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Physicochemical and Bacteriological Analyses of Well Water in Abeokuta Metropolis, Ogun –State, Nigeria

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Abstract: *Physico-chemical and Microbial analyses were carried out on fifteen well waters in Abeokuta. The ranges of the result obtained are temperature (27.1°C-27.6°C); colour (5-10HU) ; Turbidity (1.05 -6.78 NTU) ;pH (5.19-7.47).The odour was unobjectionable for samples 1,2,3 , 11,12,13,14,and 15 , others were objectionable. Sample 3 had the highest observed value for acidity (1.00mg/l). The values observed for total hardness and chloride ranged between 39-137mg/land 44-298mg/l respectively. All the samples had no alkalinity, iron and chloride residues, traces of Nitrite was observed. The total viable counts for all the water samples exceeded the standard limit of 1.0 x 10^5cfu/ml, the presumptive coliform counts, ranged between 10 x105cfu/ml and 60 x105cfu/ml, the total coliform count also ranged from 10 to 20 x10^5cfu/ml. All the water sample showed high concentration of Escharichia coli,this exceed the standard limit of zero[14].The isolated identified were, Escharichia coli, Pseudomonas spieces, Bacillus subtilis, Klebsiella species and Entrobacter species. The observations indicate that the water in these wells are not fit for consumption except they are properly treated and screened.*

Key words: Bacteriological analysis, physicochemical, water pollution, water quality, well waters.

I. Introduction

Water is essential to all life both animals and plants. It is capable of dissolving an enormous range of subtances making it ideal medium for life, both invitro and vitro cell[1]. Most people in the world have no access to save drinking water and this has led to increase in water borne diseases which kill more than six million children every year[2]. Water quality assessment has become a big issue today because of the potential hazards associated with the use of contaminated water supply. Various researchers have reported on the serious and severe illness like typhiod fever, Cholera, dysentry resulting from the use of contaminated water supply .Also water of poor physico-chemical quality may have adverse health effect causing unavoidable economic and human losses[3].

Scarcity of portable water is pronounced in Abeokuta, all the effort of the government to provide portable water to the citizens prove abortive because the government cannot afford the cost of infrastucture outlay needed to provide portable water for a population of more than 1 million people. So, the people have to resort to digging shallow wells which is cheaper than a deep well or a bore hole to meet their immediate domestic needs. Therefore, adequate attention needs to be giving to this source of water. It becomes imperative that the water meant for human consumption should be free of diseases causing germs and toxic chemicals that pose a treat to public health.Hence the objective of this research is to determine the quality of some well water in different locations in Abeokuta.

II. Material And Methods

2.1 Sample Collection

Samples were collected from four local government areas in Abeokuta metropolis. They were obafemi Owode, Abeokuta South, Abeokuta North and Odeda Local Governments Plastic sample containers(1.5Lt) were washed with detergent, rinsed with water and sterilized. The bottles were properly labelled, the samples were kept in the refrigerator prior to the analysis

2.2 Chemical Analysis

The temperature of the H_2O samples was determined by using a thermometer. The odour and taste were done using the sensory analysis according to the hedonic scale . pH was determined using the pH metre (Jenway model) which was used after it was calibrated with standard buffers 4.0, 7, 9, 14[4]. Nessler tube was used for colour determination 10mls of sample water was put in the Nessler tube, this was compared with the ionization

comparator disc, and the result was taken directly from the disc[4]. The odour was determined with sensory analysis method. Total suspended solid and total dissolved solid were estimated by gravimetric method described by Trivedi[5] . EDTA titration method was used to determined the total hardness, calcium and magnesium hardness of the water sample.Chloride was determined by adding ten mililitres of potasium dichromate($K_2Cr_2O_7$) into 100ml of water sample and titrated against silver nitrate($AgNO_3$), a faint brick red colour marked the end point[6]. Iron and chlorine residue were determined using lovibond tube[7].

