SACHET WATER: PREVALENCE OF USE, PERCEPTION AND QUALITY IN A COMMUNITY OF JOS SOUTH LOCAL GOVERNMENT AREA OF PLATEAU STATE

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ABSTRACT

Background: *Sachet water is a phenomenon that has gained widespread use as an alternative to the insufficient provision of potable water. It is an alternative that is readily available, affordable but not without concerns about its purity. The objective of this study is to determine the prevalence of use, perception of safety and assess the quality of sachet water consumed by the population.*

Methods: *A total of 360 respondents were selected using a multistage sampling technique. A semi-structured interviewer administered questionnaire was used to collect data and analysis was done using Epi info software version 3.5.4. The sachet water samples used were purposively selected and analyzed for specified physical, chemical and microbiological parameters and compared to the National and WHO Guidelines for drinking-water quality.*

Results: *There is 93.1% use of sachet water among respondents amongst other sources such as tap water, bottled water, well and stream water. Sixty seven percent of respondents affirmed that sachet water is safe. Analysis of the five different sachet water brands showed normal physical and chemical values. Microbiological analysis showed presence of coliforms in three of the sachet water samples.*

Conclusion: *The presence of contaminated sachet water available to the community increases the risk for waterborne diseases contributing to the already prevailing cases present in our society at large. There is a need for regulatory bodies to do more to improve the safety of drinking water in communities which will ultimately improve their health status.*

Key words*: sachet water, prevalence of use, perception, quality*

INTRODUCTION

Access to safe drinking water continues to be a global concern and thereby continues to receive attention. This is evident in the Millennium Development Goal (MDG) target 7 c which calls for reduction by half, the proportion of people without sustainable access to safe drinking-water and basic sanitation by 2015.[1] The stringent requirements of safe drinking water add to its scarcity and shows that in most cases the problem is not availability of water but inability to obtain quality water. Safe drinking water is water that has been treated and tested for harmful and potentially harmful substances and has met or exceeded drinking water quality standards or water with microbial, chemical and physical characteristics that meet World Health Organization (WHO) guidelines or national standards on drinking water quality.[2]

Nigeria is no exception to the prevailing social and technical cost of providing adequate services for safe water production and distribution faced in developing countries. After almost sixty years of water resources development in Nigeria, little progress was made up to 2005 as only 60% of the population had access to safe drinking water.[3] By 2009, 58.9 % of the population had access to an improved water source an improvement on the 55.9% recorded in the 2008 Nigeria Demographic and Health Survey (NDHS).[4] As the country's population and industries increase, the implication is that the population would be larger than the

available water supply; the result of which is scarcity or inadequacy of water supply presently experienced. Some recent studies – Aderibigbe et al., Maconachie, Gbadegesin and Olorunfemi have corroborated the inadequacy of the country's water supply.[5,6,7] Due to the shortfall in the provision of adequate safe drinking water for the populace, the private sector, although for profit purposes, has been of increasing significance in the effort to supply the populace with adequate and safe drinking water. They provide alternatives to the erratic municipal pipe-borne drinking water supply system in the form of packaged water of which includes the sachet water popularly known in Nigeria as 'pure water'. The production of sachet water has increased tremendously and has found its patronage mainly from the middle and low socioeconomic classes. As noted by Edoga et al.,[8] during the dry season about 70% of Nigerian adults drink, at least, a sachet of water per day. Akunyili, the former Director General of Nigeria's National Agency for Food and Drug Administration and Control (NAFDAC) attributed the inability of the Government to persistently provide adequate potable water for the growing population to have tremendously contributed to the proliferation of the so-called 'pure water' producers in Nigeria.[9]

The commodity known as sachet water was introduced to the Nigerian market around 1990 and started attracting nationwide attention from 2000 when the NAFDAC registered 134 different packaged water producers.[10] This led to the emergence and proliferation of private water enterprises that operated side by side with the government-owned public water utilities. The private enterprises purportedly treat "not-fit-for-drinking" water such as well water and borehole and in some case pipe-borne water, to make them fit for drinking, although the consumers cannot by themselves ascertain the quality of this drinking water.[9] Realistically, sachet water produced in recent years by small-scale industries has experienced drastic improvement in processing as the raw water is now treated by aeration, double or single filtration using porcelain molecular candle filters or membrane filters.[11]

