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Contaminant evaluation of major drinking water sources (boreholes water) in Lapai metropolis

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ABSTRACT

Borehole water samples were collected from seven major locations covering an area of about 3,051km^2 around Lapai metropolis in Niger State north-central Nigeria to evaluate its quality for household and human drinking purposes. The area covered falls within longitude 9°03'N and latitude 9°34'E. After each sample was collected, in-situ measurements were made for conductivity, pH, and temperature using Sension Platinum Series portable pH and Conductivity meter (HACH made). The results indicated that the values of pH in borehole BH1 and BH4 were found to be 4.6 and 4.4 against the value recommended by the FEPA, 1998 and WHO, 1992 of 6.5 to 9, thus were very acidic due to dissolved minerals as a result of leaching or corrosion of sink pipes. The pH values for BH2, BH3, BH5, and BH6 were 6.5 while BH7was 6.6 indicating that they were recommended for consuming. The conductivity values obtained were very low compared to the WHO 1992, 1993, 1996 and 1998 in the order of BH2< BH1<BH7<BH5. Meanwhile the value obtained from the boreholes BH4 and BH6 were higher above recommended value of 160µs/cm. However, the toxic and nutritive trace metals analyzed using Atomic Absorption Spectrophotometric (AAS) from all the boreholes were very much low compared to FEPA, 1998 and WHO, 1992, 1993, 1996 and 1998.

Key Words: Atomic Adsorption Spectrophotometric, NIS, WHO, FEPA, USEPA, Conductivity, pH and Borehole water.

INTRODUCTION

Water is one of the most common yet the most precious resources on earth without which there would be no life on earth [25]. Lapai is a Local Government Area in Niger State, Nigeria, adjoining the Federal Capital Territory. It has an area of 3,051 km² and a population of 110,127 at the 2006 census. The area is roughly coterminous with the Lapai Emirate. The inhabitants of Lapai located at latitude 9°03′00″N and longitude 6°34′00″E and its environs depend solely on; spring water, running stream water, private and general boreholes water for drinking and other house hold usages. Thus, water around this locality should be properly checked [22, 23] with utmost care since trace metals concentration by way of infiltration, migration, direct (accident) or indirect introduction to the water table or groundwater of high level may directly leads to death [13].

Water contamination with trace metals can be related to polluted water infiltrating through soil, rock and eventually reaching the groundwater [9]. This process might take many years and might take place at a far distance from the drinking or fetching source where the contamination is found [8]. Once the water is contaminated, it becomes very difficult to remediate it. However, research of this nature will strictly reveal the state, nature and condition of the surface and groundwater which might serve as a control measures for today and future recommendation in Lapai metropolis.

Several researchers have attempted to ascertain the total burden of water born diseases world-wide in association with high or low level contaminants [24]. Wheather [7] reported a total number of 1.4 billion annual report episode of diarrhoea in children less than five years of age with an estimation of 4.9 million children dying as a result. While [6] estimated that water, sanitation and hygiene was responsible for 4.0% of all deaths and 5.7% of the total disease burden occurring world-wide accounting for diarrhoea disease, schistosomiasis, trachoma, ascariasis, trchuriasis, and hookworm diseases. The second part of this work shall extend to the microbial level of contaminant around borehole water sources in Lapai metropolis.

Lapai and its environs where a large part of the population does not have access to a safe Government provided drinking water, a substantial number of these infections might result; indeed [5] estimated that water-borne disease might account for one-third of the interstitial infections world-wide.

Generally, surface and underground water quality is usually based on several factors such as; influx of industrial effluent, influx of water through rainfall, soil, agricultural pattern etc. Therefore, we can say that by these factors, the underground water quality varies qualitatively, quantitatively and depend imperatively on the savanna soil type [4]. We can have both trace elements and heavy metal available in the soil that are washed to the groundwater or infiltrated to the surface water that are very dangerous to our health. Lead and other heavy metals contamination of water is another aspect attention should be focus on [22] since they are related to blood poisoning resulting into broad health effects such as inhibition of biosynthesis of hemoglobin, anemia, stomatitis, ulcer, abnormal body movement and reflexes, peripheral neurological effect, peripheral neuropathy, polyneuritis, brain damage, reduced neuropsychological functioning and brain tumour with serious symptoms like joint pain, dizziness, headache, loss of appetite, constipation, abdominal colic paralysis and death [2, 14]. The contamination of water with lead (Pb) has occasionally arisen as a result of the use of bad pipes, lead – glazed tanks, metallic lead containers, atmospheric pollution or by addition of water purifying chemicals during water purification [3]. Experimental data has shown that lead in small quantity catalyses catabolic process and in significant amount is poisonous [3]. The Federal Environmental Protection Agency, Nigeria [19] has set standard and desirable limits of some toxic metals and quality criteria for domestic water supplies as shown in Table 1.

