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Ground Water Quality Assessment of some Selected Hand-Dug Wells in Wuntin Dada Community of BAUCHI- Northwest Nigeria

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Abstract

This investigation assess the water quality of ten selected hand-dug wells which for sometimes serve as alternative sources of drinking water of the *Wuntin Dada* inhabitants due to inadequate public supply of potable water**.** Water from each of the selected hand-dug wells was sampled in a sterilized 500ml plastic container and taken to the laboratory for analysis. Samples were analysed for physical, chemical and microbial parameters. Physical parameters analysed include; pH, Temperature, Turbidity, Electrical Conductivity and Total Dissolved Solids. The mean values of all the physical parameters are within the standards set by the Nigerian Industrial Standard (NIS) as stipulated in the Nigerian Standards for Drinking Water Quality (NSDWQ) guidelines. Waters from the water sources investigated are therefore safe as far as the physical quality is concerned. Chemical parameters analysed include; Sodium, Calcium, Magnesium, Iron, Lead, and Arsenic. Calcium and Magnesium concentrations are the only two parameters with concentrations higher than the maximum permissible levels set by the Nigerian Standard for Drinking Water Quality (NSDWQ). Calcium mean value is 184mg/l against the maximum permissible level (mpl) of 75mg/l while that of Magnesium is 70mg/l against the maximum permissible level (mpl) of 20mg/l. The rest are within the maximum permissible levels set by the Nigerian Industrial Standard (NIS), 2015 standards for drinking water quality. Total hardness is generally high in all the samples with range value of 154 -255mg/l. The water sources investigated provide the inhabitant with hard water**.** The mean value for Faecal Coliform is 1.6cfu/100ml against the maximum permissible level of 0.00cfu/100ml was rather alarming. This is an indication that the water sources under investigation were recently contaminated and may contain pathogens responsible for water borne diseases. Periodic disinfection of the water sources is highly recommended.

Keywords: Wuntin Dada, potable water, hard water and disinfection

المستخلص

في هذه الدراسة تم اجراء التحاليل الفيزيائية و الكيميائية والبتريولوجية لعدد من عينات المياه الماخوذة من الابار المحفورة يدويا في منطقة ونتين بغرض التعرف علي نوعية المياه وصلاحيتها لاغراض الشرب حيث انها تستخدم احيانا لسد النقص في امدادات المياه. وقد تمت الدراسة لعدد عشرة عينات من ابار المياه. الخواص الفيزيائية التي تم تحليلها لعينات المياه شملت الاس الهيدروجيني (pH) و درجة الحرارة والعكارة بالاضافة للموصلية الكهربية والاملاح الذائبة الكلية. كل الخواص الفيزيائية التي تم تحليلها لعينات المياه وجد انها في حدود او ضمن القيم والمواصفات المعتمدة بواسطة المواصفات الصناعية النيجيرية. اما الخواص الكيميائية لعينات المياه التي تم تحليلها فتشمل الصوديوم والكاليسيوم والماغنيسيوم والحديد والرصاص و الزرنيخ, وقد وجد ان تركيزات الكالسيوم والماغنيسيوم فقط في عينات المياه التي تم تحليلها اعلي من التركيزات المعتمدة بواسطة المواصفات الصناعية النيجيرية حيث ان متوسط تركيز الكالسيوم كان 184 ملغ/لتر مقابل القيمة النيجيرية المعتمدة وهي 75 ملغ/لتر بينما تركيزات الماغنيسيوم كانت 70ملغ/لتر في عينات المياه مقابل 20 ملغ/لتر للمواصفات النيجيرية. مانبقي من عناصر كانت تركيزاتها تقع ضمن المواصفات النبجيرية. عموما وجد ان العسر الكلي تعينات المياه الماخوذة عالي التركيز و يتراوح بين 154 – 225 ملغ/لتر وان المياه التي تمد السكان عسرة, اما بالنسبة للتحلبل البكتيولوجي وحد ان المياه ملوثة بكتريا وتحتاج لمعالجة حتي لا تتسبب في نقل بعض الامراض المنقولة بالمياه.