Water in sachets is readily available and the price is affordable, but there are concerns about its purity. The integrity of the hygienic environment and the conditions where the majority of the water in sachets are produced has also been questioned. Dada also documented the increased microbial contamination of sachet water as it moved down the distribution line.[12] Studies in Nigeria have documented claims of past outbreaks of water-borne illnesses resulting from the consumption of polluted sachet water, bacterial contamination with organisms such as bacillus sp, pseudomonas sp, klebsiella sp, streptococcus sp, alkalinity of the water and presence of chemicals such as aluminium and fluoride above the recommended values.[12,13,14] NAFDAC is mandated to enforce compliance with internationally defined drinking water guidelines, but the regulation of the packaged water industry aimed at good quality assurance has remained a challenge to the agency as it has in the past declared a possible 'gradual' nationwide ban on sachet waters to allow the manufacturers of sachet water to start winding-down or change to bottle packaging though this is yet to be seen.[11]

Observations in our immediate environment indicate a drastic increase in the population of sachet water consumers partly due to its affordability and the growing awareness of the consequences of the consumption of unsafe or untreated water. Also the industries that produce this commodity tend to be localised to the consumer area. This study has therefore been conducted to add to the body of evidence regarding sachet water.

While a lot of studies have been done to assess the physical, chemical as well as microbiological quality of sachet water in Nigeria, relatively fewer studies have looked at the view of the populace regarding sachet water. Notwithstanding, majority of experts have given personal views based on their research. An example of this is Dada, who advocated for increased use and acceptance of the sachet water phenomenon and warned against labelling it as unfit for drinking by organizations responsible for maintaining standards for quality drinking water (NAFDAC, WHO) in Nigeria, citing several pertinent reasons.[12] He argued that the public perception of safety in favour of packaged water in Nigeria stems out partly from the inadequate attempts of previous governments to provide potable piped water. The second contributing factor to this perception, he argued, is the prevalent doubt on the quality of 'piped water' supplied at a reasonable charge by many informal vendors (called mai'ruwa) at the community level; its use being restricted for domestic purposes alone-washing, bathing and cleaning. The sachet water, costing 5 naira to 10 naira (one bag containing 20 sachets each of 150 ml volume), is thus often relied upon for drinking purposes. Although more

expensive than the vended public water supplied for domestic uses sourced from upgraded wells of informal vendors at the community level, a public perception of safety prevails – "at least it must have gone through one form of treatment or the other, even if it were gotten from questionable sources".

RESEARCH OBJECTIVE

General objective:
The general objective was to determine the prevalence of use and to assess the quality of sachet water in relation to health standards in Abattoir community of Jos South LGA of Plateau State.

Specific objectives included:
·Determination of the prevalence of use of sachet water in the community.

·To determine the perception of the safety of sachet water.

·To assess physical, chemical and microbiological quality of sachet water brands used in the community with the use of specific parameters.

METHODOLOGY

This is a cross-sectional study conducted among adult residents of Abattoir community located in Jos South Local Government Area of Plateau State. Abattoir is an urban, multiethnic community and derives its name from the State-owned slaughterhouse (abattoir) that is situated within it. It is mostly a residential area with a rocky topography. Abattoir covers an area of 510km^2 and a population of 306,716 as at the 2006 census.[15] Respondents were eligible if they had resided in the community for at least 6 months.

Minimum sample size of 360 was determined using the formulae for single proportions (z^2pq/d^2) where a prevalence of 70% from a previous study[9] was used for the calculation. They were selected through a multistage sampling technique. Data from respondents was obtained using a pre-tested semi-structured interviewer administered questionnaire and was analysed using the Epi Info software version 3.5.4. at a confidence level of 95%.

The sachet water brands were selected purposively after analysis of the questionnaire from which a list of the commonly used sachet water brands was obtained. These, being 5 in number were then purchased from sales points within the community and used for analysis.

The physical parameters analysed were pH, turbidity and colour using the electrode method, absorptiometric and the alpha-platinum-cobalt standard method respectively.

Chemical analysis was done using the Hach calorimeter and the properties analysed were the chloride and fluoride content. Mercuric-nitrated method was used for the chloride analysis while the direct measurement Ion Selective Electrode (ISE) method was used for fluoride.

