



COMPARATIVE ASSESSMENT OF QUALITY CONSISTENCY OF SACHET-PACKAGED TABLE WATER BRANDS IN NSUKKA LOCAL GOVERNMENT AREA, ENUGU STATE, NIGERIA.

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ABSTRACT

Samples of sachet packaged table water (popularly known as pure water) of four brands labeled A, B, C and D, were taken weekly from their respective factories for four consecutive weeks. Each set of the samples was analysed for the following physicochemical parameters: pH, total solids, hardness, chloride and nitrate, to establish their levels of consistency and compliance with standard. The mean ranges of the results covering the four brands are as follows: pH=6.49-7.33; total solids=35.10-82.26 mg/l; hardness=14.00-26.00mg/l; chloride=31.95-33.02mg/l; nitrate =8.93 28.31mg/l. From the results obtained the comparative assessment of the overall levels of physicochemical quality consistency of the four brands can be stated as: B>A>D>C. Furthermore, all the brands complied with the World Health Organization (WHO) standard for potable water, except for C which produced sub-standard samples that failed the tests for pH and nitrate. Regular monitoring tests of this nature help to ensure compliance with water quality standard, while positively addressing environmental health inequalities.

Keywords: *Sachet-packaged water; analysis, physicochemical, parameter, consistency, standard.*

INTRODUCTION

Water is a useful resource for domestic, industrial, agricultural and other purposes and its importance to man cannot be overemphasized, even as it plays majors roles in body metabolism and proper functioning of cells. Though water is abundant in nature, occupying about 71% of the earth's surface, only 2.8% is accessible as fresh water for human consumption (Krantz and Kiffersstain, 2013; Agbazue and Akpanisi, 2012).

In Africa, scarcity and water pollution constitute major challenges for sustainable water resources management. Despite the World Health Organization (WHO) guidelines for drinking water quality, water pollution in various sources has been increasing over recent decades in most countries (Mihayo and Mkoma, 2012).

The inadequacy of pipe borne water in Nsukka Local Government Area (LGA) of Enugu State, just like in other parts of Nigeria is almost endemic. This inadequacy is both in quantity and quality of public water supply. As an alternative to the water supply, citizens resort to packaged table water (popularly known as pure water) comprising about 0.5 liter water in each nylon sachet, which is electrically heated, treated, sealed at both sides and widely patronized by both low and middle class Nigerians. Though it is easy to serve and the price is affordable, people still

ask questions on the quality of the sachet water. The National Agency for Food and Drug Administration and Control (NAFDAC) has been monitoring the production and quality of sachet water in Nigeria. However, most manufacturing factories abandon NAFDAC's guidelines as soon as they get registered.

In order to attain the provision of safe potable sachet water in Nigeria, NAFDAC recommended that potable water should not contain any pathogens and that the physicochemical parameters of the water should not fall outside the recommended limits (NAFDAC, 2012). Water is said to be potable when its physical, chemical and bacteriological qualities conform to specified standards. To achieve such standards, raw water is subjected to purification processes that range from simple long-term storage/aeration to enhanced sedimentation of some suspended solids, to coagulation, flocculation, filtration and disinfection among other treatment processes. Variations in the combination of treatment processes required vary with the source and hence quality of the raw water. Sources of water are many and varied; the level of contamination also varies and consequently a high degree of public health hazard can be associated with drinking water. The implication therefore is that any drinking water sold to the public must be of good quality and must meet WHO/national standards.

This research work was designed to analyse sachet packaged table water brands for their physicochemical properties and to examine their quality consistency and the level of compliance of the results obtained with WHO/NAFDAC standards for potable water.

MATERIALS AND METHODS

Materials and Methods

The samples for this analysis were collected in one and half liter capacity plastic container which was previously washed and rinsed with the appropriate sample, to avoid sample contamination. Two bags containing twenty water sachets were bought from each of the factories every week. For each factory, sachets were collected randomly from the two bags and mixed in a large container to obtain a homogeneous sample which was then tightly covered. For easy identification, the samples were labeled A, B, C, and D from the four different factories. The labeled samples were then conveyed to the laboratory for immediate analysis. This routine was done weekly for four weeks.

Determination of Physicochemical Parameters of Water

The following physicochemical parameters were determined using some standard methods (Muhammad *et al*, 2004; Ademoroti, 1996; Taiwo, 2012; Sharma, 2011): pH was determined with the aid of a pH meter (Jenway pH meter, model 3510). Total solid (TS) was determined by standard laboratory procedure of evaporating to dryness in an oven a known weight of sample and calculating the TS gravimetrically. Biochemical oxygen demand (BOD) was determined by Winkler iodometric titration method. Hardness was analysed by EDTA titrimetric method. Chloride was determined by argentometric method while nitrate was by phenoldisulphonic acid method.

The analysis of the various water quality parameters of the water samples was limited to the above mentioned parameters, due to availability of the test facilities, coupled with some local constraints.

RESULTS AND DISCUSSION

Results

The results of the analyses for six selected parameters are stated in Table 1.