Lead (Pb) occurs in the air a particulate matter and eventually gets into the atmosphere during the smelting process in industries, and also through exhaust emission from motorized vehicles [12]. In Lapia, people collect water from surface sources, shallow wells and boreholes.

Table 1: Water Quality Criteria, Domestic Water Supplies

S/N	Substance	Permissible criteria (mg/L)	Desi Desirable criteria (mg/L)
1	Arsenic (As)*	0.05	Absent
2	Calcium (Ca)	20	-
3	Cadmium (Cd)**	0.01	Absent
4	Chromium(Cr)* (hexavalent)	0.05	Absent
5	Copper (Cu)	1.5	Virtually absent
6	Iron (Total Fe)	Less than 0.3	Virtually absent
7	Lead (Pb)*	Less than 0.5	Absent
8	Magnesium (Mg)	150	150
9	Manganese (Mn)	Less than 0.5	Absent
10	Mercury (Total Hg)	0.0001	Absent
11	Selenium (Se)*	0.01	Absent
12	Zinc (Zn)	15	5
13	Ammonium (NH_3)	0.5	Less than 0.1
14	Anionic detergent	1	Absent
15	Chloride (Cl^-)*	2.5	Less than 2.0
16	Cyanide (CN^-)*	0.5	Absent
17	Flouride (F^-)**	0.9-1.7	1
18	Mineral oil	0.3	-
19	Nitrate (NO_3)**	45	-
20	Total nitrogen (exclusion of NO_3)	-	1
21	Phenol*	0.002	-
22	Plynuclear aromatic hydrocarbon	400	-
23	Sulphate (SO_4^{-2})	-	-
24	Radionuclides-gross X acitivity	-	3 pC/l
25	Coliform bacteria	-	30 pC/l
26	Biological Oxygen Demand	-	Not more than 10/1000cm3
27	Chemical Oxygen Demand	-	1-0.1
28	pH	6.5-9.2	-
29	Total hardness (CaCO3)	500	-
30	Total Dissolved Solids	1500	-

** Highly Toxic ** Hazardous to health*

Source: Report of the committee on protection of water criteria, Federal Environmental Protection Agency, Nigeria (1998)

The tap that where provided are mostly without water. Therefore majority of the populace rely heavily on untreated well-water and boreholes water amongst which the following problems were identified; water fetched from some of the boreholes have sharp taste/odour and when kept for some time, dark blueish colouration is seen with a slimy feeling on the surface of the container. Some of the streams and surface water around are unapproachable due to the presence of uncontrolled garbage disposal. The rural Hospital's out patient record shows an anomalous high prevalence of interstitial infections which is on the rise weekly. These problems have posed a serious challenge to us and we seek to tackle it using Beer's Larmbert Law base on Atomic absorption (Equation 1), portable digital pH meter, tension conductivity meter (perkin-Elmer model).

$$\text{Log}\ \frac{I_0}{I_t} = M\tau c \qquad (1)$$

where: I_o = *Intensity of incident light*, I_t = *Intensity of transmitted light, M= Molar absorptivity,* τ = *Thickness of medium and c = Concentration* Thus, the concentration and the logarithmic of the transmittance are proportional.

