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ASSESSMENT OF WATER QUALITY FROM SELECTED BOREHOLES, WELLS AND SACHET WATER IN UNGUWAR BABALLE AND SALELE SETTLEMENTS IN DANMUSA LOCAL GOVERNMENT AREA OF KATSINA STATE

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Abstract

Most households in the study area in which this research was conducted basically rely on groundwater sources as their only source of water to meet their ever-growing water demand. This calls for a study of the quality of water from these sources. Thirty (30) water samples, consisting of ten each, for boreholes, wells and sachet water within the study area had their physico-chemical parameters assessed. The laboratory results obtained were compared with standard limit specified by World Health Organization (WHO). The results of the physico-chemical tests conducted on the water sample indicated that well and boreholes samples have their pH values far below the WHO standard range as the samples from these two sources were slightly acidic with pH values of 5.85 and 5.70, respectively. The TDS for well water was found to be 607.56mg/L above the standard WHO value. The total hardness arising from the calcium and magnesium salt/ions contents of the three water samples were found to be 185.11mg/L, 200mg/L and 11.36mg/L for borehole, well and sachet water respectively. These values were for below WHO set values. All other analyzed parameters were within the permissible limit given by the WHO. It is recommended that water from borehole and well sources in the settlements should be treated to minimize possible incidence of waterborne diseases.

Keywords: **Water quality, Physico-chemical parameter, WHO, Waterborne diseases, Groundwater samples.**

Introduction

Water plays a vital role in the existence of life and various sector of the economy such as agriculture, livestock production, forestry, industrial power generation, fisheries and other creative activities. Therefore, the need for routine quality assessment of this natural resources has become a sine qua non. Water quality is a description of chemical, physical and biological characteristics of water in connection with intended use(s) and a set of standards (Khalil *et al.*, 2011). The quality of water sources deteriorates due to point source and non-point source pollution (Deepika, 2015). Point source pollution includes industrial effluents and discharges from municipal waste water treatment plant while nonpoint source pollution includes agricultural runoff, seepage of septic tank effluents into ground water, indiscriminate dumping of wastes into streams and rivers among others (Deepika, 2015).

The rising pace of Urbanization characterized by high population concentration, increased industrial and agricultural activities has exerted enormous pressure on the provision of safe drinking water. (Oria-Usifo *et al.,* 2018).

In this settlement, a significant percentage of the populace still practice random waste disposal as well as indiscriminate disposal of faeces and excreter in the stream and river channels as well as their tributaries and this is very worrisome. The risk of underground water pollution in the study area is compounded by incidences of reoccurring flooding. During flooding, bowels of septic tanks/toilets and rivers containing all manners of dirt are poured into the environment thereby deteriorating the water resources and containing the environment.

Polluted waters, when consumed, may lead to variety of water-borne diseases such as cholera, typhoid, dysentery, skin and mental disorders. The quality of groundwater resource depends on the management of human waste as well as the natural physico-chemical characteristics of the catchment area, while the availability of the portable water is indispensable feature for preventing disease and improving the quality of life (Kolo *et al.,* 2009).

2.1 Materials and Methods

Study Area

Unguwar Baballe and Unguwar Salele are both rural settlements situated at approximately 3km south of the location of the Secretariat of Danmusa Local Government Area in Katsina State. Two ponds or tafkis namely Danmagaji and Jagulau exist in the ancient agrarian settlements. The sources of drinking water available to be inhabitants are boreholes, and wells.

2.2 Sample Collection

A total of (30) thirty water samples sourced from the borehole, well and packaged or sachet water were randomly collected from the study area. Sachet water samples were included for comparison purpose. Each sample was collected in a one-litre clean polyethylene bottle and transported to the laboratory for chemical analysis at the Department of Chemistry, Federal College of Education, Katsina within two hours of collection. The samples were corked and then placed in a dark cupboard at a constant room temperature (30^{o}c) to avoid contamination as well as to avoid light effects on the parameters to be considered for study in the water samples.