Introduction

Access to safe drinking-water is essential to health, a basic human right and a component of effective policy for health protection (WHO, 2008). A person requires about three liters of potable water per day to maintain the essential fluids of the body (Fetter, 2007). Water is the major constituent of the human body, since sixty percent of adult body weight is due to water (WET, 2010). Water related diseases remain an issue of major global public health concern, with the water-sanitation-hygiene risk complex globally accounting for about ten percent of the global burden of disease (Pruess *et al*., 2008).

The quality of water obtained from hand-dug wells must be assessed considering the reliance on such sources of water by the inhabitants for their daily consumption and other uses. This study would be helpful in the determination of whether the water sources investigated are safe and therefore suitable for human consumption or not.

The area under investigation is Wuntin Dada community situated about seven kilometers northwest of Bauchi, the State Capital of Bauchi State in the northeastern Nigeria. The study area is underlain by crystalline rocks of the Nigerian Basement Complex. There is need to investigate the quality of water people consumes in the absence of public water supply, as water for human consumption need to be free from pathogens like bacteria, toxic substance like arsenic and chemical substances in concentration large enough to affect human health.

There is a steady rise in the demand for groundwater in most hard rock areas, most of which cannot boast of any constant surface source of water supply (Adamu, 1994). Oyawoye (1972) described the hydrogeologic condition found in Bauchi; he concluded that water was found in the weathered and fractured zone within the Basement Complex. Groundwater is generally less susceptible to contamination and pollution when compared to surface water bodies.

Josiah et al, (2016); Pavendan et al., (2011); Musa et al., (1999) and Elueze et al, (2004) have conducted similar investigations at Bauchi- NE Nigeria Tiruchirappali District-

South India, Peri-urban communities- Northern Sudan and Ilesha area- SW Nigeria respectively. The sole aim of such assessments is to determine the physical, chemical as well as the microbial quality of the water sources investigated. Results from such investigations determine suitability or otherwise of a particular water source to serve intended purposes.

Location and Geology:

The area under investigation is Wuntin Dada community situated about seven kilometers northwest of Bauchi, the State Capital of Bauchi State in the northeastern Nigeria. The study area is underlain by crystalline rocks of the Nigerian Basement Complex Fig (1).

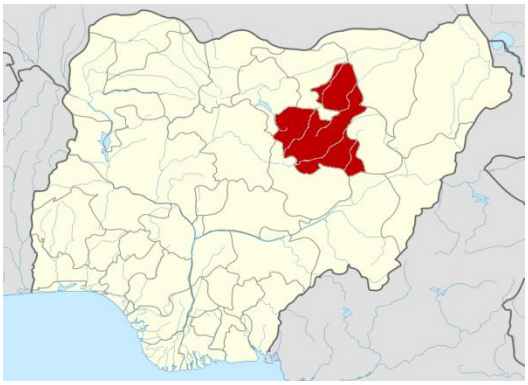

Figure 1 . Map of Nigeria showing Bauchi State

Materials and Methods

For the purpose of collecting water samples in the study area, the following instruments; Global Positioning System (GPS eTrex 10), TDS/EC Meter and pH/Temperature Meter were used. The Gamin eTrex 10 GPS was used to get the coordinates (Longitudes and Latitudes) of the location of water source sampled. Total Dissolve Solid (TDS) and Electrical Conductivity of each the water samples were measured by the TDS/EC Meter in the field. Hydrogen ion concentration (pH) and Temperature of the samples were also measured using pH/Temperature Meter.

Ten water samples (S1 –S10) from ten selected Hand-Dug Wells in different parts of Wuntin Dada community were collected and analysed for the physical, chemical and microbial parameters. Water sample from each of the ten hand-dug wells was collected in 500ml sterilized plastic containers and were instantly labeled according to sample's location. A sterilized plastic cup was also used to fetch water sample for instant measurement of some physical parameters such as pH, Temperature, Total Dissolved Solid and Electrical Conductivity. Finally, the water samples collected were preserved in the refrigerator of the laboratory before the analysis was done.

The chemical and microbial analysis has been carried out in the Water Quality Center Laboratory, Bauchi State Rural water Supply and Sanitation Agency. Microbial analysis was done using Palin test Membrane Filter, while chmical analysis was carried out using D R 2000 Spectrophotemeter 7100 Model.

Results

The ten water samples under investigation were analysed for physical, chemical and microbial parameters. The results of the physical, chemical and microbial parameters are as shown in tables 1 .2a, 2b and 3 respectively.