2.3 Microbiological Analysis

Presumptive coliform count was done as described by Arova and Arova[8], measured amount of water sample was added by sterile graduated pipettes as 50ml, 10ml,1ml,0.1ml volumes of water samples were added into 50ml,10ml double strength medium and 5ml single strength in the inoculated bottles. These were incubated at 37^{o}C for 48 hours, the presumptive coliform count per 100ml was determined from the bottles showing acid and gas using the probability table. After the presumptive test, Confirmed E.coli count was determined by preparing some subcultures from all the bottles. The media used were Mancconkey broth and Macconkey agar with sterile peptone water,the sub-cultures were incubated at 37^{o}C and 44^{o}C and examined after 24hours. Total plate count was done by pipetting 1ml of each water samples into four sterile dishes and 1ml of water to 9ml of diluents in sterile test tubes, then 1ml of 1/10 dilution was added to each of the four petri dishes and 9ml diluents, also 1/100 dilution was added to two petri dishes followed by 20ml of molten yeast extract agar, these were mixed gently in a clockwise and anti- clockwise directions.Two of the plates inoculated with undiluted sample,while the other two were inoculated with 1/10 dilution and these were incubated at 37^{o}C for about 24hours,the remaining plates having 1/10 dilution were incubated at 22^{o}C for 72hours[9]. The isolates were identified by morphological methods viz; colonial morphological gram staining and motility,indole,citrate,Urase,Methyl red voges prosker (vp)hydrogen Sulphite and sugar fermentation test[8]

III. Results And Discussion

Table 1 presents the physical parameters of water samples. The result showed that the temperature ranged between 27.1 – 27.6^{o}C, the value obtained were lower than values obtained by Amoo and Akinbode[10] for well water in Minna (30.0^0 – 32.5^{o}C) and Mulusky,(1974), they observed a range of 28 – 30^{o}C,the water body is believed to have been influenced by the intensity of sunlight. The result is slightly different from the observation of Shamaya *et al.,* (2008) who reported temperature range of 26.3-27.2^{o}C , they attributed this to early summer months which prevailed during the period of investigation.also the values observed fall within the 26 -30^{o}C reported by Albster and Lloyd (1980) for surface water, they attributed it to the insulating effect of increased nutrient discharge into the water bodies from the industries. Temperature is an important parameter for aquatic enviroment, it is governed by physical, chemical and biochemical properties. The values observed for colour were above the maximum allowed by NAFDAC and SON(3.0 and 2.0 TCU respectively) but within the maximum permisible level for WHO(15TCU). Colour and particles in water are due to the presence of organic matter associated with the humus fraction of the Soil[11].

Sample 5 has odour, this may result from contamination with dusty particle sand dissolved solids[12], all other samples were odourless, this observation is similar to the report of Daniel *et al*[13]. Obantoko well had the least value for turbidity (1.05NTU) while the highest value was observed in Adigbe well (6.70NTU),turbidity is used to indicate water and filtration effectiveness, higher turbidity levels are often associated with higher levels of disease- causing micro-organisms such as Viruses, Parasites and some bacteria which can cause symptoms such as nausea, cramps, diarrhea and associated headaches[14]. The value of total solid, total suspended solid and total dissolved solid ranged between ; 180.00 – 883.30, 162.70 – 575.00; 122.5 – 614.00 mg/l respectively,the values of total solid obtained for sample 3, 5, 6, 7, 8, 9, and 10 were above WHO and SON standards, 500gm/L[15,16]. These high values may be due to ground water pollution by waste waters which may originate naturally or introduced through human activities[11]. The results of Onuh and Isaac[17], 4.6-39.20mgl ; Amao – Kehinde *et al*[18] 2.0 -36mg/l, were lower than values observed.

