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PHYSICOCHEMICAL QUALITY OF GROUNDWATER SOURCES IN SELECTED COMMUNITIES OF LAFIA LOCAL GOVERNMENT OF NORTH CENTRAL, NIGERIA.

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ABSTRACT

The samples of boreholes and well waters were collected from Shabu, Ombi and Akunza communities in Lafia Local government of Nasarawa State in North central. The samples were analyzed physiochemical using standard method to ascertain the portability of these sources of water (A total of six groundwater samples comprising of three wells and three boreholes were monitored). Result from this study revealed that 85% of the physicochemical parameter investigated conformed to WHO standard for drinking water while 15% showed a little deviation. It was therefore recommended that a comprehensive survey that will involve both the physicochemical and bacteriological analysis be conducted on all the sources of groundwater available in all the villages where most study reside. The medical records of the students in relation to the source of water intake should also be conducted in order to compliment the result of this study.

Keyword: *Groundwater, Environmental Health, Physicochemical.*

INTRODUCTION

Water in adequate supply and quality is necessary for everyday life. The largest available source of fresh water lies underground and is referred to as ground-water[7].Groundwater accounts for 98% of the world fresh water[12, 11]and provides a reasonably constant supply that is not likely to dry up under natural conditions, as surface sources may do[21]. The quality of groundwater is the resultant of all the processes and reactions that have acted on the water from the moment it was condensed in the atmosphere to the time it is discharged by a well or boreholes.The chemical composition of surface and ground water varies considerably depending on the nature of the water body and its locations [13]. The quality required of ground water supply depends on its purpose [8, 24]. The basic purposes for which water is domestically required includes drinking, bathing, cooking, sediment, fishing and general sanitation such as laundry, flushing of closets and other household chores [3, 22].

The post-independence era in Nigeria has witnessed a series of political and socio-economical developments. Today, the nation comprises of thirty-six states and a federal capital territory and have over ninety-six universities in comparison with the initial four regions at independence in 1960. Over the years, there has been a considerable growth in the awareness of environmental pollution problems and it has become a major national and international issue.

One of these major pollution problems is water pollution. Poor drinking water quality has been identified as one of the major causes of health problems in developing countries. The basic physiological requirements for drinking water as stipulated by World Health Organization (WHO) is about two liters of water per head per day and a daily supply of one hundred and fifty to two hundred liters cannot be met by majority of the developing countries like Nigeria[1]. Indeed, the World Health Organization has estimated that approximately 80% of all illness in the world is attributed to bad water supply and poor sanitation. This percentage includes about 10-20million children who die each year of diseases associated with diarrhea[20]. Water is often being referred to as the universal solvent. Yet man's assessment of the value of water is very low until he finds himself without it [6].

Developing countries carry a heavy burden of water related diseases because most residents use unhygienic source of water as their main source of drinking, laundry, washing and other related domestic uses. This has resulted into high cases of water borne diseases such as schistomiasis, onchocerciasis, guinea worms, cholera dysentery, typhoid fever, gastroenteritis and other parasitic infections[1]. However, access to safe drinking water and sanitation is crucial in terms of health especially for children. For instance, unsafe drinking water contributed to health problems in developing countries such as one billion or more incidents of diarrhea that occur annually[1]. Consequent to the realization of the potential health hazards that may result from contaminated drinking water from any source is therefore of primary importance because of the danger and risk of water borne diseases [14, 16].In 1976, Nigeria experienced the worst cholera epidemic recorded in its written history. The statistical bulletin published by the epidemiological unit, Ministry of Health, Western Nigeria (now Ekiti, Ogun, Ondo, Osun, Oyo states) recorded 14,158 suspected cases, out of 1,721 were confirmed and 609 of them died[2]. In Ethiopia, over 60% of communicable diseases are due purely to environmental health conditions arising from unsafe and inadequate water supply and poor hygienic sanitation practices [1]. In fact, due to inadequate supply of pipe-borne water in villages, town and cities in Nigeria, many people have been sourcing their daily water needs from wells or boreholes and streams. Although the standards vary from place to place, the objective anywhere is to reduce the possibility of spreading water borne diseases to the barest minimum in addition to be pleasant to drink, which implies that it must be wholesome and palatable in all respect[14]. A good knowledge of the physiochemical and bacteriological qualities of source of water in these communities is necessary so as to guide its suitability and safety for use. The lack of sufficient pipe-borne water supply in these selected communities initiated this study, so as to investigate the suitability of the available groundwater for domestic purpose use.