Microbial analysis of the sample was based on the coliform count using the Agar plate count method. The samples were incubated at temperatures of 22 - and 37 °C degrees centigrade in eosin methylene-blue agar for 48 hours.

Permission was obtained from the Mai'anguwa of Abattoir community before commencement of the study. Verbal consent was obtained from all respondents with the assurance of anonymity and confidentiality of the information disclosed.

RESULTS

A total of 360 respondents were selected for the study with a 100% response rate. The mean age distribution of respondents was 29.5 ± 9.2. The sex distribution was fairly equal with a male:female ratio of 1.1:1.They were made up of a varied set of occupations which included students (33.3%), businessmen/women (15.8%), unemployed persons (9.7%), civil servants (8.9%), teachers (4.7%), traders (4.2%), tailors (3.3%), health workers (3.1%) and others (17.0%) such as lawyers and carpenters. Many (38.9%) households had 5 or more members. (Table1)

Respondents sourced their drinking water from multiple sources, as seen in Table 2, with sachet water being the most predominant (93.1%). Other sources were municipal tap water supply (45.0%), bottled water (34.2%), rain water (19.7%), boreholes (19.4%), wells (14.4%) and streams (0.6%).

Respondents were asked whether their use of sachet water had increased in the last five years, to which 62.4% of the respondents said "yes" and 37.6% that said "no". Those who said yes attributed it to scarcity of alternative sources of potable water, increase in the household population and easy accessibility of sachet water compared to 5 years ago. The modal average daily intake of sachet water was 3 (Figure1).Among respondents using sachet

water, reasons given for its use include its cheaper cost compared to other forms of packaged water, safety, lack of availability of other safe sources, NAFDAC approval and its portability (Figure 2).

The perception of the safety of sachet water by 68% of respondents is that it is safe while a third of respondents thought it is not safe. A total of 74% would normally check for NAFDAC registration on the packaging and 61.4% considered the NAFDAC number as an assurance of safety. Sachet water was preferred to well water by a large percentage but was a less preferred choice in the presence of water sourced from a borehole or municipal tap supply. (Table 3)

Five brands of sachet water were found to be used in the community and were labelled anonymously. Brand A was the most frequently used as shown in Figure 3. All the samples had NAFDAC registration numbers. Analysis of the samples showed that all of them met the physical requirement (colour, turbidity and pH). Chemical testing for chloride, fluoride and nitrates also showed that their presence was within normal limits. In the bacteriological analysis, brands B, C, E were found to have coliforms to a value of 1, 15 and 38 cfu/ml respectively. Organisms that were isolated included E.coli and Citrobacter. (Table 4)

DISCUSSION

The study showed a very high prevalence (>90%) of sachet water use among the residents of Abattoir community of Jos South Local Government Area. This high prevalence was buttressed by the fact that the majority of the population (62.4%) claimed that their use of sachet water had increased significantly over the last five years. The main reason given for this increase in use was scarcity of alternative sources of potable water. Only 45.0% of the population sourced drinking water from the municipal tap water supply. Assessments have shown that years of neglect by the government and inadequate investment in public infrastructure for the supply of quality drinking water has left the public water system in Nigeria in an unreliable state.[7] Gbadegesin and Olorunfemi stated that as at 2005 60% of the Nigerian population did not have access to potable tap water.[16] As at 2004, only about 40% of the population in Jos had access to clean potable water.[17,18] To compensate for this deficiency/shortfall urban communities seek for alternative sources of drinking water which include construction of privately owned wells and boreholes, harvesting of rain, patronization of water vendors whose source cannot always be determined and the use of packaged/sachet water. This compensation is also demonstrated in this study where apart from sachet and tap water, the community also use bottled water, borehole, well, rain water during the wet seasons, and a few using water from streams.

