GLOBAL JOURNAL OF BIO-SCIENCE AND BIOTECHNOLOGY

www.scienceandnature.org

ASSESSMENT OF GROUND WATER QUALITY OF SOME BOREHOLES IN WUKARI TOWNSHIP, TARABA STATE, NIGERIA

S. A. Akogwu, E.E. Goler, A.A. Ochefu & V.N. Awudu
Department of Biological Sciences, Kwararafa University P.M.B 1019 Wukari, Taraba State Nigeria
Corresponding author's email: adolesimeon@gmail.com

ABSTRACT
The study was conducted to examine the ground water quality of some boreholes in Wukari Township, Taraba State, Nigeria. 12 water samples were randomly collected from boreholes and analyzed for its pyhsico-chemical and microbial composition using standard methods for examination of water and waste water as described by America Public Health Association. Investigated parameters such as Temperature, P^H, conductivity, total suspended solid, nitrate, chloride, copper, fluoride, colour and turbidity conformed to the World Health Organization (WHO) standards for portable water. However, the water contains coliform bacteria and *E. coli* which has rendered the water unsafe for direct consumption. Therefore, there is need for appropriate treatment of water from these sources before consumption by the people to avoid the spread of water borne disease need to improved sanitation, personal hygiene and control of indiscriminant movement of animals are recommended to reduce the possible spread of waterborne disease pathogens.

KEYWORDS: Improved sanitation, personal hygiene, disease pathogens and portable water.

INTRODUCTION

Water is indispensable and also essential for life. Unfortunately quality drinking water has become scarce resources in many developing countries of the world. The quality of water for drinking has deteriorated because of the inadequacy of treatment plants, direct discharge of untreated sewage into rivers and inefficient management of the piped water distribution system (UNEP, 2001). Groundwater, which mostly originates from rain or snowmelt infiltrates through soils into subsurface aquifers, though usually purer than surface water because of the natural purification process which it undergoes while percolating through the soil, However, human activities especially production and disposal of industrial wastes and sewage systems alter and pollute the natural pure state of the water (Aturamu, 2012). Contaminants such as bacteria, viruses, heavy metals, nitrate and salt have polluted water supplies and are found to have harmful effect on human health (Geldreich, 1981). This was highlighted in Ethiopia where dental and skeletal flourosis became a serious health problem in Rift valley area after several years of drinking water from drilled wells (Reimann *et al.*, 2003). Similar case was reported in Bangladesh, where increase in natural levels of arsenic in groundwater was found to be causing harmful effects on the health of the population (Anawara *et al*., 2002). Several studies on ground water quality have been conducted in southern and Central Nigerian (Abimbola *et al*., 2002, Adekunle *et al.*, 2007, Akaahan *et al*., 2010, Emmanuel, 2011, Obasi *et al.*, 2001) and findings have shown that our water contain many impurities especially disease causing micro organism, also, harmful physical and chemical agents. Furthermore, isolated cases of cholera outbreak are reported periodically in national dailies in Nigeria. Therefore, to maintain a good health, water must be safe to drink and meet the local and international standard to taste, odour and appearance (WHO, 2006). In Wukari area, portable pipe borne water is rare; in fact less than 2% of the over 241,546 inhabitants in this local government area have access to intermittently supplied pipe borne water. Most homes in the area rely on hand dugged wells and boreholes to met their daily water needs; this has led to the annual increase in the number of wells sunk in Wukari area since it is believed that ground water is less polluted, because the water is filtered as it percolates down the ground. However, these wells are situated in towns and villages where there is indiscriminate dispersal of waste, animals like chicken, dogs and goats stray about and defecate arbiterally, hence, water from boreholes were investigated to evaluate the suitability of water use for domestic purpose and identify potential sources of contaminants. The result generated will also be used as baseline data for monitoring water quality and for advancing the health needs of the community.