2.3 Sample Analysis

The samples were analyzed for nine parameters which included pH, total dissolved solids (TDS), calcium, magnesium, total hardness, turbidity, sulphates, chlorides and nitrates using the standard procedures recommended in guidelines for water quality monitoring as described by (Maushkar, 2007). The pH was assessed by electrometric method using pH meter (Hanna H19813 Grocheck meter), TDS was measured using gravimetric method, turbidity was assessed using nephelometer, hardness, calcium and magnesium were assessed using EDTA titrimetric method and sulphate was detected by turbidometric method using turbidity meter (XINRUI, WGZ-B scattered light turbid meter). Chloride determination was carried out by Argentiometric titration while nitrate was detected using Colorimetric method. All the instruments were calibrated according to the manufacturer's specification.

2.4 Statistical Treatment of Data

The data were statistically analyzed using descriptive analysis and correlation analysis to see significant relationships between the water quality parameters. The results obtained were also compared with the threshold recommended by the World Health Organisation (WHO).

3.0 Results and Discussion

The mean values of the physico-chemical parameters of the various drinking water samples from the studied location are presented in Table 1 and Figure 2.

Table 1. Mean physicochemical parameters of water samples in the studied underground water sources

S/N	Parameter	Borehole	Well	Sachet water	WHO standard
1)	Sulphate (mg/l)	21.15	26.14	4.11	400
2)	Nitrate (mg/l)	15.81	22.15	5.31	100
3)	Chloride (mg/l)	120.51	140.17	58.22	250
4)	Calcium (mg/l)	60.12	80.00	5.95	200
5)	Magnesium (mg\l)	8.66	7.35	4.00	150
6)	Total hardness (mg/l)	185.11	200.00	11.36	200
7)	TDS (mg/l)	100.51	607.56	70.75	500
8)	Turbidity (NTU)	1.51	1.01	2.10	5
9)	pH	5.70	5.85	6.70	6.5 - 8.5

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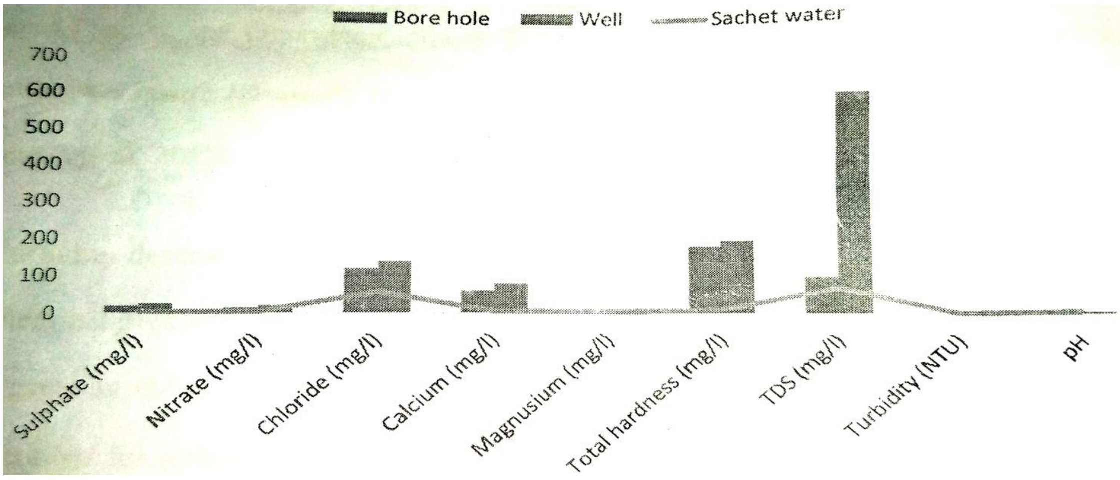

Figure 2: Chart showing the variation of the physico-chemical parameters in the water samples.