This study is aimed at investigating the contaminant level of borehole waters sources in Lapai and its environs. Atomic Absorption Spectrophotometric (AAS) method was used because of its simplicity and accuracy [21]. Though trace metals (heavy elements, minor elements, micro elements, or micronutrients) are sets of elements required in small amount [5] in water, air, soil, plants and animals (human). Some of these trace elements are important in nutrition of both plants and animals (human) such as; Zn, Cu, Mn, Ni, and V etc while others are very disastrous to nutrition of plants and animals such as; Pd, Cd, and Hg etc. Thus, as aimed in this paper, these trace metals obtained using Equation (2) from the water samples shall be grouped into nutritive quality and toxic quality.

$$\text{Metal concentration, } mg/l = A \times \frac{B}{C} \qquad (2)$$

where:
A = Concentration of metal in digested solution (mg/l)
B = Final volume of digested solution (ml)
C = Sample size

MATERIALS AND METHODS

2.1.1 Materials

Reagents and chemicals used in this work were of analytical grade. They were obtained from the National Research Institute of Chemical Technology, Basawa, Zaria Kaduna State of Nigeria. Atomic Absorption Spectrophotometer (AAS) equipped with lead hollowed cathode lamp, lamp current 10mA, wavelength 217.0nm, Band Pass 0.5nm with flame type consisting of Air/Acetylene and stochiometric fuel flow at 0.9 – 1.21min.

2.1.2 Sampling of water

Water samples were collected from seven boreholes where large mass of population visit every minute. These boreholes are distributed evenly throughout Lapai metropolis. The first sample labeled BH1 was collected at Banni Road Borehole and it provides water to a population of approximately 20,000 inhabitants. The second was collected at Bankogi Borehole labeled BH2 supplying water to approximately 15,000 people, the third collected at Ibrahim Badamasi Babangida University Hostel C labeled BH3 supplying the students in the hostel C (approximately 3,000), the fourth collected at Janary Road labeled BH4 supplying close to 5,000 people, the fifth water sample was collected at Low Cost quarters labeled BH5 supplying approximately 22,000 users, sixth sample obtained from Malle Raod labeled BH6 supplying close to 14,000 people and finally the seventh collected at Lapai main secretariat labeled BH7 supplying approximately 12,000 people. The samples were collected daily once at each location. An established, preservation and storage methodology were used to ensure that samples were of ground water quality. The samples were collected in polyethylene bottles (1.5 litres capacity) which had been thoroughly washed, and filled with distilled water, and then taken to the sampling site. The bottles were emptied and rinsed several time with the water to be collected. Also, the sample bottles were partially filled with the collected water and vigorously shaken to note the odour [1]. The sample bottles were tightly covered immediately after collection and an in-situ measurement were made for conductivity, pH, and temperature using Sension Platinum Series portable pH and Conductivity meter (HACH made). The water samples were then stored in a refrigerator at 4^0C (Haier Thermocool) to slow down bacterial and chemical reaction rates.

2.1.3 Sample Treatment

Digestion of the sample is one of the storage steps taken to preserve the samples from bacterial activities and to release metals into the analytical solution [10]. From each sample, $50cm^3$ was measured into an evaporating dish and $5cm^3$ of concentrated HNO_3 was added. The samples were digested for about 60 minutes using digestion block in a fume cupboard until the solution reduces to 5 – 6mls with a characteristic colour, indicating complete digestion. Each digest was then allowed to cool and transferred to a $50cm^3$ acid washed volumetric flask and the brought to the $50cm^3$ mark with deionized water. Diluted digest was then filter and kept in sample bottles ready for analysis [11]. The result was presented in terms of elements of nutritive quality, elements of toxic quality while the mean and ranges of each trace elements value were presented in ppm (mg/l).

RESULTS AND DISCUSSION

The results of measurements obtained in-situ are presented in Table 2. These include pH, conductivity, and temperature.

Table 2: Measurements of pH, Conductivity, and Temperature of the Seven Water Sources

S/N	Sample ID	Conductivity (µs/cm)	Temperature (^{0}C)	pH
1	BH1	111	28.9	4.6
2	BH2	74	29.5	6.5
3	BH3	156	29	6.5
4	BH4	592	29.3	4.4
5	BH5	160	29.1	6.5
6	BH6	302	29.1	6.5
7	BH7	158	29.7	6.6