Table 1: Analysis Result of Four Brands of Packaged Table Water Presented with the standard (WHO, 2003)

Parameter	Brand	Week				Mean	Std. Deviation
		1	2	3	4		
pH Std value = 6.5 - 8.5	A	7.26	7.38	7.37	7.32	7.33	0.06
	B	6.45	7.06	6.87	6.70	6.77	0.26
	C	5.91	6.82	6.71	6.51	6.49	0.41
	D	6.77	7.08	6.91	6.74	6.88	0.16
Total solids (mg/l) Std value = 1000 mg/l (max)	A	Nd	95.78	47.56	Nd	35.84	45.82
	B	Nd	47.52	Nd	92.89	35.10	44.56
	C	46.83	48.75	93.52	139.94	82.26	44.09
	D	142.66	Nd	96.80	Nd	59.87	71.62
Hardness (mg/l) Std value = 500 mg/l (max)	A	60.00	8.00	8.00	28.00	26.00	24.55
	B	40.00	12.00	12.00	40.00	26.00	16.17
	C	28.00	4.00	4.00	20.00	14.00	12.00
	D	28.00	8.00	4.00	36.00	19.00	15.45
Chloride (mg/l) Std value = 250 mg/l (max)	A	36.92	24.14	38.34	32.66	33.02	6.39
	B	29.82	17.04	25.56	24.14	24.14	5.31
	C	9.94	80.94	24.14	12.78	31.95	33.23
	D	21.30	38.34	32.66	36.92	32.31	7.72
Nitrate (mg/l) Std value = 45 mg/l (max)	A	11.68	3.50	9.79	10.77	8.93	3.71
	B	9.65	12.59	13.99	6.99	10.80	3.12
	C	51.00	30.07	6.29	25.87	28.31	18.34
	D	7.13	21.68	18.18	13.29	15.07	6.31

Nd = Not detectable at the experimental level

From the data in Table 1, the overall standard deviation of each brand of packaged water is calculated and stated in Table 2.

Table 2: Overall Standard Deviation of All Parameters

Brands	Standard Deviations	Overall Standard Deviation
A	0.06, 45.82, 1.60, 24.55, 6.39, 3.71	13.69
B	0.26, 44.56, 2.01, 16.17, 5.31, 3.12	11.91
C	0.41, 44.09, 1.31, 12.00, 33.23, 18.34	18.23
D	0.16, 71.62, 1.31, 15.45, 7.72, 6.31	17.01

Discussion

The data provided in Table 1 show the various levels of quality consistency achieved by the various brands of packaged water A-D, in all the parameters analysed. The calculated mean figures were used to compare and analyse the results.

From their respective standard deviation values, the comparative consistencies of the pH for the four brands, A-D can be stated as: $A > D > B > C$. For total solids, their comparative consistencies can be stated as: $C > B > A > D$.

The comparative consistencies of hardness for the four brands can be stated as $C > D > B > A$. The comparative consistencies of chloride for the four brands can be stated as: $B > A > D > C$. For Nitrate, the comparative consistencies can be stated as: $B > A > D > C$.

Based on the overall standard deviation of all parameters (Table 2), the comparative overall consistencies of the four brands can be stated as: $B > A > D > C$. That means that brand B is the most consistent in maintaining quality parameters at uniform levels. On the other hand, as shown by the results, C is the least consistent.

With respect to standard specification, all the brands tested complied with the WHO standards for potable water except for C that slightly fell short of the standards in two samples for pH and nitrate respectively. No wonder that brand C, being the least overall consistent, is the only brand that produced sub-standard samples.

Some earlier researches on marketed table water revealed some cases of sub-standard quality among the samples tested. Waziriet *al* (2012) analyzed fourteen 500ml sachet water samples marketed for drinking in Damaturu for their physicochemical parameters including pH, temperature, conductivity, total dissolved solids, turbidity, alkalinity, hardness, Al, As, Cu, Fe and PO_4^{3-} , using the Wagtech international physicochemical water analysis kit. The results they obtained indicated that there were considerable variations among the examined samples with respect to their chemical constituents which occasionally fell within the Nigerian drinking water standards as stipulated by NAFDAC. However, Fe which ranged between 1.000.001 mg/l to 7.000.01mg/l was much higher than the acceptable limit of 0.3 mg/l in all the examined samples (NAFDAC, 2012).

Onweluzoet *al* (2010) analyzed the physical, chemical and bacteriological qualities of 17 brands of bottled and sachet water sold in Nsukka to ascertain their compliance with recommended standards by WHO and NAFDAC. Physical parameters like total suspended and dissolved solids, turbidity and conductivity were determined by instrumental methods. Cationic and anionic constituents were determined by standard titrimetric and spectro-photometric methods. The study revealed that 88% of the brands had coliform count outside the recommended count of zero cfu/100ml (Onweluzo and Akuagbazie, 2010).

CONCLUSION

Four brands of sachet packaged water (popularly known as pure water), labeled A, B, C and D, were sampled from their respective factories at Nsukka. The samples were analysed for the

Following parameters: pH, total solids, hardness, chloride and nitrate. The results show how the brands maintain different levels of consistency in the parameters tested. Their comparative overall consistency in all the tested parameters can be stated as: B > A > D > C. Furthermore, all the results were in compliance with WHO standard for potable water, except in the case of C that produced sub-standard samples that failed the pH and nitrate tests.

Regular monitoring analysis of this nature ought to be carried out by the regulatory agencies, with feedbacks and possible cautions/commendations given to the companies concerned. This will protect the general public from environmental hazards, enhance the national economy, while at the same time positively addressing environmental health inequalities.

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