Dissolved solid's content for the samples were below 600mg/l permisible level recommended by WHO and SON [15,16], except sample 10 (614mg/l) and 11(657.00mg/l). The chemical parameters are shown in table 2, the conductivity values ranged between 73.10 and 46.7µs/cm , values obtained for samples 6, 10, 11, and 12 were above the recommended value of NAFDAC(1000µs/cm), SON(1000µs/cm) and WHO(900µs/cm). This measures the ability of the water to conduct electricity which depends on the concentration of dissolved substances and temperature. The desirable limit of alkalinity in portable water is 120mg/l[19], the maximum permissible level is 600mg/L, no alkalinity was observed in all the samples

The Nitrate contents observed for all samples were above the standards of SON, NAFDAC and WHO, samples 3,4,7,11,and 12 have Nitrate content which were a bit higher than the recommended value 0.02mg/l. The values observed for Sulphate are high in all samples compared to the recommended(100mg/l).All the water samples had traces of nitrite (0.02-0.21mg/l).WHO required that Nitrite should be negligible because it forms

N-nitroso compounds with Nitrogen in human stomach and accumulation of these act as potent carcinogens[11], Nitrite also has the ability to cause infant Methaemoglobin anaemia or blue baby syndrome[20]. Calcium content is present in almost all the samples except samples 6 and 9,Magnessium content range between (2.00-68.00mg/l),eight samples fall within the standard (20mg/l).The lead content are above the recommended value in all samples, the Chromium content is below detection limit.The result of the microbial analysis of the water samples are shown in Table 4, the presumptive total coliform count of the water samples ranged from 10 $x10^5$ – 60 $x10^5$cfu/ml, it indicates that water from Randa had the highest coliform count of 60 $x10^5$cfu/ml followed by Oluwo,Obantoko.Ijaiye and Camp (40 x 10^5cfu/ml each).The total coliform count also showed that Randa has the highest coliform count of 20 x 10^5cfu/ml followed by Ijaiye (19.5 x 10^5cfu/ml). Well water from Ita – Eko had the least value of 25 $x10^5$cfu/ml for the total plate count while Randa well had the highest(90 $x10^5$cfu/ml).The isolate identified were ; *Escharichia coli, Pseudomonas species, Bacillus subtilis, klebsiella* species and *Enterobacter species*.These wells are highly contaminated, this may be due to the fact that different users use different drawers to fetch the water, illegal dumping of domestic wastes, livestock rearing and closeness of septic tanks. This observation is similar to that Richmann(1997), he reported that the presence of coliforms group in water bodies may be due to contamination with Human or animal feces.

All the water samples showed high concentration of *Escharichia coli*, this pathogens may pose a special heath risk for infants,young children and people with severely compromised immune systems[14]. .The total plate count was also very high in comparism with NAFDAC standards (maximum level permited ,table 4). The percentage occurrence of *Escharichia coli* was 100% while the least was 27% for *Pseudomonas sp* (table5) This result indicates poor sanitary handling of the wells and the public health implication of this is obvious because feacal coliforms are associated with feacal matter, which may contain pathogens[21,22]. The water can only be used for public consumption if only the coliform count is zero, a count of one or more is taken as positive indication of feacal pollution and the possible risk of diseases[23].

The results observed indicate that most well waters in Abeokuta metropolis are highly polluted and therefore unfit for human consumption without proper treatment.

TABLE 1: PHYSICAL PARAMETERS OF WELL WATER SAMPLES COLLECTED FROM DIFFERENT LOCATIONS

S/N	LOCATION	TEMP (°C)	COLOUR (Hu)	ODOUR	TURBIDITY	TOTAL SOLID (mg/L)	TOTAL DISSOLVED SOLID (mg/L)	TOTAL SUSPENDED SOLID (mg/L)
1	Panseke	27.50	10	Unobjectionable	2.71±	385.70	223.00	162.70
2	Adigbe	27.60	10	"	6.78±	260.00	166.60	93.40
3	Oluwo	27.60	5	"	2.15±	690.00	299.00	391.00
4	Kuforiji	27.40	10	Objectionable	1.39±	180.00	122.50	57.50
5	Ojere	27.50	5	"	1.16±	450.00	287.00	163.00
6	Kuto	27.60	5	"	2.55±	687.50	527.00	160.50
7	Ijaiye	27.60	5	"	2.49±	512.50	371.00	141.50
8	Olorunsogo	27.50	5	"	2.22±	512.50	396.00	116.50
9	Ita eko	27.50	5	"	2.22	614.30	332.00	282.30
10	Randa	27.50	10	"	2.67	903.30	614.00	289.30
11	Iberekodo	27.50	5	Unobjectionable	2.73	746.70	574.00	172.70
12	Lafenwa	27.10	10	"	3.72	718.50	657.00	61.50
13	Obantoko	27.10	10	"	1.05	112.50	31.60	80.90
14	Elewe Eran	27.10	10	"	3.80	325.00	150.20	174.80
15	Camp	27.10	10	"	2.13	214.30	92.00	122.30

