Quality Assessment of Selected Sachet Water Brands in Akure Metropolis, South Western Nigeria

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Abstract

This study was carried out to ascertain the quality of selected Sachet water brands in Akure metropolis. 10 brands of sachet water were randomly selected and subjected to comprehensive physical, chemical and bacteriological analysis. The results showed that showed that the sachet water samples had good aesthetic value as all the brands of sachet water evaluated met the recommended WHO standard for appearance and taste. Four of the sachet water samples had pH values of 6.0, 6.3, 6.0 and 5.8 respectively and did not fall within WHO drinking water standard. There is a need to put a check on the pH of sachet water samples. pH values outside WHO permissible limits of 6.5 to 8.5 affects disinfection efficiency and may have an indirect effect on human health. Other chemical characteristics of all the brands of water evaluated were within the WHO recommended water limits for chloride, nitrate, sulphate, iron, copper, zinc and sodium. Phosphate was present in two brands of the sampled water samples, although they were present in very low compositions. Results of the bacteriological analyses showed that all the brands of water had viable plate counts less than the 100 CFU/mL maximum limit recommended by WHO. Only five brands of the sachet water samples had zero total bacteria count. In addition, all the brands of sachet water evaluated had zero coliform and E.coli counts. This study affirms the fact that sachet water has the potential to be a transformative public health intrusion for low income households by eliminating the need for unsafe water storage vessels.

Key words: quality, sachet water, Akure metropolis, randomly selected, comprehensive

1. Introduction

According to the World Health Organization (2004), 1.1 billion people did not have access to an improved water supply in 2002, and 2.3 billion people suffered from diseases caused by contaminated water. Each year 1.8 million people die from diarrhoeal diseases, and 90% of these deaths are of children under 5 (WHO, 2004). Amoo and Akinbode (2005) claimed that of the more than six billion people on earth, more than one billion (one in six) lack access to safe drinking water. Furthermore, about 2.5 billion (more than one in three) do not have access to adequate sanitation services. It is important that the water meant for human consumption be free of disease-causing germs and toxic chemicals that pose a threat to public health (TWAS, 2002). Many drinking water contaminants including various chemicals, physical, microbiological and radiological are known to be hazardous to health (WHO, 1999). There are number of reported cases of typhoid, diarrhea and other water borne diseases arising from consumption of sachet water (Ogamba, 2004).

Sachet water is any commercially treated water, manufactured, packaged and distributed for sale in sealed food grade containers and is intended for human consumption (Denloye, 2004). In Nigeria, this water is popularly referred to as “pure water” by the general public. The production of sachet water requires two important raw materials, water source (which is usually borehole or tap water), and the packaging materials. The production of sachet water started in the late 90’s in Nigeria. Today, the advancement in scientific technology has made sachet water production the fasted growing industry in Nigeria. Nigeria has small and large scale industries that pack and machine-seal sachet water. Today, the advancement in scientific technology has made sachet water production the fasted growing industry in Nigeria. The deterioration of water quality during transport and storage is established in public health literature (Clasen and Cairncross 2004; Wright *et al*. 2004; Gundry *et al.* 2006) and the potential for high-quality sachet water to improve health outcomes by eliminating these contamination pathways cannot be over emphasized. Given the importance of sachet water as a clean source of drinking water for many underserved areas, the overall desirability of sachet water from a public health and urban planning perspective remains uncertain.

Water vending is as old as civilization and the issues surrounding vended water in the developing world have received contemporary appraisal elsewhere (Sansom, 2004; Kjellén and McGranahan, 2006). In time past, citizens in urban sub-Saharan Africa, lacking piped potable water, have traditionally relied on both formal and informal types of water kiosks and pushcart vendors who deliver water to communities. According to McGranahan *et al.* (2006) water vendors can positively contribute to the millennium development goal of halving, by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation by filling in gaps in water supply provision in areas that lack access to water and also by improving livelihoods through employment generation in both rural and urban poor areas.

According to WHO/UNICEF (2000), vended water is considered an “unimproved” source of water. Modern sachet water is, in essence, the latest low-cost technological incarnation of vended water. In the past, the purchaser of vended water drank directly from a plastic or metal cup, which the vendor used to scoop water out of a larger storage vessel. This form of water entrepreneurship was aimed at poor, transient population segments, but eventually demand grew beyond this demographic. Increased demand coupled with the obvious sanitary shortcomings of such a system led to the packaging of water in small plastic bags in the 1990s. These small bags were tied by the corners at the top and generally contain 250–500 mL of water. Hygiene remained an issue, as bags were generally filled by women and children with suspect sanitary practices (Olayemi 1999, Obiri-Danso *et al.* 2003). In the late 1990s, new Chinese machinery that heat-sealed water in a plastic sheath successfully created the modern sachet that is currently sold on the streets of several West African nations including Nigeria.

