



Chemical Assessment of Sachet Water in Ado-Ekiti Metropolis, Nigeria

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Authors' contributions

This work was carried out in collaboration between both authors. Author OSA designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. Authors OSA and MAA managed the analyses of the study. Author MAA managed the literature searches. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CSJI/2019/v26i430097

Editor(s):

(1) Dr. Marcelo Daniel Preite, Professor, Department of Organic Chemistry, Pontifical Catholic University of Chile, Chile.

Reviewers:

(1) S. Satyanarayana, R V College of Engineering, India.

(2) P. N. Palanisamy, Kongu Engineering College, India.

Complete Peer review History: <http://www.sdiarticle3.com/review-history/28148>

Original Research Article

Received 19 March 2016

Accepted 30 July 2016

Published 05 April 2019

ABSTRACT

Twenty five different brands of sachet water produced in Ado-Ekiti metropolis have been analysed for drinking water quality using standard analytical method. The result obtained for all the water samples indicated a pH range of 6.06 - 7.96, total solid (TS) 40.00 – 120.00 mg/l, total dissolved solids (TDS) 20.00 – 100.00 mg/l, turbidity (0.25 – 2.20 NTU) , conductivity (30.00 – 252.00 μ ohm/s), acidity 9 0.10 – 0.30 mg/l), chloride (28.40 – 50.11 mg/l) and nitrate (18.70 – 43.00 mg/l). Iron has the highest value (0.05 – 3.95 mg/l) in heavy metal analysis while concentrations of Pb, Cr and Ni were below detection limit in all samples. The total bacteria count (TBC) ranged between 1 and 8. The total coliform count (TCC) in almost all water samples was below detection limit. The physicochemical parameters of the analysed sachet water samples were within the WHO, NAFDAC and SON standards for drinking water. However it was observed that all the samples required chlorination prior to packaging.

Keywords: *Water; Sachet; assessment; metropolis.*

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1. INTRODUCTION

Accessibility and availability of fresh clean water is a key to sustainable development, an essential element in good health, food production and poverty reduction. A communiqué issued after the Third World Water Forum in 2003, reported that an estimated 1.2 billion people around the world lack access to safe water [1]. Sources of water available for drinking include: surface water, groundwater and rain water. But some of these sources can be contaminated through human activities [2]. In most developing countries, water supply is a severe problem. Sometimes, water is provided only for few hours in a week. It is estimated that about half of the population of developing countries receives water on an intermittent basis. Safe and potable water supplies in urban centres in Nigeria are still inadequate after over four decades of independence and several efforts of the government [3]. The importance and contribution of low cost alternative drinking water schemes to sustained access in rural and urban settings of developing nations cannot be overemphasized [4]. One of such alternative in Nigeria in general and Ado Ekiti in particular, where public drinking water supply is unreliable, is drinking water sold in polythene sachets called "pure water". This product is either registered with national food regulatory body or sometimes not registered. This sachet water is produced by small scale industries, registered with government regulatory body like NAFDAC [5]. The water is cheap and affordable to medium and low income groups. The production, marketing and consumption of sachet water have increased tremendously. There are several brands of this packaged water marketed in Nigeria and other developing nations [6].

The manufacturers of these sachet waters are often more concerned about their profit than the quality of water sold to the public. Therefore, the objective of this work is to determine the quality of brands of sachet water sold in Ado metropolis, to ascertain whether they conform to standards for drinking water.

2. MATERIALS AND METHODS

Twenty five different brands of sachet water were purchased from vendors within Ado-Ekiti metropolis. A total of seventy five samples were analysed and the analyses were carried out in triplicate.

Colour, odour, taste were determined with sensory organs as describe by Edema et al. [7]. Other physical and chemical analyses were carry out according to methods described in AOAC [8]. Metal analysis in the samples were obtained by method described by APHA [9] followed by Atomic Absorption Spectroscopy. The Bacteriological analyses were done using standard methods employed by Oyedeji et al. [10].

3. RESULTS AND DISCUSSION

The result of mean physical parameters of the Sachet water samples are presented in Table 1. The data shows that TSS ranged between 20.00 and 80.00mg/l, while TDS, TS and turbidity range between 20.00-100.00 mg/l, 40.00 – 120mg/l and 0.25 – 2.20 respectively. The colour of the sachet water samples are clear while the odour are pleasant, which infer that the water samples were colourless, odourless and tasteless. The result is in agreement with results of [11,12,13].

The measured chemical parameters are presented in Table 2. The pH, conductivity, acidity and alkalinity values range between 6.06-7.96, 30-252 μ /cm², 0.10-0.30mg/l and 0.01-0.15mg/l. These values are below World Health Organisation (WHO) [14], Standards Organisation of Nigeria (SON) [15] and National Agency for Food and Drug Administration and Control (NAFDAC) [5] standard limits. The detected values are also in agreement with values reported by [7] in similar study for Abeokuta metropolis, Ogun state, Nigeria. All water samples are low in total hardness (24.00-42.00mg/l), calcium hardness (15.00-30.00mg/l) and magnesium hardness (7.00-16.00mg/l). And the obtained values are similar to values reported by [7,12,13,14].