The modal average intake of sachet water obtained from our study was 3 sachet of water per day. This result is similar to the modal average of 2 sachet of water consumed per day in a related study done by Adetunji and Ilias among residents of Kwara State in 2010.[9]

The reasons that were given for the preference of sachet water is similar to those offered by respondents in the Kwara state study.[9] Its relative cost was the main reason provided. There is a large proportion of students and unemployed persons among the respondents, also many are low and middle income earners. Hence the idea of it being cheap may not necessarily be so. A paradox has been established where poor and middle class who have the least access to quality public water supply pay more for drinking water than the rich. This was aptly stated by Kjellén and McGranahan in the article "Informal water vendors and the urban poor" by the statement "it is expensive to be poor".[19] Their study revealed the tendency of volumetric prices to be lowest for household connections, lower for users of public taps or standpipes, or household resale users, and highest, by far, among those paying to distributing vendors including retailers of packaged water. The urban poor find it easier to purchase in small quantities which is commensurate with their often irregular and unpredictable incomes. Notwithstanding, minute purchases typically entail a higher unit cost than what wealthier households pay for their utility-provided water.[20] Its perceived safety is another major reason for its use. In the absence of adequate public services and high poverty level, it is expected that the population will seek for the most affordable alternative to meet their needs. A total of 248 (74.0%) respondents check the NAFDAC certification number on the sachet water plastic and about 221 (61.4%) respondents think sachet water with NAFDAC certification number is safe. This shows that the people have a high level of confidence and reliance on NAFDAC as a regulatory body. When asked whether they would like sachet water to be banned, 84.2% said "No". It may not be possible to impose a ban in the absence of an adequate, reliable and affordable alternative.

Dada stated it more learly in the following words "By oppressing packaged water in a bid to protecting public health in developing nations, there is a danger that authorities could be making it still more difficult for deprived residents to obtain water which again could lead to more grievous conditions as people may revert to poorer sources".[12] He emphasized that using the developed world's high standard measure of quality as a reason to banning the sachet water may be detrimental, as developing countries like Nigeria do not have the luxury of an alternative source of drinking water as do the Western world. Adetunji and Ilias in their study also acknowledged the importance of sachet water to the Nigerian people.[9] The perception of most of the population is that it is safe and preferred by most to well and by many to borehole and tap water. This study showed that 58.8% of the population concurred that if tap water is readily available their consumption of sachet water will reduce. Also, most people indicated that easy access to boreholes will reduce their dependence on sachet water. This indicates the need of the community in terms of drinking water and the possibility that if the residents have easy and constant access to tap water the level of consumption of sachet water may reduce significantly.

The physical properties that were assessed were in keeping with regulatory guidelines so also were the chemical parameters that were analysed for.
It was found that Brands B, C and E had total coliform counts of 1, 15, and 38 coliform bacteria/100ml respectively. The organisms isolated were thermo-tolerant coliforms: Citrobacter spp and Escherichia coli. This particularly high level of coliforms in Brands C and E show that these two brands are not safe for drinking, not just in relation to international standards but also to the Nigerian Industrial Standard for Drinking Water Quality; which like the WHO, does not permit the presence of any thermotolerant coliform per 100ml of sample.[21,22] Total coliform bacteria that are able to ferment lactose at 44–45 °C are known as thermotolerant coliforms the predominant genus is *Escherichia*, but some types of *Citrobacter*, *Klebsiella* and *Enterobacter* are also thermotolerant. *Escherichia coli* is considered the most suitable index of faecal contamination These organisms are also used as disinfection indicators, but testing is far slower and less reliable than direct measurement of disinfectant residual. In addition, *E.coli* is far more sensitive to disinfection than are enteric viruses and protozoa. In an assessment done by Omalu et al. on contamination of sachet water in the western part of Nigeria, the presence of bacteria such as bacillus sp, pseudomonas sp, klebsiella sp, streptococcus sp, and oocyst of cryptosporidium sp was reported.[13] This further substantiates that not all sachet water are devoid of microbial contaminants. However, the point of contamination could have been at various points in the production and distribution cycle which was not taken into consideration in this study. The presence of contaminants means that the community are exposed to diarrhoel diseases which according to WHO are responsible for the deaths of 1.8 million people yearly.[23] This underscores the need for regulatory efforts to be stepped up in order to ensure the quality of water that reaches the consumer. Encouraging was the fact that the most commonly used brand, which was also the most preferred of all the brands of sachet water (Brand A), was found to be in keeping with all the parameters of the WHO guidelines for drinking water quality.

CONCLUSION AND RECOMMENDATIONS

The study found a high prevalence of use of sachet water among the residents Abattoir community which was perceived to be a safe alternative in the absence of potable municipal water supply. However 3 of the commonly used brands were found to be contaminated and unfit for consumption.