MATERIALS & METHODS

Study Area

The study was conducted in Wukari situated on longitude 9º 47'E and latitude 7º 51'N in Taraba State, Northeastern Nigeria. The vegetation of the area is predominantly characteristics of savannah zone and with major climatic seasons of wet or rainy seasons, which starts in March or April, and ends in October and the dry season, and the dry season which starts in November and ends in March or April. Wukari covers an area of 4,308 square kilometers and with a population of about 241,546, a traditional state rich with various cultures, norms and value. Fishing,

farming and trading are the major occupation of the people.

Sample collection

A total of twelve (12) drinking water samples were randomly collected from boreholes in Wukari area for analysis between July and August 2013. The samples were taken in 2-litre polythene bottles, previously acid washed and rinsed with copious amount of distilled water in accordance with Rump (1999). Samples for bacteriological evaluation were collected in clean, sterile bottles of 200 ml capacity. All samples were then packed in ice-boxes and transported to laboratory for chemical and bacteriological analysis as described by APHA (1998). Immediately after sample collection, some onsite parameters were recorded. Temperature was measured with the help of mercury thermometer, p^H was determined using Suntex (TS-2 Ph meter). Electrical conductivity (EC) and total dissolve solids were measured using EC/TDS HACH (CO150 meter). Turbidity and colour were determined with HACH Data Logging Spectrometer (2010). Chloride, Nitrate, fluoride, copper and bacteriological evaluation were done in the laboratory using standard methods for the examination of water and waste water (APHA 1989).

RESULTS

Groundwater quality of boreholes in Wukari Township

The mean values of physicochemical parameters of boreholes are presented in table 1. The result indicates that Temperature ranged from 25.5- 27.4^0C, pH varied from 6.50-7.80 turbidity of sampled water ranged between 5.20-15.0 NTU. Conductivity of examined water ranged from 208-220 µS/cm, colour varied from 5.45-16.00TCU, The total dissolved solids of sampled water ranged from 205-787 *mg/L*, copper content of sample borehole was between 0.42 -1.05 *mg/L*, fluoride ranged from 0.54-1.05 *mg/L*, The chloride composition of sample was between 18.9-69.0 *mg/L*, while nitrate determined in sampled borehole ranged from 4.50-25.08 *mg/L*. The mean value of microbial contaminant is presented in table (2). Total coliform counts ranged from 13 to 30 in the 12 boreholes investigated. Faecal coliform count varied from 6 to 22, while total viable bacterial count ranged from 27 to 42 in the 12 boreholes sampled respectively.

TABLE 1: Mean value of Physico-Chemical parameter for borehole water in Wukari Township

Sample	Temp. (^{0}C)	PH	Turb. (NTU)	Conduct. (µS/cm)	Colour (TCU)	TDS *(mg/L)*	CU *(mg/L)*	F^- *(mg/L)*	CL^- *(mg/L)*	NO^-_3 *(mg/L)*
S1	25.2	6.90	11.5	350	5.45	420	0.07	0.81	70.5	8.95
S2	25.8	6.85	13.0	450	6.20	345	0.21	0.67	33.5	10.20
S3	26.2	7.20	15.0	280	7.00	205	0.10	0.97	69.0	4.50
S4	25.8	7.40	13.5	550	5.60	568	0.20	1.05	22.5	25.08
S5	25.9	6.70	9.5	208	7.50	145	0.66	0.54	77.5	9.00
S6	25.0	7.00	7.00	650	10.20	715	0.55	0.61	27.5	1.80
S7	26.4	6.50	10.0	600	16.00	580	0.95	0.73	29.0	24.20
S8	26.0	6.80	5.20	720	8.50	787	0.75	0.91	45.6	12.45
S9	26.0	7.60	5.50	430	11.50	335	0.67	0.56	57.0	6.20
S10	24.5	7.20	6.20	335	5.56	218	0.62	0.78	24.5	13.00
S11	27.4	6.75	5.20	485	9.85	305	0.87	0.89	18.9	8.35
S12	25.0	7.80	4.85	285	3.38	105	0.42	0.67	22.5	6.38