Table 3: Trace Elemental Concentration Determined from Water Samples

S/N	Trace Elemer	BH1	BH2	BH3	BH4	BH5	BH6	BH7	Range
1	Co (ppm)	0.28	0.13	0.27	0.87	0.04	0.01	BDL	0.01-0.87
2	Mg (ppm)	2.24	0.49	1.53	2.26	0.04	3.25	0.79	0.04-3.25
3	Na (ppm)	15.3	5.11	12.4	12.1	3.09	15	13.8	3.09-15.3
4	Ca (ppm)	40.1	0.56	BDL	0.96	0.33	3.44	0.12	0.12-40.1
5	Zn (ppb)	45.6	31.5	54.8	11	60.8	107.8	8.9	8.9-107.8
6	Cr (ppb)	BDL	42.8	83	80.5	BDL	52.8	55.33	42.8-83
7	K (ppm)	23.7	6.75	4.76	15.8	6.25	16.8	5.08	5.08-23.7
8	Mn (ppb)	46.2	31.1	0.45	23.6	23.1	16.6	30.6	0.45-6.2
9	Pb (ppm)	0.07	0.07	0.17	0.16	0.13	0.05	0.1	0.05-0.16
10	Cd (ppm)	5	5	10.3	12.6	BDL	5	6.2	5-12.6
11	Fe (ppm)	BDL	BDL	BDL	20.2	BDL	53.8	60.5	20.2-83.8
12	Cu (ppb)	28.6	18.1	6	21.1	26.4	11.3	12.1	11.3-28.6
13	Al (ppm)	0.05	0.11	0.14	0.01	0.17	0.22	0.17	0.1-0.22

Results of analysis of major and minor elements, nutritive and toxic quality determined from the water types are presented in Tables 4 and 5. A bar chart showing the distribution of these two group-types of elements is presented in Figure 1 and 2.

The elements that was very essential at trace level to human health where selected and tabulated below (Table 4). This was aimed at knowing how much in ppm consumer of this metropolis consumed when drinking or using the water in cooking. The results were compared to the Report of the committee on protection of water criteria, Federal Environmental Protection Agency, Nigeria [19] and [20].

Table 4: Element of Nutritive Quality

S/N	Trace Elements	BH1	BH2	BH3	BH4	BH5	BH6	BH7	Range
1	Mg (ppm)	2.24	0.49	1.53	2.26	0.04	3.25	0.79	0.04-3.25
2	Na (ppm)	15.3	5.11	12.4	12.1	3.09	15	13.8	3.09-15.3
3	Ca (ppm)	40.1	0.56	BDL	0.96	0.33	3.44	0.12	0.12-40.1
4	Zn (ppb)	45.6	31.5	54.8	11	60.8	107.8	8.9	8.9-107.8
5	K (ppm)	23.7	6.75	4.76	15.8	6.25	16.8	5.08	5.08-23.7
6	Mn (ppb)	46.2	31.1	0.45	23.6	23.1	16.6	30.6	0.45-6.2
7	Fe (ppm)	BDL	BDL	BDL	20.2	BDL	53.8	60.5	20.2-83.8
8	Al (ppm)	0.05	0.11	0.14	0.1	0.17	0.22	0.7	0.10.22

Table 5: Element of Toxic Quality

S/N	Trace Elements	BH1	BH2	BH3	BH4	BH5	BH6	BH7	Range
1	Co (ppm)	0.28	0.13	0.27	0.87	0.04	0.01	BDL	0.01-0.87
2	Cr (ppb)	BDL	42.8	83	80.5	BDL	52.8	55.33	42.8-83
3	Pb (ppm)	0.07	0.07	0.17	0.16	0.13	0.05	0.1	0.05-0.16
4	Cd (ppm)	5	5	103	126	BDL	5	6.2	5-12.6
5	Cu (ppb)	28.6	18.1	6	21.1	26.4	11.3	12.1	11.3-28.6

(ppm=part per million, ppb=part per billion, BDL=Below detection limit and ppm=mg/l)