TABLE 2: CHEMICAL PARAMETERS OF WELL WATER SAMPLES FROM DIFFERENT LOCATIONS

S/N	LOCATION	CONDUCTIVITY (µS/cm)	ACIDITY (mg/L)	ALKALINITY (mg/L)	TOTAL HARDNESS (mg/L)	SULPHATE (mg/L)	NITRATE (mg/L)	NITRITE (mg/L)	CHLORIDE (mg/L)	IRON (mg/L)	CHLORINE RESIDUAL (mg/L)	pH at 20 ^{0}C
1	Panseke	486	0.40	NIL	69	1815.60	268.67	0.21	90	NIL	NIL	6.64
2	Adigbe	364	0.70	NIL	40	1911.05	218.50	0.02	106	NIL	NIL	6.20
3	Oluwo	510	1.00	NIL	93	1910.92	412.00	0.06	270	NIL	NIL	5.19
4	Kuforiji	269	0.40	NIL	39	1817.70	373.60	0.03	44	NIL	NIL	6.53
5	Ojere	623	0.40	NIL	67	1913.16	36.01	0.01	90	NIL	NIL	6.60
6	Kuto	1128	0.30	NIL	127	1912.01	44.10	0.02	271	NIL	NIL	6.91
7	Ijaiye	800	0.10	NIL	80	1912.50	258.60	0.03	176	NIL	NIL	7.40
8	Olorunsogo	853	0.10	NIL	63	1912.66	363.63	0.02	132	NIL	NIL	7.47
9	Ita eko	718	0.30	NIL	92	1911.41	269.40	0.02	112	NIL	NIL	6.89
10	Randa	1306	0.20	NIL	123	1913.01	209.40	0.02	298	NIL	NIL	7.01
11	Iberekodo	1223	0.30	NIL	137	1912.12	410.14	0.05	264	NIL	NIL	6.90
12	Lafenwa	1467	0.20	NIL	82	1819.70	311.12	0.08	210	NIL	NIL	7.15
13	Obantoko	73.1	0.90	NIL	11	1911.20	15.09	0.02	34	NIL	NIL	5.79
14	Elewe Eran	335	0.40	NIL	43	1913.65	37.79	0.02	83	NIL	NIL	6.68
15	Camp	205	0.50	NIL	17	1912.77	57.59	0.02	53	NIL	NIL	6.04

TABLE 3: MEAN VALUES OF METAL CONTENTS OF THE SAMPLES (mg /L)

S/N	Mg	Na	K	Fe	Cu	Cr	Mn	Pb	Ca
1	16	102.56	11.13	18.60	0.06	BDL	0.75	0.14	53
2	3	48.30	7.66	16.12	0.02	BDL	0.53	0.12	37
3	47	12.31	1.24	19.07	0.04	BDL	0.28	0.12	46
4	2	78.60	13.21	18.90	0.03	BDL	0.59	0.15	37
5	13	72.00	41.30	20.01	0.02	BDL	0.55	0.15	54
6	31	6.04	1.54	19.37	0.04	BDL	0.23	0.17	96
7	10	31.94	2.16	18.15	0.06	BDL	0.29	0.15	70
8	41	98.24	12.14	17.54	0.03	BDL	0.50	0.14	22
9	14	174.34	39.14	19.71	0.04	BDL	0.57	0.11	78
10	48	88.28	13.46	18.90	0.08	BDL	0.55	0.12	74
11	68	78.01	28.14	18.92	0.04	BDL	0.59	0.17	69
12	33	104.12	9.11	19.80	0.02	BDL	0.49	0.19	49
13	6	39.16	11.74	18.29	0.03	BDL	0.50	0.17	5
14	6	190.12	32.16	17.80	0.05	BDL	0.51	0.20	37
15	5	11.34	10.09	19.34	0.06	BDL	0.42	0.18	12

