	28.6	24	14
C	6.42	7.3	4.8	10.0	3.37	36	35
D	6.13	11.8	6.8	0.7	80.1	24	ND
WHO standard limits	6.5-8.5	10	7.0	250	1200	0-120	500

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