The major constituents of drinking water include the nutritive trace metals shown in Table 4. In the case of Mg range from 0.04 to 3.25 compared to 150 ppm of World Health Organization, [15, 16, 17, 18] and the Report of the committee on protection of water criteria, Federal Environmental Protection Agency, Nigeria [19] sited in Table 1. Thus, this range for all the seven studied boreholes falls below the recommended or restricted value of 150ppm. The case of Na associated to high blood pressure and heart diseases risk, the recommended values must strictly hold on to. The high intake of salt which aggravate cirrhosis, renal diseases and congestive heart failure made it possible for the American heart association to recommend in 1986, the intake of Na in drinking water to be 20mg/l. The United State Environmental Protection Agency (USEPA) proposed a permissible health safety limit for Na in drinking water to be 20mg/l. However, in this work, we obtained a ranger of 3.09 to 15.3 mg/l indicating all the boreholes are devoid of heart related diseases. The value obtained for Ca was from 0.12 to 40.10 mg/l against 1.5 to 200 mg/l proposed WHO [15, 16, 17, 18]. Thus, the values obtained for all the boreholes constantly in usage are within the permissible range. The concentration of Zn ranged from 8.9 to 107.8 ppb compared to 15 ppm recommended by the Federal Environmental Protection Agency (FEPA), Nigeria (1998) sited in Table 1. This value is very low in all the borehols. This implies that lacking of Zn in all the boreholes water sources can lead to growth failure, loss of taste and hypoganadism. Adult generally on average scale requires 15 mg/day and about 3 percent ought to come from drinking water. However, excess of Zn has been reported to have caused muscular weakness, pain, irritability and nausea affections. USEPA established standard safely limit of Zn in drinking water to be 5 ppm based upon taste. In the aspect of Al the values obtained ranged from 0.1 to 0.22 ppm against 0.03 ppm recommended by WHO, [15, 16, 17, 18]. Generally, a concentration of 0.2ppm can posed serious health problem even though Al occurs naturally in all food and dietary intake substances. The values obtained for Mn, Fe, and Cu were below the recommended values shown in Table 1.

In the aspect of toxic elements, all the boreholes as shown in Table 5 were below the threshold value of WHO [16, 18], FEPA [19]. The dose obtained in this work indicates that none of the drinking water sources posed any risk when consumed.

The values of pH in borehole BH1 and BH4 were found to be 4.6 and 4.4 against the value recommended by the FEPA [19] of 6.5 to 9. This values shows that the two boreholes were very acidic due to dissolved minerals and probable contamination of sample containers, leaching or corrosion of sink pipes. Also, the pH values obtained shows that BH2=BH3=BH5=BH6=6.5 and BH7=6.6 indicating that they were recommended for consuming. The conductivity values obtained were very low compared to the WHO [15, 16, 17, 18] in the order BH2< BH1<BH7<BH5. Meanwhile the value obtained from the boreholes BH4 and BH6 were higher above recommended value of 160µs/cm Table 1. This was due to high dissolved inorganic minerals and temperature of the samples during measurement. These boreholes are located along the road (Janary road and Malle road) were some of the dissolved elements may be from car exhaust circulating in the atmosphere during collection of samples.

CONCLUSION

In this study, the Authors have established a database of toxic and nutritive heavy trace metal concentration in some of the major boreholes within Lapai metropolis. This work revealed that the levels of Co, Pb, Cu, Cd, and Cr in the test borehole water samples did not exceeds the permissible limits recommended by FEPA 1998, WHO 1992, 1993, 1996, 1998 and Nigerian Industrial Standard (NIS) for drinking water quality, 2007. Also, the concentrations of Ca, Na, Mg, Zn, K, Mn, Al and Fe obtained using Atomic Absorption Spectrophotometric (AAS) in the borehole water samples fell far below the standard limits of WHO and USEPA. The results of pH values in borehole BH1 and BH4 were found to be 4.6 and 4.4 against the value recommended by the FEPA, 1998 and WHO, 1992, 1993, 1996, 1998 and NIS, 2007 of 6.5 to 9, thus were very acidic due to dissolved minerals due to leaching or corrosion of sink pipes. The pH values for BH2, BH3, BH5, and BH6 were 6.5 while BH7 was 6.6 signifying that they are recommended for consuming. The conductivity values obtained were very low compared to the WHO 1992, 1993, 1996, 1998 in the order of BH2< BH1<BH7<BH5. Meanwhile the value obtained from the boreholes BH4 and BH6 were higher above recommended value of 160µs/cm.