TABLE 2: Microbiological data for boreholes water in Wukari Township

Sample	Total Coliform (MPN/100Ml)	Faecal Coliform (MPN/100Ml)	Total Viable Bacterial Counts (CFU/Ml) $X10^7$
S1	24	07	42
S2	18	11	28
S3	16	04	32
S4	13	13	35
S5	19	09	41
S6	25	12	40
S7	27	22	44
S8	30	10	37
S9	18	14	27
S10	24	06	29
S11	19	11	30
S12	21	08	38

DISCUSSION

Physico-chemical parameter

The sampled wells have almost uniform temperature range of 24.5°C – 27.4°C, none of the water samples had temperature higher than 28°C which is the maximum allowable standard for drinking water by WHO (table 3).

A relative stable Ph range of 6.50 – 7.80 was recorded across the months sampled. p^H is one of the influencing parameter in chemical reaction within water. However, the observed pH is within the maximum acceptable limits for drinking water standards set by WHO. Similarly, turbidity

range of 5.20 to 15.0NTU recorded in ground water during this study was acceptable for consumption base on WHO guidelines for drinking water (table 3). Turbidity in water may be caused by particulate matter that may be present from soil around water sources; it also contributes to the aesthetics of the water. Electrical conductivity of between 208 to720 µS/cm was obtained from boreholes in Wukari area. EC of water is direct function of its dissolve mineral content, so high concentration of inorganic compound implies high EC of water as inorganic compound dissociates more in water than organic compound. Although the observed EC of water in this study was within the drinking water quality standard (table 3) colour is an important parameter that is indicative of the presence of soluble organic and inorganic substance. However, Colour range of 5.45-16.00 TCU obtained in ground water in Wukari area were found to be within the minimum and maximum allowable concentration of WHO for drinking water. Consequently, the mean copper concentration of water sampled in wukari area is between 0.42 -1.05 *mg/L*. Although, copper is one of the heavy metals that is known to be toxic to humans even at low concentration, however, observe copper level in sampled drinking in within the minimum and maximum permissible standards set by WHO. So also, fluoride concentration varied in the 12 wells sampled, with wells (5 and 9) having relatively low concentration of fluoride level of 0.54 *mg/L and* 0.56 *mg/L* respectively. Very low fluoride concentration (<0.5 *mg/L*) may result in dental crisis in children under the age of 7 (Okoye *et al.*, 2009), thus, the rural population in Wukari area may probably be at risk with respect to development of dental problem for this age group. Slightly high nitrate level of 25.08 *mg/L* and 24.20 *mg/L* were recorded in well (4 and7) respectively. Although the observed level of nitrate is not higher than the WHO permissible value for drinking water standard (Table 3).However, high level of nitrate in the areas may be associated with animal and human waste, open septic or sewage system and fertilization of farms considering the occupation of the populace who are mostly farmers.

Microbiological analyses

From the result above (table 2), it is obvious that boreholes in Wukari area are contaminated with micro organisms. The contamination of the sample may be as a result of location of boreholes where domestic animal stray and defecate around them, more so, the presence of pit latrines in some areas, which was invaded by floods during the rainy season may also distribute pathogens in to water sources, since flood water settles around the boreholes and gradually sinks in to the well via cracks and holes around the boreholes. These disease causing pathogens in the water can cause diarrhea, cramps, meningitis or other symptoms which may pose a special health risk for infants, young children and people with severely compromised immune system (Prescott *et al*., 2008).