In Nigeria, sachet filling operations are generally positioned in neighborhoods with steady water access and then they aim neighborhoods that are subject to greater water rationing or have no access at all. Despite scientific interest in microbiological quality of sachet water that dates back to the 1990s, there is a striking scantiness of research on the topic. Hence, the objectives of this study are to investigate the quality of the selected sachet water in Akure metropolis water samples through laboratory tests, and to compare the results of the water quality tests with WHO drinking water standards.

2. Methodology

This study was carried out in Akure metropolis. Akure is the capital of Ondo State in South Western Nigeria and is located on Latitude: 7°15′09″ N and Longitude: 5°11′35″ E. Its elevation above sea level is 396 m. The 2014 World Population Review puts the population of Akure as 420,594. A street map of Akure is shown in Figure 1.

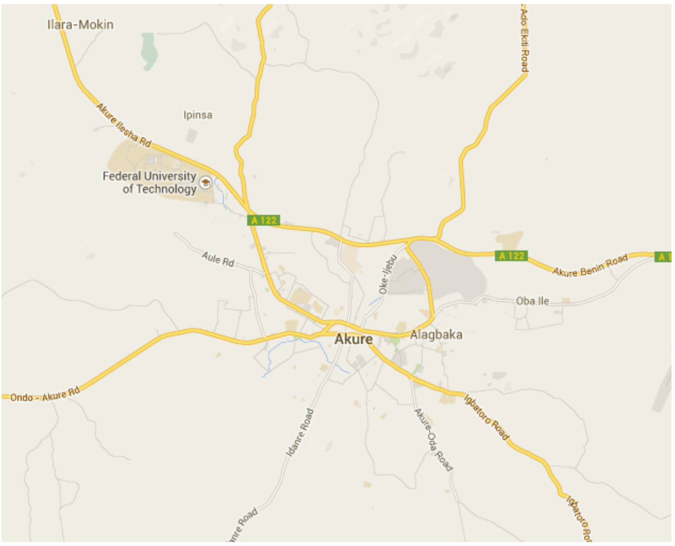

Figure 1: Map of Akure.
Source: Google maps

2.1 Experimental methods

At the time of the study, there were several brands of sachet produced and sold in Akure town out of which 10 brands were randomly selected and analyzed. Plate 1 shows a sachet water sample. . A comprehensive physical, chemical and bacteriological analysis was carried out on the water samples. The analysis of water sample was carried out within twenty four hours of collection at Malo-Kris Laboratory, Oyemekun Road, Akure.

2.1.1 Physical and Chemical Analysis of the water Samples

The physicochemical examination of the water samples were completed within six hours of sample collection. The pH of each water sample was determined immediately after receiving the sample at the laboratory using a calibrated pH meter. The colour and turbidity of each sample was measured with a digital spectrophotometer. A calibrated conductivity meter was employed for the determination of the Conductivity of the water samples. Other chemical analyses of the samples were done using methods specified in APHA (2005).

2.1.2 Bacteriological parameters

Bacteriological examination of the samples was conducted by multiple tube fermentation tests described in APHA (2005) and Adetunde and Glover (2010).

3 Results and Discussion

Table 1 shows the result of the water analysis carried out on the selected water samples in Akure metropolis.