REFERENCES

[1]. Adermoroti, C.M.A., Standard methods for water and effluents analysis, **1992**,41
[2]. Itah.A.Y., and Akpan C. E.. *J. Appl. Sci. Environ. Mgt.*Vol. **2005**, 9 (1) 135 - 141
[3]. Musa H., Yakasai I. A., and Musa .H. H. (**2004** *ChemClass Journal, (14-18);* AWA, Newsletter of American Water work ,**1991**, 12 – 16.
[4]. Bhatia, C.S., Environmental pollution and control in chemical process industries, First Ed., Khanna Publishers, Naisarak, Delhi India, **2001**, 23 – 25

[5]. Jatau.B.S., Bajeh. I.and Inocent. S. (**2008**). *Journal of Applied Sciences* 3 (1): 81-87
[6]. Palanisamy P. N., Sivakumar. P.,Kumar P. G., Geetha . E A., and Sujatha .M. (**2008**). *Journal of Chemistry* Vol. 5, No.4, pp. 696-705
[7]. Wheather, D.W.F. Marx, D.D.; Jawal, L. and Oragin,J.(**1980**). *Water Research*. 14: 713-721.
[8]. Tennant, D.R. (**1981**). Manganese. World Health Organization International Programme on Chemical Safety. Environmental Health criteria. 17: 218-220.
[9]. Kowal J.M and Andrews D.F (**1973**). Pattern of Water availability, and Requirement for Grain Sorghum Production at Samaru Nigeria, Tropical Agriculture (Trinidad) 50, 89-100.
[10]. Radojavic, M. and Vladimir, N.B., Bulletin of the Royal society of chemistry, London, 1992, WHO, Bulletin of the WHO, **1999**, 86 – 88
[11]. Raphael, P., Tsafe, A.I. Abdulrahman, F.W. Itodo, AU and Shabanda, I.S. *International Journal of Natural and Applied sciences*, **2009**, 5(2): 140 – 144.
[12]. Udo, E.J. and Ogunwale, J.A., Laboratory Manual for the Analysis of Soil, Plant and Water Samples. 2nd Ed. University Press Ltd. Ibadan, Nigeria, **1986**, 32 – 35.
[13]. Kowal J.M and Andrews D.F (**1973**). Pattern of Water availability, and Requirement for Grain Sorghum Production at Samaru Nigeria, Tropical Agriculture (Trinidad) 50, 89-100.
[14]. Jatau.B.S., Bajeh. I.and Inocent. S. (**2008**). *journal of Applied Sciences* 3 (1): 81-87
[15]. WHO, Technical Reports Sheet, **1992**, 76
[16]. WHO, Guidelines for drinking water quality. Vol. 1 (Second edn.). WHO, Geneva. Supporting Information 2nd Edition Geneva WHO **1993**. 152-279.
[17]. WHO, *Guidelines for Drinking water Quality* Vol. 2 Health Criteria and Other World Health Organization (**1996**) *Guidelines for Drinking water Quality*. Vol.2 Recommendations.
[18]. World Health Organization, Geneva. 4. World Health Organization. *Guidelines for Drinking water quality*. Addendum to Vol. 2 Health Criteria and other supporting information 2nd Edition Geneva World Health Organization **1998**: 58
[19]. Federal Environment Protection Agency (**1998**) *Report of the Committee on Water Quality Criteria*, Federal Water Pollution Administration PP. 9 – 10.
[20]. Nigerian Industrial Standard (**2007**). Nigerian Standard for Drinking Water Quality. NIS 554
[21]. Ogbonna O., Jimoh W.L., Awagu E. F. and Bamishaiye E.I. (**2011**). *Advances in Applied Science Research*, 2011, 2 (2): 62-68
[22]. Elinge, C. M., Itodo, A.U., Peni I.J., Birnin-Yauri U.A., Mbongo A, N (**2011**). *Advances in Applied Science Research*, 2 (4):279-282
[23]. Kishore K. Das, Bhanita Das, Bhupen K. Baruah, and Abani K. Misra (**2011**). *Advances in Applied Science Research*, 2 (4):306-313
[24]. Alli JA., Okonko I O., Kolade AF., Nwanze J C., Dada VK., and Ogundele M (**2011**). *Advances in Applied Science Research*, 2 (4): 1-13
[25]. Yadav S.S. and Kumar Rajesh. (**2011**). *Advances in Applied Science Research*, 2 (2): 197-201