Physico-chemical Assessment of some Selected Hand Dug Wells Water in Bida Metropolis, Niger State, Nigeria.

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ABSTRACT

Physico-chemial analyses of selected hand dug wells in Bida Metropolis of Bida Local Government Area of Niger State were conducted. Twenty five water samples were collected from selected hand dug wells in the study area. The analysis was aimed at determining the physic-chemical parameters and safety of the water samples for consumption and domestic purposes. The results were compared with world health organization standard and National standard for drinking water quality limits. From the result of the analysis, it was found that P^H value of the samples has the highest value of 7.56 (Alkaline), bicarbonate ranges from 0.52 mg/l to 47.94 mg/l. Chlorine ranges from 29.40 mg/l to 161.7 mg/l. The result of BOD and COD ranges from 8.00 mg/l to 17.0 mg/l and 16.0 mg/l to 56.0 mg/l respectively, it was found that turbidity test range from 0.30 NTU to 1.94 NTU. The electrical conductivity of the hand dug well water samples range from 93 ohms/cm to 1583 ohms/cm the mean average value of total dissolve solid was 186.33 mg/l and the result of calcium ranges between 3.36 mg/l to 65.60 mg/l. All the analyzed samples fall within the allowable limit of world health organization standard and National standard for drinking water quality. Therefore the water samples were free from all health related diseases like kidney stone, constipation and others. Hand dug well should be constructed at least 15 m away from waste dumpsite, pit latrine or soak away.

Keywords: *Raw water, Analysis, Contamination, Treatment*

1   INTRODUCTION

The increasing population in the world, especially developing nations has led to increasing demand for good quality water. Water is essential for life, It is universal solvent and the most abundant substance in plants and animals tissues (Fabio *et al.,* 2009). Water occurs in all spheres of the environment, in the oceans as a vast reservoir of salt water, on land as surface water (lakes and rivers), underground as groundwater, in the atmosphere as water vapor and in polar ice caps as solid ice (Bhatia, 2002; Goel, 2000).

Hand dug well also known as shallow well are developed between one to few meters below the ground surface to explore ground water. Ground water is recharged from the precipitation and surface run off which percolation into the ground. Groundwater movement is generally slow and it concentration changes as water percolates through natural sediments. These changes are drastic in certain sediments, while negligible in other some sediment (Deju *et al.,* 1990). During its movement through the surface and subsurface porous rock layers of the earth, it dissolves some soluble minerals (Glenn and William, 1981). In the zone of aeration, soil pore spaces contain both air and water which may have zero low depth in swamp lands and several hundred feet in mountainous regions. This research is aimed at determining the physical and chemical properties of 25 hand dug well water in Bida metropolis. The precise objectives are to determine the physical and chemical parameters of the shallow wells; the depth of sampled wells in the study area.

Well water is one of the major sources of water supply to the entire populace of Bida and its environs, owing to the fact that, there is no supply of pipe-borne water from the water works and boreholes water development is highly cost effective. The sedimentary formation of the Bida basin is hydrologically attractive due to the good hydraulic characteristics of soil formation. This research therefore, became necessary to ascertain the quality of the wells and invariably its suitability for various purposes, in order to ensure the protection of the health of common man and determine liable sources of pollution.

In developing world, 80% of all diseases are directly related to poor drinking water and unsanitary conditions (Olajire and Imeokparia, 2001; Chung *et al.,* 2007). Ground water quality is affected by various pollution sources. The

connection between agricultural and ground water pollution is well established (Hamilton and Helsel, 1995). According to Chandio (1999), applications of Nitrogen, Phosphorus and Potassium fertilizer (NPK) have been increasing in Pakistan over the last few decades. As a result, high concentration of NO_3 has been reported to be common in ground water sources in the world (Wassenaar, 1995; Goulding, 2000).