TABLE 3: WHO (2006) standards for drinking water

Parameter acceptable(mg/L)	Minimum Concentration acceptable(mg/L)	Maximum. Concentration
Temperature (^{0}C)	-	28
PH	6 7.0-8.5	6.5-9.2
Turbidity (NTU)	5	25
Conductivity (µS/cm)	-	1500
Colour (TCU)	5	50
TDS (*mg/L)*	500	1500
Copper (*mg/L)*	1.0	2.0
Flouride (*mg/L)*	1.0	1.5
Chloride (*mg/L)*	200	600
Nitrate (*mg/L)*	-	45
Total coliform (MPN/100Ml)	0	0
Faecal coliform (MPN/100Ml)	0	0
Total viable bacteria counts (CFU/Ml) X10^7	0	0

CONCLUSION

The study revealed that investigated parameter such as p^H, temperature, turbidity, conductivity, total dissolve solids, fluoride, chloride, copper and nitrate were within the maximum permissible limit prescribed by WHO for portable water. However, boreholes contain coliform and faecal bacterial which render it unsafe to be consumed directly. This may be responsible for high cases of typhoid fever disease recorded in the area. However, the ground water can be made completely portable by scientific treatment through filtration, chlorination and boiling. This study therefore recommends regular water quality test of boreholes in Wukari area to determine which borehole water meet standard for drinking water quality.

REFERENCES

Abimbola, A.F., Odukoya, A.M. and Adesanya, O.K. (2002) The environmental Impact assessment of waste disposal site on ground water in Oke, Ado and Lagos, southwestern Nigeria. Proceedings 15th Annual conference Nigerian Association of Hydrogeologists Kaduna, Nigeria, 42pp.

Adekunle, I. M., Arowolo, T.A., Ndahi, N.P., Bello, B. and Owolabi, D.A. (2007) Chemical characteristics of humic acids relations to lead, copper and cadmium levels in contaminated soil of South west Nigeria. *Annals of environmental sciences*, vol. (1), 2334.

Akaahan, T. J., Oluma, H.O.A. and Sha'Ato, R. (2010). Physicochemical and bacteriological quality of water from shallow wells in two rural communities in Benue State. *Pak. J. Anal. Environ. Chem*. Vol. 11, (1), 73-78

American Public Health Association (1998) *Standard Methods for the Examination of water and wastewater*, 20th edition, APHA, Washington D.C.

American Public Health Association (1989) *Standard Methods for the Examination of water and wastewater*, 17th edition, APHA, Washington D.C.

Aturama, A.O. (2012) Physical, chemical and bacterial analyses of groundwater in Ikere Township, Southern Nigeria. *International journal of science and technology*. Vol.11 (5) 301-308.

Anawara, H. M., Akaib, J., Mostofac, K.M.G., Safiullahds, Tereqd, S.M. (2002) Arsenic Poisoning in groundwater health risk and geochemical sources in Bangladish. Environ. Int. 27:577-604

Reimann, C., Bjorvatn, K., Frengstad, B., Melaku, Z., Tekle-Hamanot, R. and Sewers U. (2003) The science of the total environment.361:65

Okoye, C.O.B and Nyiatagher, T.D. (2009) Bulletin of the chemical society, Ethiopia 23:123.

Emmanuel, S. A. (2011) Ground water quality assessment of some sampled boreholes in five rural communities of Misau local government area of Bauchi State, Nigeria. *International Journal of Environmental Issues Vol.8No.2.*

Geldreich (1981) *E. coli* detection from river water. Environmental science publication.Springer Netherlands journal, Vol. 43, pp 139-145.

Obasi R.A. and Balogun, O. (2001) Water quality and Environmental impact Assessment of water resources in Nigeria. *African Journal of Environmental Studies*, 2(2), 228-231.

Prescott, M.L., Harley, J.P. and Klein, D.A. (2008) *Microbiology*. New York: Mc Graw Hill publication.

Rump, H.H. (1999) Laboratory manual for examination of water, waste water and soil.Wiley, Newyork

UNEP (2001) State of the environment Nepal. United Nations Environment Program in collaboration with ICIMOD and NORAD

WHO (2006). Guidelines for drinking water quality. First addendum to 3rd ed. Vol. 1. Geneva. WHO press, P515.

WHO (2008) Guidelines for drinking-water quality, electronic resource: incorporating 1st and 2nd adgenda, Vol.1, Recommendations. 3rd ed. Geneva.