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Physico-Chemical and Microbial Assessmentof *Some* Well Water from Mista-Ali Town, Bassa LGA, Plateau State-Nigeria

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Abstract

The Physico-chemical and Microbial assessment of well water in Mista-Ali were carried out to determine its suitability for domestic consumption. Samples were collected from eight wells in duplicate and analyzed using standard methods. The results revealed the physical parameters of the well water as colourless, odourless, tasteless, with total solids (240-370mg/L), Total suspended solids (280-320 mg/L) and Total dissolved solids (195-240mg/L). The chemical `parameter showed that the well has pH(6.9-7.3) conductivity ($2.0x10^2$ -$7.0x10^2$µmhos/cm), alkalinity(12-28mg/L),Chloride (10-28 mg/L), Total hardness (180-320mg/L), Sulphate (280-300mg/L), and Nitrate (7.70-8.20mg/L) . Arsenic and zinc were not detected while the following metals were detected with the following concentrations Pb (0.003-0.005), Fe (0.120-0.890),Mn (0.002-0.029), Ca (20.00-220.00), Cu (0.002-0.006), Cu (0.002-0.006), Cr (0.001-0.008), Ni (0.004-0.011), K (2.24-9.84), Mg (15.60-18.80). The physical, chemical and microbial assessment results were within the permissible standard for portable water. The well water in Mista-Ali can be used for domestic purposes and recommended that the water be analyzed atleast once every year to check for contamination. There should also be State Agency that would license well water to maintain high hygienic conditions.

Keywords: Well water, Physico-chemical assessment, *M*icrobial assessment, *T*race metals, Contamination, Nigeria.

1. Introduction

Water is very essential to the survival of all organisms and The human body is composed of approximately 70% water by mass [1].Safe drinking water is a human birthright as much a birthright as clean air. An adequate supply of safe and portable water assist in preventing the spread of gastrointestinal diseases, supports domestic and personal hygiene and improves the standard of living. However, much of the world's population does not have access to safe drinking water. Lack of portable water threatens the economy of a nation and the people's health in different ways, which is true of the Nigeria case that oil spillage kills all aquatic life form and leaves the people without good drinking water in some villages of the Niger-Delta region of the country, also indiscriminate dumping of refuse and other wastes into ponds, rivers, lakes and other water bodies in the South West [2]. The most important and life sustaining human drink is hardly found 100% pure in nature due to human activities and other natural factors. Many diseases in developing countries are caused by drinking contaminated water [3] And Ibe, et al. [4]. This is because dead vegetation, metal leachates from solid waste dumps; leaching of rocks, sewage, industrial wastes and agricultural chemicals return eventually to the river by run offs [5].The quality and quantity of water are affected by an increase in anthropogenic activities and any pollution either chemical or physical causes changes to the quality of the recurring water body [6].

As population increases, the need of water for domestic, transport, power, Agricultural And industrial purposes also increases. Government has been the major supplier of portable water for its populace in Nigeria. With the way population is increasing at a very fast rate and subsequent expansion in settlement, government finds it difficult to satisfy the water need of its citizens. This results in individuals and communities depending on other sources of water such as rivers, streams, boreholes and well. Apart from expansion as a result of increase in population, other reason such as crises has led to the development of settlement towns in Nigeria. These private water sources are not subjected to any quality standard before usage by the residents thereby resulting in the consumption of contaminated water.

Jos the capital city of Plateau State, Nigeria has had ethno-religious crises for the past decade which has resulted in the development of new settlements outside the state capital in which Mista-Ali is one of such towns. Although an old tin mine village, it has metamorphosed into a settlement with a population of over fifty thousand inhabitants.

Most residents do not have access to pipe borne or borehole water and have resorted to the use of stagnant water in the old tin mine ponds and hand dug wells as sources of water for their domestic consumption/usage.

In this study, the work aimed at examining the water quality and microbial characteristics of wells that serve as the main source of portable water for the inhabitants/residents of Mista Ali, a settlement close to Jos metropolis.