Water quality is the measure of the condition of water, relative to the requirements of one or more biotic species and to any human need or purpose. Water quality is determined by the concentration of physical, chemical and biological contaminants (Nsi, 2007). Fresh and pure, water has no taste, odour, colour or turbidity. Although water is never 100% pure as it carries traces of other substances, which bestow physical, chemical and biological characteristics Most common physical contaminants of water are suspended sediments. These are properties which are often apparent to casual observer such as colour, odour, taste and turbidity. Chemicals are the major sources of water contamination (Nsi, 2007). Okunye and Odeleye (2015) carried out Bacteriological investigation of well water samples from selected market locations in Ibadan, Colony counter was used to carry out Bacteriological analysis of well water samples. Well water samples were collected and analyzed. The result revealed that all sample investigated were found to be heavily ladened with coliforms and other isolates, pseudomonas and klebsiella were obtained in varying percentage. The PH of the 24 well water sampled were progressively acidic with the exception of 2 well water with PH 7.0 though the regressive analysis to determine the significant of extrinsic and intrinsic value of the sampled water extend beyond the P-value ≤ 0.5, the total viable count obtained from six well water elicited the water as grossly contaminated therefore, it is unsafe for drinking to avoid water borne infection.

Oladipo and Adeboye (2015). Carried out physico-chemical and bacteriological analysis of well water used for drinking and domestic purposes in Ogbomosho, Nigeria. Reagents were used to carried out the physico-chemical and bacteriological analysis, five different well water samples were collected from five different locations in Ogbomosho. The result revealed that total viable count was between 1.0×10^3 and 2.2×10^3 cfc/ml, the PH ranges from 5.9 to 6.9 while the turbidity of the well water samples ranges from 0.67 to 1.0. The

chemical oxygen demand of the samples was within the range of 1.0 to 3.33 while the chloride content of the samples was within the range of 7.43 to 18.47, none of the water sample met the chloride content standard set by EPA. The total bacterial count for the water sample where generally high exceeding the limit of 1.0 by 10^2 cfu/ml which is the standard limit of heterotrophic count for drinking water conclusively, proper well location and construction, control of human activities to prevent sewage from entering water body is the key to the avoiding bacterial contamination of drinking water, house hold treatment such as boiling should be encouraged before water from these wells is used for drinking and domestic purposes.

Ali and Abdulkadir (2012) Carried out physico-chemical and bacteriological analysis of well waters in Zango-abattoir Kaduna, Nigeria. A total of twelve samples were collected from 3 open wells, the means PH, electrical conductivity, turbidity, dissolve oxygen (DO) and biochemical oxygen demand (BOD) were 5.98, 228µs/cm 18.1 NTU, 0.4mg/L and 0.23mg/L respectively, the result indicated very high concentration of sodium and potassium with a range of 4.25 to 2.817mg/L for sodium and 132.5 to 222.5mg/L for potassium the concentration of lead and cadmium were also significant ranging from 0.3972 to 0.652mg/L and 0.0062 to 0.0193mg/L respectively. The bacterial analysis also revealed that nine (9) of the samples had total coliform bacterial and for fecal bacterial, though the overall physico-chemical and bacteriological quantity of water samples lies within the maximum permissible limit of established standard. The high metal concentration makes it unsuitable for drinking.

Olajubu and Ogunika (2014) carried out the assessment of physico-chemical and microbiological properties of borehole water samples from Akungba-Akoko Ondo State, Nigeria. Chemical reagents and colony counter were used to carried out the experiments. In the physico-chemical analysis of the borehole water sample, the lowest PH (6.54) was recorded IBKI sample AKA water gave highest calcium concentration (86.97mg/L) the total hardness ranges between 171.76 and 327.33mg/L. element such manganese, zink, copper, cadmium were below detectable levels in the water samples. Seven bacterial species were isolated. AKA sample gave the highest bacterial count of 1.6×10^5 cfu/ml. staphylococcus aureus was the most frequently isolated among the bacterial

having been isolated in three out of the seven samples examined. The antibiotics susceptibility test showed that proteins vulgaris and klebsiella pnemonie were susceptible to most antibiotics.

2 MATERIALS AND METHOD

The materials used for this research work include: ground water samples, water bottles, global positioning satellite (GPS), Chemical reagents and level indicator

2.1 METHODS

The analysis/experiment conducted on the water samples collected from hand dug wells in the study area includes analysis of the physical parameters; Analysis of the chemical parameters and the depth of each hand dug wells.

The samples container (5 liters plastic container with a screw cap) was rinsed with distilled water until acid free and finally the water source. The water samples were collected from 25 selected hand dug wells into the prepared containers manually. The containers were labeled with masking tape containing sample number, date and time. The temperature of each sample was taken immediately using digital thermometer. The samples were kept in the laboratory refrigerator at 4^0C prior to analysis. The total hardness, Chloride, Total Alkalinity, Magnesium and Bicarbonate were determine using titirmetric method, phosphate content was determined using spectrophotometric method, BOD and COD of the samples were both determined using Winkler azid method, the PH was also determined using potentiometric method. Total suspended solid and total dissolve solid were both determined using TSS and TDS meter repectively. The turbidity of Hand dug well was also determined using Turbdimeter. Level indicator was used to determine the depth of the wells.

