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Full Length Research Paper

Physico-chemical and Bacterialogical Analyses of Sachet water samples in Abeokuta Metropolis

***Taiwo A.A, Idowu Oluwadare, Lanre-Iyanda Y.A, Jolaoso A.A, Jiboku O.O, Ijaola T.O and Taiwo A.G**

Science Laboratory Technology Department, Moshood Abiola Polytechnic, Abeokuta, Ogun State, Nigeria.

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Sachet water samples were purchased from 26 different wholesale depots in Abeokuta, Physico-chemicals and bacteriological analyses were carried out on them to ascertain their wholesomeness using standard methods . Results obtained showed a consistent pH range of 6.00-7.87 for all samples, Total Solids (TS) were between 25.00mg/L -187.5mg/L, Total Dissolved Solids (TDS) (26.20mg/L-122.20mg/L), Acidity (0.10-0.80mg/L), Total hardness (2.00mg/L-43.00mg/L) and Conductivity (35.00µS/cm) -257.00µS/cm). 96.15% of the samples had acceptable world Health Organisation values of <10CFU/ml while 100% of the sample had acceptable Coliform or Escharichia coli values of <10CFU/ml (WHO,1999) . The results showed that an effective quality control system and a high level of sanitation in all the production depots.

INTRODUCTION

Water is present in almost all part of the earth, it makes up three quarter (3/4) of the entire earth surface and exists in three states ; Vapour, Liquid and Solid, it is mostly needed by all forms of life, Man, Animals and plants (Tebutt, 1998 and Symons *et al*., 1998,). Water constitutes a sizeable percentage of our daily food intake as human bodies do not have reserve supply and due to its natural abundance, it is considered a universal solvent (Nwosu and Ogueke, 2004). Supplies are derived from springs, rivers, reservoirs, boreholes and natural lakes, the water passes through the ground and during its passage will dissolve some minerals in rocks, suspended particles, and pathogenic microorganisms from feacal matters. These and other factors make water unfit for drinking leading to problem of scarcity or insufficient portable drinking water which is more pronounced nowadays (Raymond, 1992). Dada and Ntukepo(1997), reported that 30% of Nigerians have access to portable water, they also stated that 80% of all diseases and over 30% of deaths are water related.

In many areas in Abeokuta, availability of pipe borne water has become a critical and urgent problem, most indigenes depend on sachet water to survive. Therefore it becomes imperative to evaluate the physical, chemical and bacteriological qualities of these sachet water sold in Abeokuta metropolis to ascertain whether they conform to recommended standards for portable water.

MATERIALS AND METHODS

Sachet water samples were purchased at twenty- six different wholesale depots within Abeokuta metropolis. A total of 78 samples of different brands were analysed because the analyses were carried out in triplicates.

Sensory analysis was determined using the 9-point hedomic scale as described by Edema *et al* (2001). pH was determined using Jenway model pH meter after the meter was calibrated with standard buffers of pH 4.0,7.0 and 9.0 (Ademoroti,1996), Mettler multiparameter meter was used to measure the conductivity of the samples, Alkalinity was obtained by titrating 100ml of the samples with 0.02M HCl solution using methyl orange as indicator. Chloride was determined by titrating 100ml of the samples with 0.025M $AgNO_3$ solution using 5% K2Cr2O7 as indicator (AOAC,2000).Total solid, total dissolved solid and total suspended solid were estimated by gravimetric method(Trevedi and Ray,1997)*E.coli* counts were determined using multiple tube technique and bacterialogical analyses were determined using spread plate technique (APHA, 1985). The temperature of the