Table 1 Physical Parameters Result

Location	pH	Temperature (0C)	Turbidity (NTU)	Electrical Conductivity (µS/cm)	Total Dissolved Solid (mg/l)
Near Wikki	8.4	32	2.8	718	376
Wuntin Dada Primary	7.9	33	2.3	490	245
Wuntin Dada Market	8.6	30	4.2	1150	538
Mato Lame	7.7	31	3.4	660	323
Malam Abdullahi	7.6	31	3.1	980	550
Kara I	8.3	32	4.2	1020	545
Kara II	8.7	31	2.7	979	534
Kara III	8.5	30	3.9	740	373
Kara IV	8.4	31	4.0	770	340
IBB Squaare	7.9	30	4.1	1035	540
Range	7.6-8.7	30-33	2.3-4.2	490-1150	245-550
Mean	8.2	31.10	3.5	854	436
NSDWQ*MPL	6.5-8.5	Ambient	5	1000	500

NSDWQ: Nigerian Standard for Drinking Water Quality MPL: *Maximum Permissible Level

Table 2a Chemical Parameters Result

Location	Total Alkalinity (mg/l)	Total Hardness (mg/l)	Total Iron, Fe^{2+} (mg/l)	Calcium, Ca^{2+} (mg/l)	Magnesium, Mg^{2+} (mg/l)	Sodium, Na^{+} (mg/l)
Near Wikki	120	184	0.2	106	78	5.3
W/Dada Primary	115	160	0.3	111	49	1.7
W/Dada Market	160	258	0.1	179	79	0.3
Mato Lame	144	154	0.5	107	47	4.0
Malam Abdullahi	78	248	0.2	199	49	1.9
Kara I	224	156	0.1	117	39	3.8
Kara II	180	378	0.1	286	92	1.1
Kara III	188	288	0.2	201	87	1.6
Kara IV	136	350	0.4	239	111	0.7
IBB Square	168	370	0.1	290	80	0.3
Range	78-188	156-378	0.1-0.5	106-290	39-111	0.3-5.3
Mean	151	255	0.2	184	71	2.1
NSDWQ *MPL	**100**	**150**	**0.3**	**75**	**20**	**200**

NSDWQ: Nigerian Standard for Drinking Water Quality *MPL: Maximum Permissible Limit

Table 2b Chemical Parameters Result

Location	Lead, Pb^{2+} (mg/l)	Arsenic, As^{+} (mg/l)	Chloride, Cl^{-} (mg/l)	Fluoride, F^{-} (mg/l)	Sulphate, $S0_4^{2-}$ (mg/l)	Nitrate, $N0_3^{-}$ (mg/l)	Nitrite, $N0_2^{-}$ (mg/l)
Near Wikki	0.00	0.00	8.2	0.9	116	10	0.1
Wuntin Dada Primary	0.001	0.00	2.6	0.7	72	14	0.1
Wuntin Dada Market	0.00	0.00	0.4	1.2	107	23	0.6
Mato Lame	0.00	0.00	6.1	0.6	60	18	1.1
Malam Abdullahi	0.00	0.002	3.0	1.4	145	5	0.1
Kara I	0.00	0.00	5.8	1.1	12	22	6.4
Kara II	0.00	0.00	1.6	0.8	70	10	0.1
Kara III	0.00	0.001	2.4	0.3	131	21	8.7
Kara IV	0.00	0.00	1.0	0.0	37	17	0.36
IBB Square	0.00	0.00	0.5	0.1	69	17	0.2
Range	0.0-0.001	0.0-0.002	0.4-8.2	0.0-1.1.4	12-145	5-23	0.1-8.7
Mean	0.00	0.00	0.3	0.7	82	16	1.8
NSDWQ *MPL	0.01	0.01	250	1.5	100	50	0.2

NSDWQ: Nigerian Standard for Drinking Water Quality * MPL: Maximum Permissible Limit

Table 3 Microbial Parameters Result

Location	Total Coliform (cfu/100ml)	Faecal Coliform (cfu/100ml)
Near Wikki	19	7
Wuntin Dada Primary	12	5
Wuntin Dada Market	0	0
Mato Lame	0	0
Malam Abdullahi	2	0
Kara I	0	0
Kara II	0	0
Kara III	0	0
Kara IV	13	3
IBB Square	9	1
Range	0-19	0-7
Mean	5.5	1.6
NSDWQ*MPL	**10**	**0**