3.0 Result and Conclusion

Table 1: Physical Parameters of 25 Handdug wells in Bida Metropolis

Sample	Area	Coordinate (degree)	Depth (m)	Temperature (°C)	PC	Conductivity µS/cm	Colour (HZ)	Turbidity (NTU)	Total dissolve solid(mg/l)	Total suspended solid(mg/l)
A	Rice market		11	25	7.27	93	5	0.72	33.95	0.1
B	Arra Oza (1)		10	25	6.74	671	5	0.48	234.72	0.1
C	Mayaki Legbodza		10.5	29	7.18	1589	5	1.94	506.56	0.3
D	Kabalegu		9	25	7.05	1178	4	1.00	376.96	0.2
E	Alh Kabaraini		12	29	6.93	1391	5	1.06	442.56	0.2
F	Gerina Saaray		11	24	6.58	1348	4	1.07	422.74	0.2
G	Majin Kimpa		10	30	7.81	243	4	0.55	77.76	0.2
H	Tswanira Gaza		11	26	7.17	434	5	0.90	136.25	0.2
I	Sarkin Bora		10	29	7.12	593	4	0.90	187.42	0.1
J	Emi Labushi Marsha		12	28	7.54	476	5	0.99	152	0.2
K	Emi Yagba		8.5	24	7.33	1034	4	1.01	330.88	0.1
L	Emi Nda Ilorin		10	27	7.30	295	5	0.300	82.80	0.2
M	Umaru Sanda		9.5	30	7.07	381	4	0.35	121.92	0.2
N	Tulakaira		9.5	30	7.41	205	5	0.35	62.38	0.2
O	Kamanzota		11.5	30	7.18	258	5	0.35	80.12	0.1
P	Emi Jiba		10.5	26	7.47	145	5	0.10	44.02	0.2
Q	Emi Anni		12	27	7.05	420	4	0.35	135.55	0.1
R	Gogoraida		12	29	7.56	253	5	0.27	80.36	0.2
U	Old market		12.5	28	7.9	389	5	0.34	54.08	0.2
V	Lafanta Lanchin		12	28	6.94	358	5	0.45	111.54	0.2
W	Wakili Oshas		10	24	6.68	1276	5	0.67	372.41	0.2
X	Mas dawakwa		11	27	7.27	832	5	0.66	266.24	0.2
Y	Emi Kangiwa		10	27	7.31	902	5	0.69	288.64	0.2
NSDW						894	No guideline	5NTU	500mg/l	500mg/l
WHO Standard (2006)			No guideline	6.5-8.5		1000	0-15Hz	5NTU	500(mg/l)	250mg/l