2. Materials/Methods

The samples containers (one litre plastic container with a screw cap) were washed properly with detergent, leached with conc. HNO_3, rinsed with distilled water until acid free and finally with the water source. Water samples were collected from eight different wells into the prepared containers manually. The containers were labeled with masking tape containing sample number, date and time and kept in the laboratory refrigerator at 4^oC prior to analysis. Samples for heavy metals analysis were preserved by adding 3 drops of conc. HNO_3.The water samples for bacteriological analysis were collected in sterilized neutral glass bottles of 120ml capacity with stoppers and kept in the refrigerator pending analysis. Colour, odour and taste were analysed with sense organs. The temperature of the water sample at point of collection was determined using a mercury in glass thermometer (British standard, BS 593) while the pH was determined using a Philips model PW 9418 pH meter after the meter had been dully calibrated with standard buffers of pH 4.0, 7.0 and 9.0 [7]. Conductivity was determined using the bridge type M.C 3 conductivity meter calibrated in limbos. Alkalinity, total hardness, and chlorides were determined by titrimetric method. Total solids and total dissolved solids were determined by gravimetric technique.Sulphates were done by turbidimetric technique while metallic elements including heavy metals were analyzed using Atomic Absorption Spectroscopy model VGB 210 system. Microbial analysis were carried out by pour plating method using serial dilution technique [8].

3. Results

Table-1. Results of the Physical Parameters of Well Waters in Mista Ali Town.

parameters	**1**	**2**	**Sample 3**	**Numbers 4**	**5**	**6**	**7**	**8**
Temperature (^oC)	28.00	27.90	28.10	27.80	28.10	28.40	27.80	28.00
Color	colorless	colourless	colourless	colourless	colourless	colourless	colourless	colourless
Odor	odorless	odorless	odorless	odorless	odorless	odorless	odorless	odorless
Taste	unobj	unobj	unobj	unobj	unobj	unobj	unobj	unobj
TS(mg/l)	240	290	370	255	260	300	310	300
TSS(mg/l)	320	220	300	310	315	280	275	300
TDS (mg/l)	215	200	220	195	210	210	240	210

TSS-total suspended solids, TS-Total solids, TDS-total dissolved solids, unobj-unobjectionable

Table-2. Chemical Parameters of Well Waters in Mista Ali town.

parameters	**1**	**2**	**Sample 3**	**Number 4**	**5**	**6**	**7**	**8**
Conductivity (µmhos/cm)	$2.0x10^2$	$4.0x10^2$	$8.0x10^2$	$5.0x10^2$	$4.0x10^2$	$6.0x10^2$	$7.0x10^2$	$6.0x10^2$
Alkalinity (mg/l)	28.00	16.00	16.00	12.00	24.00	20.00	18.00	23.00
Chlorides (mg/l)	12.00	28.00	12.00	16.00	16.00	12.00	10.00	18.00
Total hardness (mg/l)	270.00	280.00	252.00	280.00	140.00	180.00	300.00	320.00
Sulphate (mg/l)	300.00	320.00	280.00	200.00	300.00	290.00	300.00	310.00
Nitrate (mg/l)	8.00	7.80	8.00	7.60	6.00	8.20	8.00	7.70
pH	7.0	7.2	6.9	7.3	7.2	7.3	7.2	7.0

Table-3. Metal content concentration (mg/l) of the well waters in Mista Ali

Parameters	**1**	**2**	**Sample 3**	**Number 4**	**5**	**6**	**7**	**8**
Zn	ND	ND	ND	ND	ND	ND	ND	ND
Pb	0.005	0.005	0.004	0.004	0.005	0.003	0.003	0.004
Fe	0.890	0.180	0.780	0.326	0.430	0.120	0.180	0.170
Mn	0.029	0.025	0.011	0.012	0.016	0.001	0.002	0.020
Ca	220.00	20.00	40.00	100.00	120.00	100.00	130.00	80.00
Cu	0.002	0.004	0.004	0.002	0.003	0.005	0.006	0.005
Cr	0.006	0.008	0.002	0.001	0.004	0.003	0.002	0.002
Ni	0.008	0.004	0.007	0.008	0.011	0.006	0.007	0.008
K	2.240	3.170	9.840	5.470	6.200	5.300	6.000	5.400
Mg	18.400	17.000	16.600	15.600	12.700	18.000	12.000	18.800
As	ND	ND	ND	ND	ND	ND	ND	ND

Table-4. Microbiological analysis of well waters of Mista Ali

Sample number	MPN/100ml/l of total coliform
1	50.30
2	57.20
3	26.00
4	24.00
5	55.00
6	56.00
7	31.00
8	80.00

4. Discussion

Table 1 presents the physical parameters of the sampled well waters. The results show that the temperature ranged between 27.80 and 28.00^{0}C. Temperature is one of the most important parameters for aquatic environment because all the physical, chemical and biochemical properties are governed by it [9]. All the values are lower than the ones reported by Amoo and Akinbode [10] for well waters in Minna and environs but close to the values reported for shallow wells near dump sites in Akure [11]. Although there is a seasonal fluctuation in well water temperature values, this may be due to function of the climatic condition at a particular geographical location and period. The sampled water are colourless, odourless and has unobjectionable taste which makes the water aesthetically acceptable [8]. The values of the TS, TSS and TDS ranged between 240-370, 220-315 and 195-240mg/L respectively. These values are all below the SON [12] and WHO [13] maximum values of 500 and 600mg/L and similar to the ones reported by Ezeribe, et al. [14] for well water samples in Kaltungo, Dass and Langtang North.