*Corresponding Author E-mail : ladytaiwo2005@yahoo.com

Tables 1 : Mean of Physical parameters of the samples

Sample	Temp(^{O}C)	Colour	Odour	Total solids (mg/L)	Total Dissolved solids (mg/L)	Total suspended solids (mg/L)	Turbidity
1	26.20	5	Unobjectionable	171.43	79.8	91.63	1.01
2	26.10	5	"	157.14	81.40	75.74	0.17
3	26.30	5	"	120.00	70.60	49.40	0.43
4	26.30	5	"	170.00	61.60	108.40	0.89
5	26.20	5	"	130.00	74.40	55.60	0.32
6	26.20	5	"	100.00	26.20	60.60	0.25
7	25.50	5	"	62.50	18.80	43.70	3.04
8	25.10	5	"	87.50	65.20	22.30	3.10
9	25.30	5	"	112.50	94.20	18.30	2.70
10	25.70	5	"	100.00	84.70	15.30	3.82
11	25.40	5	"	150.00	111.80	38.20	4.13
12	25.50	5	"	55.00	16.40	39.50	4.05
13	25.70	5	"	100.00	81.50	18.50	3.79
14	25.30	5	"	175.00	122.20	53.80	3.10
15	25.60	5	"	125.00	115.10	9.90	0.71
16	25.80	5	"	100.00	82.10	17.90	0.30
17	27.20	5	"	142.90	67.80	75.10	0.50
18	27.60	5	"	120.00	79.10	40.90	0.60
19	27.70	5	"	114.60	79.90	34.90	0.57
20	27.60	5	"	112.50	57.50	55.00	0.44
21	27.71	5	"	120.00	79.10	40.90	0.60
22	27.50	5	"	128.60	72.70	55.90	0.48
23	27.50	5	"	25.00	15.30	9.70	0.17
24	27.50	5	"	98.30	69.10	29.20	0.38
25	27.50	5	"	125.00	76.10	48.90	0.30

water was determined using mercury glass thermometer, EDTA titration method was used for Total hardness,Calcium and Magnesium hardness determinations.(AOAC,2000). Iron was determined spectrophotometrically at wavelength of 555nm (APHA,1992) .Bacteriolgical analysis was carried out using pour aplate technique,1ml of water sample was transferred into prepared sterilized medium(macconkey agar) in the glass petri dish, the content in the petri dish was mixed by gentle agitation,cooled,then transfer into the incubator for 24hours at 35oC.Durham tubes were used for detection of coliform, 5ml of sterilized medium was measured into into the tubes , 1ml of the water sample was added,incubated at37oC for 24hours(WHO,1985)

RESULTS AND DISCUSSION

The results of the physical and chemical analyses are presented in tables 1 and 2. The temperature ranged between 25.10^{O}Cand 27.70^{O}C, this parameter is one of the most important parameters for aquatic environment because almost all the physical, chemical and biochemical are temperature dependent (Edema *et al*.,2001).

The water samples were colourless, odourless and tasteless. This is in accordance with the results of Nwosu and Ogueke (2004), and Daniel et al (2007), they observed that poor odour and taste may result from contamination with dusty particles and dissolved solids. Turbidity observed in sample 5 was the highest (4.13NTU), while samples 6 and 21 had the least value (0.30NTU). All values fall within the SON recommended standards of 5NTU (SON,2003)

Total solid values ranged between 25.0mg/L-175.0mg/L, this is lower than the maximum value allowed by SON ,NAFDAC and WHO (500mg/L). Presence of solid particles in water indicate contamination (Goel, 2006). Nwosu and Ogueke (2004) observed that presence of solids may be as a result of poor filtration method.

All samples had no trace of alkalinity, alkalinity in water gives unpalatable taste (Goel,2006) .The chloride content ranged between 31 and 65mg/L, these values are lower than the standards of WHO (250mg/L). WHO (1999) stated that high chlorine concentration gives an undesirable salty taste to water

Tables 2. Mean of Chemical Parameters of the Samples.