The chloride content ranges between 28.40 and 50.11mg/l. These values are lower than the standards of WHO [14], SON [15] and NAFDAC [5] of 250mg/l. WHO [14] stated that high chloride content gives an undesirable salty taste in water. The nitrate values for the water samples ranged between 18.70 and 43.00mg/l. Samples 20 has the highest nitrate value of 43.00mg/l, while sample 21 has the lowest value of 18.70mg/l. All these values are lower than permissible maximum contamination of 50mg/l in drinking water by WHO [14]. Some values of nitrate in the sachet water samples were higher than 30mg/l. It is necessary for such samples to be properly monitored to avoid the tendency of

nitrate accumulation in human body. Similar observation has been reported by Ajiwe et al. [3] on sachet water sold in Akwa metropolis Anambra state, Nigeria.

The mean concentrations of metals in all the sachet water samples are presented in Table 3. In all the samples, lead, chromium and nickel were not detected while copper (ND-0.04) was detected in low concentration in some of the water samples.

The concentration of iron detected in the water samples range between 0.05-3.75mg/l while manganese has value between 0.02 and 2.84mg/l. The value of iron largely falls within the maximum permissible value by WHO [14]. However, its concentrations in samples 7, 18 and

19 are higher than maximum permissible value. However, most of these values were higher than SON [15] and NAFDAC [16] values of 0.30mg/l. The values of iron in this study is similar to the one obtained by Muhammad and Fanan [16] on sachet water samples in Abuja metropolis, Nigeria.

Bacteriological analysis (Table 4) revealed that total bacterial count values is between 1 and 6. Most of the samples has no Total Coliform count except samples 12-14 and all the water samples has no Total *E. coli*. The observed result for bacterial count indicates that most of the water samples have not been treated with chlorine before packaging.

Table 1. Mean value of physical parameter of the Sachet water samples

Sample	Temp(°c)	Odour	Colour	T.S(mg/l)	TDS(mg/l)	T.S.S(mg/l)	Turbidity(NTU)
1	27.00	Unobjectionable	Clear	80.00	40.00	40.00	1.01
2	25.90	Unobjectionable	Clear	120.00	80.00	40.00	0.25
3	26.00	Unobjectionable	Clear	80.00	40.00	40.00	0.42
4	26.00	Unobjectionable	Clear	80.00	40.00	40.00	0.17
5	26.00	Unobjectionable	Clear	60.00	40.00	20.00	0.82
6	27.00	Unobjectionable	Clear	100.00	60.00	40.00	0.34
7	26.40	Unobjectionable	Clear	180.00	100.00	80.00	0.35
8	26.80	Unobjectionable	Clear	100.00	60.00	40.00	0.41
9	26.90	Unobjectionable	Clear	40.00	20.00	20.00	0.29
10	27.00	Unobjectionable	Clear	140.00	100.00	40.00	0.28
11	26.60	Unobjectionable	Clear	40.00	20.00	20.00	1.41
12	26.00	Unobjectionable	Clear	60.00	60.00	20.00	2.20
13	26.40	Unobjectionable	Clear	80.00	40.00	40.00	2.10
14	26.40	Unobjectionable	Clear	100.00	60.00	40.00	0.60
15	26.70	Unobjectionable	Clear	120.00	70.00	50.00	1.01
16	26.50	Unobjectionable	Clear	80.00	20.00	60.00	0.92
17	26.90	Unobjectionable	Clear	130.00	80.00	50.00	0.31
18	27.00	Unobjectionable	Clear	140.00	100.00	40.00	0.42
19	26.50	Unobjectionable	Clear	180.00	100.00	80.00	0.42
20	26.80	Unobjectionable	Clear	100.00	60.00	40.00	0.68
21	27.00	Unobjectionable	Clear	80.00	40.00	40.00	0.75
22	26.90	Unobjectionable	Clear	80.00	20.00	60.00	0.63
23	26.70	Unobjectionable	Clear	100.00	60.00	40.00	0.90
24	27.00	Unobjectionable	Clear	80.00	40.00	40.00	0.31
25	26.80	Unobjectionable	Clear	60.00	40.00	20.00	0.30