The mean values of the physico-chemical parameters of the studied water samples are presented in Table 1. The mean pH values of the different samples ranged from 5.70 in bore hole to 6.70 in sachet water. Though the mean pH value for sachet water sample falls within the standard maximum permissible limit set by WHO (WHO, 2011), the values for borehole water and well water samples with slightly acidic mean pH value of 5.70 and 5.85, respectively, however fall below the minimum value of 6.5 set by WHO. The low pH value observed in well and borehole samples may be attributed to several factors such as percolating carbon-dioxide charged meteoric water that produced weak carbonic acid.

Turbidity describes the cloudiness of water caused by suspended particles such as clay and silts, chemical precipitates such as manganese and iron, and organic particles such as plant debris and organisms (Musa *et al.,* 2018). It is the measure of relative clarity of water. The mean values recorded for turbidity ranged between 1.01 NTU in well water samples and 2.10 NTU in sachet water samples. The mean values recorded for all the samples fall below set standard, 5 NTU (Nephelometric Turbidity Unit) (WHO, 2011). It also implies that the turbidity of the sampled water is invisible to the naked eye because turbidities below 4 NTU can only be detected by instruments; however, at 4 NTU and above, a milkywhite, muddy, red-brown or black suspension can be visible and can reduce the acceptability of drinking water (WHO, 2017).

Total dissolved solids (TDS) is a general indicator of the overall water quality and a measure of organic and inorganic materials dissolved in the water (Mandal and Nand, 2012). An increase in TDS value above the permissible limit may impart a bad odour or taste to drinking water and also causes scaling of pipes (Ackah et al. 2011). Thus, increased TDS in water sample reduces its portability. Mean TDS values observed in the different water samples were within the limit set by WHO standard with the exception of well water samples which had a higher value of 607.56 mg/l.

The mean values recorded for total hardness, calcium and magnesium ranged from 11.36 mg/l to 185.11 mg/l, 5.95 mg/l to 60.12 mg/l and 4.00 mg/l to 8.66 mg/, respectively. The values for these parameters fell below the WHO specifications. These para-meters reflect the nature of the geographical characteristic of the study area. Water samples with low magnesium has been linked to cardiovascular disease, high risk of motor neuronal disease, pregnancy disorders and pre-eclampsia while water with low calcium may be associated with higher risk of fracture in children (Balan *et al.*, 2012).

Ingestion of sulphate in large quantity has been linked to catharsis and gastrointestinal irritation (Balan *et al.*, 2012). Nitrate has been implicated in a number of health defects which include cancer, hypertension, increased infant mortality, CNS birth defect, diabetes, respiratory tract infection and changes in the immune system (Park, 2009). The concentration of sulphate ranges from 4.11 mg/l in sachet water to 26.14 mg/l in well water and nitrate ranged from 5.31 mg/l in sachet water to 22.15 mg/l in well. These values are still within the WHO specification for these parameters.

The presence of chloride in potable water is attributed to both natural and anthropogenic sources such as dissolution of salt deposits, the use of inorganic fertilizers, animal feeds, landfills chemical effluent from industries, sewage, refuse leachates and oil-well operations (Lathamani *et al.*, 2014). In this study, the chloride concentration was in the range of 58.22 mg/l in sachet water to 140.17 mg/l in well water which is still below WHO set standard.
To understand the variation of the parameters across the three water sources analyzed, a correlation analysis was carried out on the results obtained. The result of the analysis is presented in Table 2. The correlation coefficient of 0.57 was observed between borehole and well water. Likewise, a correlation coefficient of 0.52 was observed between sachet water and borehole. An excellent correlation coefficient of 0.82 exists between well water and sachet water. It implies that most sachet water factories operating within this locality may be getting their raw water from well water

Table 2: Correlation Matrix for Water Quality Parameters in the three water sources