Sample	pH	Conductivity (µs/cm)	Acidity (mg/L)	Alkalinity (mg/L)	Total Hardness (mg/L)	Calcium Hardness (mg/L)	Magnesium Hardness (mg/L)	Iron (mg/L)	Chloride (mg/L)	Chlorine residue (mg/L)
1	6.80	166.00	0.30	Nil	37.00	30.00	7.00	0.10	41.00	Nil
2	6.93	178.78	0.20	"	41.00	28.00	13.00	0.10	42.00	"
3	6.87	150.10	0.30	"	36.00	25.00	11.00	Nil	38.00	"
4	7.87	136.20	Nil	0.10	12.00	10.00	2.00	Nil	38.00	Nil
5	6.63	158.00	0.40	Nil	36.00	24.00	12.00	"	36.00	"
6	6.74	57.90	0.40	"	2.00	2.00	0.00	0.10	32.00	"
7	6.80	40.00	0.30	"	6.00	3.00	3.00	0.10	26.00	"
8	7.20	137.60	0.10	"	25.00	16.00	9.00	Nil	32.00	"
9	7.20	198.60	0.10	"	29.00	19.00	10.00	Nil	50.00	"
10	7.20	174.80	0.10	"	31.00	23.00	8.00	"	40.00	"
11	7.20	235.00	0.10	"	35.00	23.00	12.00	0.10	54.00	"
12	7.00	35.00	0.20	"	5.00	3.00	2.00	0.10	30.00	"
13	7.00	71.70	0.20	"	38.00	18.00	20.00	"	32.00	"
14	7.20	257.00	0.10	"	25.00	24.00	1.00	"	65.00	"
15	6.00	243.00	0.80	"	24.00	21.00	3.00	"	38.0	"
16	6.60	174.90	0.40	"	24.00	18.00	6.00	"	37.0	"
17	7.12	134.30	0.10	"	34.00	20.00	14.0	"	36.00	"
18	7.32	157.10	0.10	"	39.00	27.00	2.00	"	41.00	"
19	7.27	159.30	0.10	"	38.00	26.00	12.00	"	28.00	"
20	7.27	115.10	0.10	"	28.00	21.00	7.00	"	31.00	"
21	7.13	152.30	0.10	"	35.00	27.00	8.00	"	31.00	"
22	6.87	145.60	0.30	"	30.00	22.00	8.00	"	40.00	"
23	7.08	31.68	0.20	"	Nil	Nil	NIL	"	40.00	"
24	7.18	167.30	0.10	"	31.00	26.00	5.00	"	30.00	"
25	7.18	139.30	0.10	"	43.00	29.00	14.00	"	42.00	"
26	7.54	130.50	0.10	"	25.00	23.00	2.00	"	32.00	"

For conductivity, sample 8 has highest value (257.00µS/cm), while sample 6 has the least (35µS/cm). These values are below the highest desirable level of 1000µS/cm (SON). All the water samples had low values for total hardness (2.00-43.00mg/L),the values obtained fall within 38.40-72.50mg/L reported by Nwosu and Ogueke (2004) for total hardness of satchet water. Samples 1, 2, 6,7,11, and 12 had traces of iron while others are free of the elements.This values are withing the range of 0.005-0.635mg/, reported by Amao- Kehinde et al (2004). Presence of iron in substantial quantities can make the water unsuitable for food processing.(Oyeku *et al*., 2001).

The pH values observed for the water samples were between 6.0 and 7.54,these values are within the permissible levels of SON ,NAFDAC(6.50-8.50),and WHO(6.50-9.50). pH values lower than 6.5 can lead to corrosion of pipes causing release of metals like Zinc,Lead and copper in water samples,high pH on the other hand can increase scale formation in heating vessels,reduce the bacterialcidal effect of Chlorine (Onuh and Isaac ,2009). .

The acidity level in sample 15 (0.80mg/L) was the highest, while the lowest value was observed in samples 2, 3, 4, 5, and 8 (0.10mg/L).

Result of the bacteriological analysis (Table 3) revealed that 96.15% of the water samples were within the world health organization guideline value of < 10cfu/ml(WHO,1999),the water samples 1 to 26 exceptsample 18 fall within the recommended limits of<10cfu/ml E.coli or coliform counts which has been used extensivelyas a basis for regulating the microbial quality of drinking water. In this study the results showed 100% of the samples used for analysis did not contain E. coli,its presence of in any drinking water poses a serious threat to health of individual, since it is an intestinal

Table 3. Result of the bacteriological analysis.