Table 2: Chemical Parameters of 25 Handdug wells in Bida Metropolis

Sample	AREA	Coordinate (Degree)	Depth (m)	Total Alkaline (mg/l)	Total Hardness (mg/l)	Calcium (mg/l)	Magnesium (mg/l)	Chloride (mg/l)	Bicarbonate (mg/l)	Nitrate (mg/l)	Phosphate (mg/l)	COD (mg/l)	BOD (mg/l)
A	Rice market		11	12.37	18	3.16	1.35	19.40	3.09	3.84	3.18	13.0	12.17
B	Arra Oza (1)		10	8.02	18	20.91	4.58	39.40	3.22	4.63	0.32	34.0	14.40
C	Mayaki Legbodza		12.5	30.69	249	82.23	23.84	147	33.98	7.36	4.39	33.0	15.20
D	Kabalegu		9	95.07	389	47.93	17.15	327.4	47.94	4.88	0.35	32.0	21.20
E	Alh Kabaraini		12	55.97	248	82.69	20.92	261.7	27.77	8.22	8.34	48.0	17.30
F	Gerina Saaray		11	80.01	240	58.87	22.63	258.8	33.66	6.95	3.40	34.0	10.80
G	Majin Kimpa		10	8.02	104	29.43	7.44	80.76	3.61	5.36	3.30	43.0	13.30
H	Tswanira Gaza		11	12.00	70	18.82	4.83	73.50	2.53	3.88	0.28	42.0	15.20
I	Sarkin Bora		10	12.92	158	29.45	8.43	88.20	3.92	4.72	3.21	15.0	14.30
J	Emi Labushi Marsha		12	53.00	210	38.27	8.88	44.00	17.03	2.34	0.34	32.0	20.00
K	Emi Yagba		8.5	12.00	140	37.00	12.92	217.0	3.61	2.60	0.33	28.0	13.20
L	Emi Nda Ilorin		10	9.02	38	3.41	4.14	148.08	2.06	2.84	0.23	42.0	10.40
T	Emi Sokyo		12	10.00	30	9.25	1.68	29.40	2.58	1.86	0.28	16.0	14.52
U	Old market		12.5	6.00	30	7.56	2.70	58.99	6.53	3.52	0.40	24.0	9.00
V	Lafanta Lanchin		12	39.20	118	21.02	15.98	46.06	7.32	3.84	0.26	32.0	11.60
W	Wakili Oshas		10	110	228	67.23	14.64	142.1	34.12	6.68	0.64	32.0	11.30
X	Mas dawakwa		11	12.00	70	21.02	4.27	81.60	3.60	3.72	0.28	21.0	16.00
Y	Emi Kangiwa		10	70.00	150	40.37	12.00	88.20	33.51	4.34	0.40	56.0	15.00
NSDW (2007)				No guideline	500		200	250	No guideline		No guideline		
WHO Standard 2006				No guideline	500	100	150	250	250		50		

Table 1&2 represent the results of physical and chemical characteristic twenty five selected Hand dug wells in Bida. All the samples were odorless and tasteless. The color indication of water sample is 4Hz-5Hz. The mean pH of the well water is 7.3 which fall within the range of 6.5-8.5 specified by World Health Organization (WHO, 2006; WHO, 1993) and National standard for drinking water (NSDW, 2007)).the mean Turbidity values of the well ranges within 0.15 to 1.94NTU Which is within permissible limit 5NTU of WHO standard and total dissolved Solid (TDS) ranged from 25mg/l to 500mg/l except sample from Mayaki Legbodza that has highest value up to 506.56. Total Hardness gives palatability to water. It has been suggested that moderately hard water containing sufficient calcium is essential for normal growth and health. However, high values of hardness arising from high level of magnesium phosphate are undesirable (Dodoo, Quagraine, Okai-Sam, Kambo and Headley,

2006).the result of nitrate concentration is within permissible limit of WHO standard, high concentration of nitrate ion is known to result in cyanosis infants (Tayeh, 1996). The mean concentration of phosphate ions in water sample was 0.46.24mg/l which is below World Health Organization standard (WHO, 1993; WHO, 2000).

Chloride ions are non-cumulative toxins, an excess amount of which if taken over a period of time can constitute a health hazard. World Health Organization, 1993 recommended 250mg/l as the maximum chloride ion level allowable in drinking water. It is believed that higher concentration of chloride ions may result in taste problems (Adekunle,Srindhar, Ajayi, Oluwoyi, 2004). The water samples chloride ion levels between 29.40 - 143mg/l isdesirable. The excess calcium level is commonly known as hypercalcemia.two much calcium can weaken once borne,create kidney stones but from the sample result of calcium concentration proved to be permissible from WHO standard as the values were below the maximum limit.The excess presence of HCO3 in the body may result in to health complication such as headech,nauses and vomiting. the HCO3 average result 12.4mg/l from the sample is within permissible limit.

The mean total magnesium is 8.762mg/l is within permissible limit as well by WHO standard .even though magnesium is essential for well being, too much of it can caused problem including digestive issues, lithargy and irregular hearthbeat,

4. CONCLUSION

The value obtained for all water samples (25 selected hand dug wells) were found to be within the safe limits, and suitability for human consumption and agricultural uses. Although the study revealed that the well water from mayaki legboza has highest total dissolved solid. This could be source from the proximity of the open wells to the pit-latrine, soak aways and dumps sites or the natural geochemistry of the soil in the area.

The ground water will neither cause salinity hazard nor have an adverse effect on the soil properties and are thus largely suitable for irrigation purposes. The result of physical analyses also indicates that all the other parameter fall within the recommended limit of world health organization (WHO, 2006) and National standard for drinking water quality except for sample C in Mayaki legboza area.

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