	Borehole	**Well**	**Sachet Water**
Borehole	1		
Well	0.574588	1	
Sachet water	0.524525	0.824412619	1

Conclusion

The result of this research reveals that of the three samples studied, packaged (sachet), though deficient in calcium and magnesium, appears to be the best source of drinking water in the settlements. This could be attributed to better treatment of this sample before being packaged and sold to the populace. However, Water samples from boreholes and wells are slightly acidic, deficient in calcium and magnesium in addition to possessing high TDS (well water in this regard), thus may not be safe for human consumption without requisite chemical treatment.

Recommendations

1) It is recommended that further research be carried out periodically to ascertain the level of pollution of underground water in this location.
2) Also, the study of the possible presence of heavy metal (Ag, Hg, Sn, Pb, Cd, Cr), composition and content in the groundwater samples should be carried out.
3) There should be enforcement of environmental laws that will minimize indiscriminate waste disposal in order to mitigate flooding and likely pollution of underground water which serves as a major source of portable water in the studied area.
4) Investigate the presence of water contaminants like chemicals, such as farmland inorganic fertilizers/manure, microbial and radiological materials etc in other to assess the overall water quality.
5) Any further researches in the study area should be done continuously, for a longer period of times in order to obtain a set of data that will have a good reliability.

References

Ackah, M., Agyemang, O., Anim, A.K., Osei, J., Bentil, N.O. & Kpattah L. (2011). Assessment of groundwater quality for drinking and irrigation: The case study of Teiman-Oyarifa Community, Ga East Municipality. *Ghana Proceedings of the International Academy of Ecology and Environmental Sciences*.;1(3-4):186-194.

Balan, I.N., Shivakumar, M. & Kumar. P.D.M. (2012). An assessment of ground water quality using water quality index in Chennai, Tamil Nadu, India. Chronicles Young Scientists. 3(2):146-150.

Deepika, Singh S.K., (2015). Water quality index assessment of Bhalswa Lake, New Delhi, *Int. J. Adv. Res*.,3(5):1052-1059.

Khalil, B., Ouarda, T.B.M.I. & St-Hilaire, A. (2011). Estimation of water quality characteristics at ungauged sites using artificial neural networks and canonical correlation analysis. *J. Hydrology*. 405:277-287.

Kolo, B., Dibal, J.M., Ndakawa, 1. 1. (2009). Elemental Analysis of Tap and Borehole Waters in Maiduguri. Semi-Arid Region, Nigeria. *European Journal of Applied Sciences* I (2): 26-29.

Lathamani R. Janardhana MR, Suresha S (2014). Application of water quality index method to assess groundwater quality in Mysore city, Karnataka, India. *Inter. J. Innovative Res. Sci., Eng. Tech*.:3(5):501-508.

Mandal NS, Nand D (2014). Study of some physicochemical water quality parameters of karola river. West Bengal An attempt to estimate pollution status. *International Journal of Environmental Protection*.; 2(8):16-22.

Maushkar JM (2007). Guidelines for water quality monitoring. Central pollution control board (A government of India organization), Delhi.

Musa, D.M., Garba, Y. L., Yusuf, M. S. & Ishaq A. (2018). Assessment of Water Quality for Selected Boreholes and Sachets Water in Maigatari Town, Jigawa State, Nigeria. *Bayero Journal of Pure and Applied Sciences*, 11(2): 122-127

Oria-Usifo, E. E., Cole, N. O., Odiase, G. E., & lyeke, S. D (2018). Assessment of Borehole Water Quality in OredoMunicipality. *International Journal of Engineering Science Invention*. 7(10); 4-28

Park, K. (2009). Textbook of preventive and social medicine, 20th edition, BanarsidasBhanot publishers, Jabalpur, India.

World Health Organisation, (2017). Water Quality and Health- Review of Turbidity, Information for regulators and water suppliers. WHO.