Sample	Bacteria(CFU/1ml)	Ecoli(CFU/1ml)
WHO	<10	<10
1	Nil	NIL
2	"	"
3	"	"
4	"	"
5	"	"
6	"	"
7	"	"
8	"	"
9	"	"
10	"	"
11	<10	"
12	<10	"
13	<10	"
14	Nil	"
15	"	"
16	"	"
17	<10	"
18	>10	"
19	Nil	"
20	<10	"
21	Nil	"
22	"	"
23	"	"
24	<10	"
25	Nil	"
26	"	"

Table 4: Standards of physico-chemical parameters.

S/N	Parameter	NAFDAC	SON Standard	WHO Standards	
		Maximum Allowed limits		Highest Desirable	Maximum Permissible
1	Color	3.0 TCU	3.0 TCU	3.0 TCU	15 TCU
2	Odor	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
3	Taste	Unobjectionable	Unobjectionable	Unobjectionable	Unobjectionable
4	pH at $20^{U}C$	6.5-8.5	6.5-8.0	7.0-8.9	6.5-9.5
5	Turbidity	5.0 NTU	5.0 NTU	5.0 NTU	5.0 NTU
6	Conductivity	1000(µs/cm^{4})	1000(µs/cm^{4})	900(µs/cm^{4})	1200(µs/cm^{4})
7	Total Solids	500mg/L	500mg/L	500mg/L	1500mg/L
8	Total Alkalinity	100mg/L	100mg/L	100mg/L	100mg/L
9	Phenolphthalein Alkalinity	100mg/L	100mg/L	100mg/L	100mg/L
10	Chloride	100mg/L	100mg/L	200mg/L	250mg/L
11	Fluoride	1.0mg/L	1.0mg/L	1.0mg/L	1.5mg/L
12	Copper	1.0mg/L	1.0mg/L	0.5mg/L	2.0mg/L
13	Iron	0.3mg/L	0.3mg/L	1mg/L	3mg/L
14	Nitrate	10mg/L	10mg/L	10mg/L	50mg/L
15	Nitrile	0.02mg/L	0.02mg/L	0.02mg/L	3mg/L
16	Manganese	2.0mg/L	0.05mg/L	0.1mg/L	0.4mg/L
17	Magnesium	20mg/L	0.20mg/L	20mg/L	20mg/L
18	Zinc	5.0mg/L	5.0mg/L	0.01mg/L	3.0mg/L
19	Selenium	0.01mg/L	NS	0.01mg/L	0.01mg/L
20	Silver	-	-	NS	NS
21	Cyanide	0.01mg/L	0.01mg/L	0.01mg/L	0.07mg/L
22	Sulphate	100mg/L	100mg/L	250mg/L	500mg/L
23	Calcium	75mg/L	750mg/L	NS	NS
24	Aluminum	0.5mg/L	NS	0.3mg/L	0.3mg/L
25	Potassium	10.0mg/L	10.0mg/L	NS	NS
26	Lead	0.01mg/L	0.01mg/L	0.01mg/L	0.01mg/L
27	Chromium	0.05mg/L	0.05mg/L	0.05mg/L	0.05mg/L
28	Cadmium	0.003mg/L	0.003mg/L	0.003mg/L	0.003mg/L
29	Arsenic	0.01mg/L	0.01mg/L	0.01mg/L	0.01mg/L
30	Barium	0.05mg/L	0.05mg/L	0.05mg/L	0.07mg/L
31	Mercury	0.001mg/L	0.001mg/L	0.001mg/L	0.001mg/L
32	Antimony	NS	NS	-	0.02 mg/L
33	Tin	-	-	-	1-µg/L
34	Nickel	-	-	-	0.02mg/L
35	Total Hardness	100mg/L	100mg/L	100mg/L	500mg/L
36	Vinyl Chloride	0 mg/L	0 mg/L	0 mg/L	0.003 mg/L

parasitethat may indicate feacal contamination(Rose et al.,1993).the absence of E.coli in all the water samples showed an effective quality control system and a high level of sanitations in all the production depots.

The bacteriological and physico-chemical properties observed in all the sachet water samples were within the permissible limits,they showed that there is improvement in the quality of sachet water produced in Abeokuta metropolis because Edema et.al (2001) observed that the sachet water in Abeokuta as at that time had offensive taste and all the parameters did not meet the recommended standards for portable water stipulated by the World Health Organisation.

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