Table 2. Mean of chemical parameters of the sachet water samples

Sample	pH	Conductivity	Acidity	Alkalinity	Total hardness	Ca hardness	Mg hardness	Chloride	Nitrate
1	6.27	240.00	0.20	0.15	42.00	28.00	14.00	45.90	26.00
2	7.35	152.10	0.10	0.13	41.00	26.00	15.00	48.58	22.10
3	7.12	130.10	0.10	0.06	28.00	18.00	10.00	34.38	30.16
4	6.70	40.00	0.10	0.03	35.00	24.00	11.00	49.00	36.10
5	6.61	30.00	0.10	0.14	34.00	20.00	10.00	33.10	19.10
6	7.45	150.00	0.15	0.07	27.00	16.00	11.00	50.10	25.00
7	6.58	90.00	0.12	0.15	28.00	20.00	8.00	52.00	26.19
8	6.60	110.00	0.22	0.07	40.00	24.00	16.00	36.00	41.10
9	7.06	86.00	0.18	0.13	34.00	22.00	12.00	33.00	19.45
10	6.06	252.00	0.17	0.07	35.00	28.00	7.00	43.15	30.35
11	6.92	171.00	0.20	0.04	24.00	15.00	9.00	37.00	24.10
12	7.20	184.00	0.30	0.12	36.00	28.00	8.00	28.40	25.79
13	7.84	125.00	0.20	0.11	38.00	20.00	18.00	50.11	22.11
14	7.90	131.00	0.20	0.05	40.00	30.00	10.00	38.16	38.45
15	6.63	75.00	0.20	0.01	32.00	18.00	14.00	35.00	24.67
16	7.96	161.10	0.20	0.11	30.00	21.00	9.00	36.00	35.09
17	7.28	152.15	0.10	0.04	37.00	27.00	10.00	34.00	26.19
18	7.57	80.10	0.10	0.13	39.00	30.00	9.00	41.00	28.01
19	7.24	140.00	0.11	0.08	30.00	18.00	12.00	45.00	28.00
20	7.18	125.00	0.13	0.10	36.00	28.00	8.00	42.00	43.00
21	7.13	128.10	0.10	0.01	26.00	17.00	9.00	35.00	18.70
22	6.98	85.10	0.30	0.01	24.00	16.00	8.00	36.00	22.03
23	7.07	130.00	0.11	0.02	39.00	29.00	10.00	30.00	27.30
24	7.14	201.10	0.10	0.10	37.00	26.00	11.00	33.10	30.10
25	7.25	211.00	0.10	0.05	25.00	15.00	10.00	38.20	31.00

Table 3. Mean concentration of metals in Sachet water samples.

Sample	Fe	Cu	Mn	Pb	Cr	Ni
1	0.56	ND	0.02	ND	ND	ND
2	0.22	0.02	0.05	ND	ND	ND
3	1.62	ND	0.21	ND	ND	ND
4	0.27	0.02	0.10	ND	ND	ND
5	2.25	ND	2.78	ND	ND	ND
6	0.81	ND	2.78	ND	ND	ND
7	2.04	0.04	ND	ND	ND	ND
8	1.10	ND	0.99	ND	ND	ND
9	0.54	ND	0.88	ND	ND	ND
10	0.34	ND	0.10	ND	ND	ND
11	2.00	ND	1.66	ND	ND	ND
12	1.22	0.02	2.84	ND	ND	ND
13	1.03	0.01	0.29	ND	ND	ND
14	0.77	ND	ND	ND	ND	ND
15	0.05	ND	0.42	ND	ND	ND
16	1.65	0.01	1.23	ND	ND	ND
17	3.95	ND	0.17	ND	ND	ND
18	3.69	0.01	0.26	ND	ND	ND
19	3.69	0.01	0.36	ND	ND	ND
20	0.73	ND	ND	ND	ND	ND
21	2.76	0.03	0.17	ND	ND	ND
22	1.65	ND	0.06	ND	ND	ND
23	1.45	ND	ND	ND	ND	ND
24	0.80	0.01	0.32	ND	ND	ND
25	0.78	0.02	ND	ND	ND	ND

Table 4. Results of bacteriological analysis of sachet water sample

Sample	TBC	TCC	TEC
1	2	ND	NIL
2	4	ND	NIL
3	2	ND	NIL
4	5	ND	NIL
5	6	ND	NIL
6	3	ND	NIL
7	2	ND	NIL
8	NIL	ND	NIL
9	NIL	ND	NIL
10	7	ND	NIL
11	8	1	NIL
12	4	1	NIL
13	2	1	NIL
14	2	1	NIL
15	2	ND	NIL
16	1	ND	NIL
17	1	ND	NIL
18	1	ND	NIL
19	1	ND	NIL
20	1	ND	NIL
21	5	ND	NIL
22	3	ND	NIL
23	4	ND	NIL
24	2	ND	NIL
25	2	ND	NIL

4. CONCLUSION

The physico-chemical, metal and bacteriological parameter in the sachet water samples have shown that most of the water samples are good for drinking. However, the producers should enhance the treatment and purification of their water before packaging. Also, there is need to monitor all the operation process of sachet water producers by NAFDAC and SON to improve on the quality and comply with the drinking water quality standard.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:

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