BDL=Below Detection Limit

TABLE 4: BACTERIOLOGICAL ANALYSIS OF WATER

S/N	Sample Location	Presumptive Coliform Count (x10 cfu/ml)		Total Coliform count (x10 cfu/ml)		Confirm E.coli count (x10 cfu/ml)		Total Plate count (x10 cfu/ml)		Organism
		Test	Max Permitted level (NAFDAC)	Test	Max Permitted level (NAFDAC)	Test	Max Permitted level (NAFDAC)	Test	Max Permitted level (NAFDAC)	
1	Panseke	20	10	10.0	10	10	0	40	10	Escherichia coli, Pseudomonas sp, Enterobacter sp.
2	Adigbe	35	10	17.0	10	10	0	40	10	Escherichia coli, Klebsiella sp.
3	Oluwo	40	10	15.0	10	15	0	55	10	Escherichia coli, Enterobacter sp.
4	Kuforiji	35	10	12.0	10	10	0	50	10	Escherichia coli, Enterobacter sp.
5	Ojere	40	10	18.0	10	10	0	60	10	Escherichia coli, Pseudomonas sp., Klebsiella sp.
6	Kuto	25	10	10.0	10	10	0	30	10	Escherichia coli, Klebsiella sp.
7	Ijaiye	40	10	19.5	10	10	0	60	10	Escherichia coli Pseudomonas sp., Bacillus subtilis
8	Olorunsogo	40	10	15.0	10	20	0	70	10	Escherichia coli, Bacillus subtilis, Enterobacter sp.
9	Ita eko	10	10	10.0	10	5	0	25	10	Escherichia coli, Klebsiella sp. Bacillus subtilis
10	Randa	60	10	20.0	10	20	0	90	10	Escheric

										hia coli, Enterobacter sp.
11	Iberekodo	35	10	15.0	10	5	0	55	10	Escherichia coli, Bacillus subtilis, Klebsiella sp.
12	Lafenwa	35	10	16.0	10	10	0	45	10	Escherichia coli, Pseudomonas sp., Bacillus subtilis
13	Obantoko	40	10	19.0	10	15	0	50	10	Escherichia coli, Enterobacter sp.
14	Elewe Eran	40	10	15.0	10	12	0	64	10	Escherichia coli, Enterobacter sp., Klebsiella sp.
15	Camp	40	10	17.5	10	10	0	65	10	Escherichia coli, Bacillus subtilis, Klebsiella sp.

TABLE 5: TYPES OF BACTERIA IDENTIFIED IN THE WATER SAMPLES.

LOCATIONS	ORGANISMS				
	E.coli	*Pseudomonas sp.*	*Bacillus subtilis,*	*Klebsiella sp.*	*Enterobacter sp.*
Panseke	+	+	-	-	+
Adigbe	+	-	-	+	-
Oluwo	+	-	-	-	+
Kuforiji	+	-	-	-	+
Ojere	+	+	-	+	-
Kuto	+	-	-	+	-
Ijaiye	+	+	+	-	-
Olorunsogo	+	-	+	-	+
Ita eko	+	-	+	+	-
Randa	+	-	-	-	+
Iberekodo	+	-	+	+	-
Lafenwa	+	+	+	-	-
Obantoko	+	-	-	-	+
Elewe Eran	+	-	-	+	+
Camp	+	-	+	+	-
%	100	27	40	47	47

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