3.1 Physical and Chemical Characteristics of the Sampled Sachet water samples

All the brands of sachet water evaluated met the recommended WHO standard for appearance and taste. This showed that the sachet water samples had good aesthetic value (Denloye, 2004). The sachet samples showed a range of 32.5 – 113.9mg/L of Total Dissolved solids (TDS). The TDS of all the water samples fell within the WHO maximum permissible limit of standard 500 mg/L. TDS is a measure of the level of dissolved solid in water and it influences the taste of drinking water. All the sampled sachet waters in this study had zero turbidity. Turbidity in water results from the presence of suspended solids, hence the zero turbidity is reflected in the low TSS result. All the sampled sachet water sold in Akure town met the recommended WHO standards in terms of physical characteristics. The sachet water samples showed a wide pH range of 5.8 – 7.7. Six out of the ten sachet water samples evaluated showed pH values within the WHO recommended range of 6.5 – 8.5. Feotamy, Chiva, Zion and Edna sachet water samples measured 6.0, 6.3, 6.0 and 5.8 respectively and did not fall within WHO drinking water standard. Other chemical characteristics of all the brands of water evaluated were within the WHO recommended water limits for chloride, nitrate, sulphate, iron, copper, zinc and sodium. Phosphate was present in two brands of the sampled water samples (Chiva and Bofa), although they were present in very low compositions. The implication of this result is that the processors of these brands of sachet water obtain raw water from chemically good sources and adopt standard operating procedures for chemical water treatment. Apparently the level of residual chloride observed in the samples used for this study was not high enough to have impact on the taste of the samples. However, there is a need to put a check on the pH of sachet water samples. pH values outside WHO permissible limits of 6.5 to 8.5 affects disinfection efficiency and may have an indirect effect on human health. Low water pH can cause gastro-intestinal irritation in sensitive individuals (White, 1985).

3.2 Bacteriological characteristics of the sachet water samples

Results of the bacteriological analyses showed that all the brands of water had viable plate counts less than the 100 CFU/mL maximum limit recommended by WHO. 50% of the sachet water samples (Chiva, Aktols, Tuntop, Bolab and Edna brands) had total bacterial count ranging from 1 to 9 CFU /100mL. This range is permissible for drinking water samples. In addition, all the brands of sachet water evaluated had zero total coliform and E.coli counts.

4. Conclusion

It is evident from the study that all selected sachet water samples sold in Akure town at the time of the study met the recommended standards for physical, chemical and microbiological qualities. Since the study was conducted using randomly selected sachet water samples produced in Akure South Local Government area, it is advised that further study should be carried out on more sachet water brands in order to ascertain strict compliance with WHO standards. This would help to avert public health hazards associated with the consumption of contaminated sachet water. Paradoxically, while water quality continues to be the primary topic of interest, sachet water has the potential to be a transformative public health intrusion for low income households by eliminating the need for unsafe water storage vessels.

Table 1: Results of water Analysis carried out on selected sachet water samples in Akure metropolis.

Parameter/Name of sample	**Feotamy**	**Chiva**	**Primus**	**FUTA**	**Bofa**	**Aktols**	**Tuntop**	**Zion**	**Bolab**	**Edna**	**WHO Standard**
Physical and Chemical Analysis											
Colour	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless	Colourless
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Taste	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless	Tasteless
Temperature, ^{o}C	25.6	26.4	29.3	27.0	28.4	28.1	29.4	26.0	26.4	29.1	Nil
pH @ $20^{o}c$	6.0	6.3	6.5	7.2	6.6	6.5	7.7	6.0	7.5	5.8	6.5 - 8.5
Conductivity, us/cm	181	172	161	124	121	171	183	153	164	181	1000
Turbidity, NTU	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	5
Total Dissolved Solids (mg/L)	37.6	42.5	32.5	41.28	113.9	63.47	82.77	41.98	111.54	91.8	500
Total suspended solid, mg/l	0.0084	0.0071	0.0060	0.0041	0.0052	0.0066	0.0090	0.0053	0.0060	0.0055	Nil
Iron (Total), mg/l Fe^{2+}	<0.2	<0.1	<0.1	<0.01	<0.1	<0.01	<0.2	0.01	<0.02	<0.1	0.3
Manganese mg/l Mg^{2+}	Nil	Nil	Nil	<0.002	0.001	<0.02	<0.002	<0.02	0.1	<0.01	0.5
Copper, mg/l Cu^{2+}	<0.002	<0.01	<0.02	Nil	<0.002	<0.1	<1.0	<0.01	<0.1	<0.02	2.0
Zinc, mg/l Zn^{2+}	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Phosphate mg/l PO_4^{2-}	Nil	<0.04	Nil	Nil	<0.001	Nil	Nil	Nil	Nil	Nil	Nil
Nitrate mg/l NO_3^-	<2.0	Nil	<0.005	Nil	<4.0	<7.0	Nil	<0.1	<0.01	<0.01	50
Residual Chlorine, mg/l Cl_2^-	Nil	Nil	Nil	Nil	Nil	<0.001	Nil	Nil	Nil	Nil	0.3
Ammonia, mg/l NH_3^-	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
Bacteriological Analysis											
Total Bacterial Count, CFU/100ml	00	05	00	00	00	03	09	00	01	09	10^2
Total coliform, MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil
E.Coli, MPN/100ml	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil	Nil

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