MATERIALS AND METHODS

Shabu, Ombi and Akunza are part of the communities in lafia state capital of Nasarawa state, North central Nigeria. In this region there were two main seasons, the rainy season from April to October and the dry season from November to March. During the rainy season, the rains are heavy, and the average air temperature is about 29°C with a range of less than 20°C. There is sunlight daily, although its intensity is reduced considerably during a few month in the rainy season. The population of people living within Shabu, Ombi and Akunza is estimated to be between twenty-seven to thirty thousands 85 percent of it are mainly students and staff of Nasarawa state college of Agriculture, Polytechnic and Federal University of Lafia. The population is expected to increase to about thirty-three to thirty-six in the next five year due to the rapid development that is going on. Most of these populace suffer from the shortage and non-availability of pipe borne water supply which have forced most of these communities inhabitants to use wells, boreholes and Shabu stream as their main domestic source of water supply. The following are the main source of water supply in these selected communities:

i. The borehole within the College of Agriculture (Source A, CBW)
ii. Shabu borehole (Source B, SBW)

iii. A borehole located within Ombi student village called fatabolous water (Source C, OBW)
iv. A borehole in the University premises, Akunza (Source D, UBW)
v. A borehole in polytechnic borehole (Source E, PBW)
vi. Shabu well water (Source F, SWW).

Water Sampling and Analyses

Samples were collected from the six identified sources of groundwater supply in these communities. The sampling was carried out bimonthly for three months between the hours of 6am to 6pm, when the pumping machine is just switched on to allow for uniform mixture of the water samples for all the boreholes samples. The grab method was used for the well samples[1]. All the samples were collected in a labeled white plastic containers that were thoroughly rinsed out thrice prior to sample collection. The samples were subsequent kept in the refrigerator and moved to the laboratory for analysis.

Physical parameters such as colour and odour were determined by direct observation. Analytical methods were according to "Standard Methods for Examination of Water and Wastewater"[4]. pH and conductivity were determined in-situ using a BNCpH meter and conductivity meter (WTW L95 model), respectively. Dissolved solids, total alkalinity, total hardness were done by titrimetry[5]. The total Iron and trace metal were determined using the Atomic Absorption Spectrophotometer after samples were digested with concentrated Trioxonitrate(V) acid and the volume made up to 60ml with distilled water.

RESULTS AND DISCUSSION

The mean for the three months analytical results of the physicochemical parameters and trace metals of the six water samples are as shown in Table1.0 and 2.0 respectively. In the six sources studied, the mean level of all the organoleptic and some of the physical parameters were determined are within the desirable levels for drinking water as recommended by World Health Organization,[27]. The mean level of hardness, total solid, conductivity, chloride and alkalinity for source E (PBW) are above the highest tolerable levels for drinking water, while the mean level of hardness and alkalinity for four other samples are considerably good for human consumption.

This high value observed in source E, could be attributed to the presence of dissolved Calcium and magnesium which are both present in high quantity when compared with other samples analyzed. In the same vein, the high mean value of alkalinity observed in this sample (Source E) showed that it possessed a high amount of dissolved carbonate and bicarbonate salt. PBW samples showed a high increase in the chloride value (247.8mg/l) as against that of the WHO's standard value(247.8mg/l). This implies that it contains more dissolved chloride materials like Iron (III) chloride salt which might have arisen as a result of the drawer (metal rusting drawer) used in drawing water from the well. Though UBW samples also showed a remarkable high value but since the value is lesser than that of WHO's standard, it indicates that the water sample is still of good quality All the six water samples analyzed contain various dissolved metals which could be attributed to much enhance water-soil interaction resulting in the dissolution of the geological medium, but their mean values are minimal and tolerable when compared with WHO's standard.

Ca^{2+} and Mg^{2+} values are higher for all samples when compared with other metals determined. This is expected because Ca^{2+} and Mg^{2+} are usually released into groundwater by the dissolution of feldspars and micas[15].
The high iron content and its wide distribution throughout the sampling points (all samples) reflect what has been reported regarding its presence at high concentration in Nigeria soils[7, 18]. Iron is one of the essential components of haemoglobin which is responsible for the transport of oxygen in the body. Iron also facilitates the oxidation of carbohydrates, proteins and fats. It therefore contributes significantly to the prevention of anaemia, which is spreading wide especially in developing countries like Nigeria[8]. The iron contents in all the water sample are higher than WHO\ USEPA guideline value ($0.30mgL^{-1}$) for drinking water [26 ,28]. This is not acceptable to the consumers, but could give rise to iron-dependent bacteria which in turn can cause further deterioration in the quality of water by the production of slimes or objectionable colour. The result obtained may be due to run-offs geological formation of sample area. Some methods of aeration can remove or reduce iron level through simple chemical reaction [23].