The chemical parameters are shown in Table 2 for the sampled well waters. The conductivity ranged between $2.0x10^2$ and $8.0x10^2$µmhos/cm. These values are below the highest permissible values recommended by SON [12] of 900µmhos/cm and WHO [13] 1000µmhos/cm. These values are higher than the values reported by Ezeribe et al for Dass, Kaltungo and Langtang. The difference may be due to difference in geochemical conditions and soluble ions in the locations analysed. The total alkalinity of the samples which ranged between 12.00 and 28.00mg/L are below the maximum desirable level of 100mg/L for drinking water. The low values of alkalinity indicate absence or low amount of carbonates and bicarbonates in the well waters which contributes to the hardness of the water. The values of the chloride in the sampled waters also fall within the 100mg/L recommended for drinking water. Chlorides results from the leaching of chloride containing rocks and soils with which the water comes in contact. Also chlorides are the most stable components in water and its concentration is largely unaffected by most natural physico-chemical and biochemical processes, hence its value in water is a useful measure in water sample. The total hardness and sulphate values of 140-300mg/L and 200-310mg/L shows that the sampled well waters were fairly soft, being within WHO limits of 400 and 500mg/L respectively. This further explains the absence or low amount of carbonates and bicarbonates that may cause poor lather formation and scales in boilers. The nitrate content of all the well waters 10.00-18.00mg/L is within the SON permissible limits of 100mg/L. Nitrates indicates the presence of oxidized organic matter. Excess nitrates cause methemoglobin as blue baby disease and also indicates presence of other serious residential or agricultural contaminants such as bacteria, fertilizers and pesticides [15]. The pH values range of 6.9 -7.3 are within the permissible level recommended by WHO of 6.5-7.85.It is in agreement with what was reported in other researches in similar studies. Low pH values causes corrosion which can lead to leaching of household common metals and increase the toxic and fowl smelling hydrogen sulphide [10].

Table 3 shows the level of Pb, Fe, Mn, Ca, Cu, Cr, Ni, K and Mg in the sampled well waters. Pb concentration of (0.003-0.005mg/L) shows that the sampled waters are not exposed to indiscriminate disposal of lead battery. Lead even at low concentration is known to be toxic and has no known function in biochemical process. It can impair the nervous system and affect foetus, infants and children resulting in lowering of intelligent quotient even at its lowest dose [16]. Fe concentration of (0.120-0.590 mg/L) is within the permissible level of SON and WHO, high concentration could give rise to iron-dependent bacteria which in turn can cause further deterioration in the quality of water through the development of slimes and unobjectionable odour. Also high concentration of iron could causes haemasiderosis. Mn concentration of (0.011-0.029 mg/L) is within the WHO and SON permissible level, this could also be because of no direct contact with pipes and taps. It is an essential element and has a moderate toxicity. It has being implicated in neurological problems especially when inhaled. Calcium concentration is between (20.00-220.00 mg/L) for the wells. Copper concentration of (0.02-0.06 mg/L) is within the SON and WHO permissible level. Copper is an essential metal and play an important role in enzyme activities [17]. Chromium concentration (0.011-0.006 mg/L) is within the permissible level. The metal is essential to life and its deficiency results in diabetic mellitus and increase the toxicity of lead [17]. Ni (0.004-0011 mg/L), K (2.24-9.80 mg/L) and Mg (12.70-18.00 mg/L) were within the permissible level for portable water. Zn and As were not detected. The observed trend could be as a result of the geographical location of the wells.

The results for the microbial analysis are shown in Table 4, which indicates very low coliform counts for all the wells, indicating few presence of coliform.The coliform counts are all below the standard of 3MPN/mL for coliform in drinking water [18]. This can be due to the fact that all the sampled well water were ringed and properly covered preventing entrance of dirts into the well water.

5. Conclusion

All the water quality parameters examined for well waters in Mista-Ali town, Bassa Local Government Area Plateau State revealed that the well water is fairly soft, has low level of trace metals and absence of micro organism that are harmful. It is recommended that the settlers/inhabitants can use their well water for domestic purposes and also advised to carry out analysis on the Well Water at least once every year because groundwater movement is

usually slow, polluted water may go undetected for a long time as most contamination is discovered only after drinking water has been affected and people become ill. Government should also involve health workers in giving awareness to inhabitants on use of safe water.

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