NSDWQ: Nigerian Standard for Drinking Water Quality *MPL: Maximum Permissible Level

Discussion

For the purpose of this investigation, water quality was assessed based on the Nigerian Standard for Drinking Water Quality (NSDWQ) of the Nigerian Industrial Standard (NIS) provisions. Analysis results of the five physical parameters: pH, Temperature, Turbidity, Total Dissolved Solid (TDS) and Electrical conductivity (EC) as shown in table 1, indicated that the mean values of these parameters are within the permissible levels set by the Nigerian Standard for Drinking Water Quality (NSDWQ).

Six cations' (Sodium, Calcium, Magnesium, Iron, Lead, and Arsenic) concentrations were determined and their mean values, with the exception of Calcium and Magnesium, were below the maximum permissible levels set by the Nigerian Industrial Standard

(NIS), 2015 standards for drinking water quality. Calcium mean value is 184mg/l against the maximum permissible level (mpl) of 75mg/l while that of Magnesium is 70mg/l against the maximum permissible level (mpl) of 20mg/l. The mean values for these two cations were much higher than permissible levels set by the Nigerian Standard for Drinking Water Quality (NSDWQ), consequently, water from these sources are classified as hard. Though Calcium and Magnesium are essential minerals and beneficial to human health in several respects, inadequate intake of either nutrient can result in adverse health consequences (WHO, 2011). Total Alkalinity and Total Hardness concentrations' mean values are 151mg/l and 255mg/l are higher than the maximum permissible levels (mpl) of 100mg/l and 255mg/l respectively.

On the other hand, five anions' (Chloride, Fluoride, Sulphate, Nitrate, and Nitrite) concentrations were also determined. The mean values of Chloride, Fluoride, Sulphate and Nitrate are within the maximum permissible levels set by the Nigerian Standard for Drinking Water Quality (NSDWQ). The mean values for Nitrite is 1.8mg/l which is higher than the maximum permissible levels (mpl) 0f 0.2mg/l.

The mean values for Total and Faecal Coliforms as shown in (table 3) are 5.5cfu/100ml and 1.6cfu/100ml respectively. While the mean value for Total Coliform was lower than maximum permissible level of 10cfu/100ml set by the Nigerian Standard for Drinking Water Quality (NSDWQ), the mean value for Faecal Coliform of 1.6cfu/100ml against the maximum permissible limit of 0.00cfu/100ml was rather high. This is an indication that the water sources under investigation were recently contaminated and may contain pathogens responsible for water borne diseases.

Conclusion

This investigation assessed the water quality of ten selected hand-dug wells which for quite sometimes serve as alternative sources of drinking water of the Wuntin Dada inhabitants due to inadequate public supply of potable water. Water from each of the selected hand-dug wells was sampled in a sterilized plastic container and taken to the laboratory for analysis. Samples were analysed for physical, chemical and microbial parameters.

Physical parameters analysed include pH, Temperature, Turbidity, Electrical Conductivity (EC) and Total Dissolved Solids (TDS). The mean values of all the physical parameters are within the standards set by the Nigerian Industrial Standard (NIS, 2015) as stipulated in the Nigerian Standards for Drinking Water Quality (NSDWQ) guidelines.

Total hardness is generally high in all the samples with range value of 154 -255mg/l. Calcium and Magnesium concentrations were the only two cations with concentrations higher than the maximum permissible levels set by the Nigerian Standard for Drinking Water Quality (NSDWQ). Water hardness is the traditional measure of the capacity of water to react with soap, hard water requiring considerably more soap to produce lather (WHO, 2011).

The mean value for Faecal Coliform is 1.6cfu/100ml against the maximum permissible level of 0.00cfu/100ml was rather alarming. This is an indication that the water sources under investigation were recently contaminated and may contain pathogens responsible for water borne diseases.

Waters obtained from the water sources investigated are safe as far as the physical

quality is concerned but periodic disinfection of the water sources is highly recommended to get rid of the microbial contamination. Toxic chemical constituents (Pb and As) were not found in all the sample analysed, this rule out presence of toxicity in the analysed samples. The water sources investigated provide the inhabitants with hard water which require more soap when washing.

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