Comparison of the mean concentration of the metals in well and borehole samples with WHO guidelines value for drinking water shows compliance with Mg, Ca, Cd, Ld, Ni, and Cr (Table 2.0). However, because a metal concentration in the aquatic environment is low and considered to be naturally occurring or background; does not mean that the concentration could not cause adverse ecological effects [23]. The presence of one metal can significantly affect the impact that another metal may have on an organism. The effect can be synergistic, additive or antagonistic [13].

CONCLUSION

From this study, the physicochemical parameters results revealed that all the six samples examined are within the tolerable level for human consumption except source E. But since the coli form counts were not determined, it cannot be categorically said that the water samples are free from pathogenic organism which in most cases determines the microbiological quality of water. The primary health care of the local government lack well organized environmental health unit to monitor the quality of drinkable water; It is therefore, seriously suggested that It was therefore recommended that a comprehensive survey that will involve both the physicochemical and bacteriological analysis be conducted on all the sources of groundwater available in all the villages where most students reside. The medical records of the students in relation to the source of water intake should also be conducted in order to compliment the result of this study. Lastly health awareness (education) on conventional methods of water treatment should be embarked upon so that people can manage their source of water effectively.

REFERENCES

1. Ademoroti, C.M. A.(1996). Environmental Chemistry and Toxicology, Foludex press Ltd: Ibadan Nigeria. p 20-30.

2. Ademoroti, C.M. A.(1979). Studies on physicochemical methods of wastewater.Unpublished Ph.D Thesis, University of London.

3. Anzene, S.J.; Aremu, M.O (2007). Quality and antiseptic properties assessment of indigenous black soap produced in Nasarawa State, Nigeria. *j. Eng. & Appl. Sci*2(8): 1297-1300.

4. American Public Health Association(APHA), (1992).*Standard Method for the Examination of water and wastewater* 18th ed. Washington D.C

5. American Water Works Association and water pollution control federation, 1995. *Standard Method for the Examination of water and*

wastewater 19[th]edn. American Public Health Association (APHA) New York..

6. Aremu, M.O. (2008). Environmental pollution by toxic heavy metals and its possible abatement for developing a healthy ecosystem. In: *Environment, Health and Nutrition*: aGlobal perspective, APH Publishing Inc. New Delhi, India, Eds, Basu, S.K and DattaBanik(in press).

5 10.Ariyo, S. O.; Adeyemi, G.O.; Odukoya, A. M. (2005). Geochemical characterization of aquifers in the basement complex sediment transition zone around Ishara, southwestern Nigeria. *Water Res. J. Nigeria Assoc. Hydrogeologists.,* 16: 31- 38.

6. Asuquo, F. E. (1999). Physiochemical Characteristics and anthropogenic pollution of the surface water of Calabar River, Nigeria. *J. Pure &Apple .Sci*5(4): 595-600.

7. Ayejuyo, O.O.; Oluwu, R. A.; Megwa, K. C.; Denloye, A. A. B.; Owodehinde, F.G. 2003. Trace metals in *Clariaslazera,* water and sediments from Majidun River, Ikorodu, Nigeria. *Res. Commun. Fisheries,* 1: 27-31.

8. Bender, A. (1992). Meat and meat products in human nutrition in developing countries. FAO Food and Nutrition Paper 53, Rome, Italy, 46- 47.

9. Bouwer, H. (2002). Artificial recharge of groundwater: Hydrology and Engineering. *Hydrology j.,* 10(1): 121-142.

10. Buchanan, T.J. 1983. International Water Technology Conference and Exposition (AUGA Expo 83) Acapulco, Mexico.

11. Cheesbrough, M.(2004). District Laboratory Practice in Tropical Countries. 108.

12. Edema, M. O.; Omemu, A. M and Fapetu, O. M. 2001. Microbiology and Physicochemical Analysis of different sources of drinking water in Abeokuta, Nigeria. Nigeria Journal of Microbiology **15(1):** 57- 61

13.Eisler, R. (1993).Zinc harzard to fish, wildlife and invertebrates': A Synoptic Review. U.S. Fish and wildlife service, biological report 10. Publication unit USFWS. Washington. D.C 20240.

14.Fapetu, O. M. (2000). Comparative Analysis of different Sources of drinking water in Abeokuta South LGA, Ogun State. B.Sc Thesis UNAAB, Abeokuta 44

15. Freeze, R.A. and Cherry, J.A, (1979): Groundwater. Prentice-Hall, Inc. New Jersey.

16. Kakulu, S. E.; Osibanjo, O. (1988). Trace heavy metal pollutional status in sediment of the Niger Delta Area of Nigeria. *J. Chem. Soc. Nig.,* 13: 9-15

17. Mark,W R., XimingCai and Sarah, A.C.(2002). World water and food to 2025; Dealing with scarcity, International Food Policy, Research Institute, NW, Washington DC, USA,

18. Morrison, A. (1983): ''In Third World Villages. A Simple Recreation in National Streams'' Transactions of the America society of Civil Engr., 153,641.

19.Ofoma, A.E.; Omologbe, D.A.; Aigberuna, P. (2005). Physico-chemical quality of groundwater in parts of Port-Harcourt city, eastern Niger Delta, Nigeria. *Water Res. J Nigeria Assoc. Hydrogeologists.,* **16:** 18-24.

20. Ogunawo, C. O. (2004). Coping with domestic water supply problems in Nigeria Urban Centers, The Ijebu-Ode City experience. *Int. J. Env. Issues,* 7(1&2): 21-25.

21.Okedi, C.; Oni, O.O (1997). Basic Water Treatment Operations, edited by outreach department, Published by National Water Resources Istitute, Kaduna, 190.

22.Todd, D.K 1984. Groundwater Hydrology.2nd. *John Wiley and Sons*, New York. 267-312.

23. US Environmental protection Agency, (1992). Interim guidance on interpretation and implementation of aquaticlife criteria for metals. (USEPA, Health and Ecological Criteria Division, Office of science and Technology)

24.. US Environmental protection Agency, (2002). Current drinking water standards (Office of groundwater drinking water. Government printing office; Washington DC).

25. World Health Oorganisation (1984): Guidelines for drinking water quality, health criteria and other supporting information. World Health Organization, Volume 1, Geneva pp 130.

26. World Health Organisation, (WHO), 1993. Guidelines for Drinking Water Quality, 3rd Edition, vol. 1, Geneva.

Table 1.0: Physico-Chemical Characteristics of Water Sample Analysed.

Parameter	CBW	SBW	OBW	UBW	PBW	SWW	Range	WHO's standard
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	-	-
Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	-	-
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	-	-
PH	7.10±0.5	7.40±0.2	7.60±0.2	8.10±0.1	7.90±0.5	8.10±0.6	7.10-8.10	6.5- 8.5
TDS (mg/l)	117.7±4.6	280.50±3.4	346.4±2.7	287.6±9.8	392.8±12.6	219.6±4.2	117.7-392.5	2,000
TS (mg/l)	221.6±10.12	145.6±8.4	167.4±9.6	357.5±10.4	891.2±22.1	689.1±16.6	145.6-891.2	500
Temp (^{o}C)	28.2±0.3	29.4±0.6	24.9±0.8	29.5±0.3	26.6±0.4	27.9±0.22	4.9-29.4	<40
Alkalinity (mg/l)	48.0±12.3	141.2±8.4	106.7±70.6	61.0±41.2	263.6±89.7	59.6±12.8	48.0- 263.6	200
Conductivity (μs/cm)	369.0±4.8	431.6±8.8	296.8±6.2	367.9±68.3	689.7±51.3	305.1±45.8	296.8-431.6	-
Total hardness (mg/l)	45.3±0.6	53.2±0.2	38.4±4.8	29.1±3.6	130.0±4.7	148.6±6.8	29.1-53.2	100
Nitrate (mg/l)	9.6±8.9	12.7±2.4	6.3±1.7	18.7±2.2	15.5±2.0	10.1±2.6	9.6-25.1	45
Chloride (mg/l)	91.6±12.3	54.4±16.2	89.7±6.8	105.1±12.4	247.8±17.5	65.7±10.75	4.4-247.8	200
Sulphate(mg/l)	42.6±7.2	8.9±0.5 3	8.6±10.2	53.8±13.6.	62.6±4.9	29.0±6.2	8.9-62.6	200

Table 2.0: Trace Metals Content(mg/l) of Water Samples Analysed

Metal(mg/l)	CBW	SBW	OBW	UPW	SBW	SWW	WHO STANDARD
Lead	0.008	0.006	0.04	0.01	0.05	0.012	0.01
Cadmium	0.0003	0.0002	0.0006	0.0001	0.0008	0.0004	-
Iron	0.03	0.06	0.04	0.08	0.06	0.07	0.3
Magnesium	22.4	20.2	12.6	28.5	19.7	23.6	30
Calcium	19.6	8.9	16.4	12.3	22.8	30.0	45
Chromium	Nd	nd	nd	nd	nd	Nd	nd
Nickel	Na	na	na	na	na	Na	na