Government need to increase its efforts of ensuring the adequate supply of potable drinking water to meet up with the demands of the growing populace. In the interim, alternatives that are in use, in particular the sachet water need rigorous monitoring and enforcement of regulatory standards to ensure that quality products reach the consumers.

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Table 1: Socio-demographic characteristics of respondents

AGE (years)	FREQUENCY (N=360)	PERCENTAGE (%)
18 – 27	187	51.9
28 – 37	107	29.7
38 – 47	41	11.4
48 – 57	17	4.7
58 – 67	7	1.9
68 – 77	1	0.3
SEX		
Male	190	52.8
Female	170	47.2
Total	360	100
MARITAL STATUS		
Single	221	61.4
Married	137	38.1
Separated	1	0.3
Divorced	1	0.3
OCCUPATION		
Students	120	33.3
Business	57	15.8
Unemployed	35	9.7
Civil servant	32	8.9
Teacher	17	4.7
Trader	15	4.2
Tailor	12	3.3
Health worker	11	3.1
Others*	61	17.0
NUMBER OF PEOPLE IN THE HOUSEHOLD		
1	61	16.9
2	46	12.8
3	57	15.8
4	56	15.6
5 or more	140	38.9

**Others: lawyer, barber carpenter, housewife*

Table 2: Sources of drinking water

SOURCES OF DRINKING WATER MULTIPLE RESPONSE	FREQUENCY N = 815	PERCENTAGE (%)
Sachet water	335	93.1%
Tap	162	45.0%
Bottled water	123	34.2%
Rain water	71	19.7%
Borehole	70	19.4%
Well	52	14.4%
Stream	2	0.6%

Table 3: Perception of safety of sachet water

PERCEPTION OF SAFETY	YES FREQ (%)	NO FREQ (%)	NOT SURE FREQ (%)	TOTAL
Sachet water is safe	*240(66.7%)*	120(33.3%)		360
Sachet water with NAFDAC Certification				
Do you check?	248(74.0%)	87(26.0%)		335*
Is it safe if there is a NAFDAC number?	221(61.4%)	139(38.6%)		360
Want sachet water to be banned?	57(15.8%)	303(84.2%)		360
Preference of sachet to				
Well water	304(84.4%)	35(9.7%)	21(5.8%)	360
Borehole	147(40.8%)	160(44.4%)	53(14.7%)	360
Tap water	150(41.7%)	165(45.8%)	45(12.5%)	360
Sachet water consumption will reduce if				
Borehole is readily available	206(61.5%)	82(24.5%)	47(14.0%)	335*
Tap water is readily available	197(58.8%)	86(25.7%)	52(15.5%)	335*

**Responses obtained only from those who use sachet water*

Table 4: Analysis of sachet water samples

Sachet water brands (coded)	Colour (TCU)	Turbidity (NTU)	PH	Chloride (mg/L)	Fluoride (mg/L)	Nitrate in mg/L	Coliform bacteria/ 100ml	Organisms isolated
A	0.00	0.00	7.5	0.80	1.00	1.00	0	
B	0.01	0.02	6.5	1.00	1.30	1.00	1	E. coli
C	0.00	0.00	8.0	0.90	1.50	1.00	15	Citrobacter
D	0.01	0.01	7.5	0.70	1.00	1.30	0	
E	0.01	0.01	7.0	0.80	1.00	1.20	38	E. coli
WHO	≤15.00	≤1.00	6.5-8.5	≤250	≤1.50	≤50.0	0	

Figure 1: Number of sachets taken per day

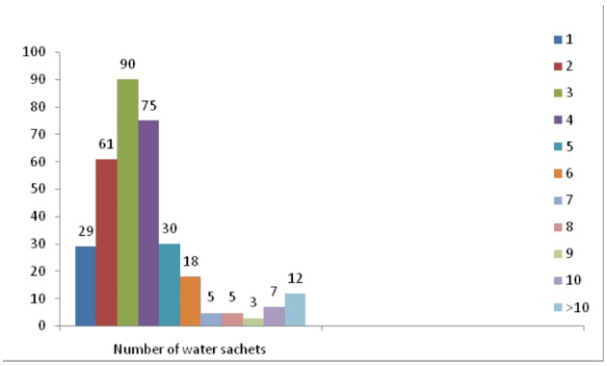


Figure 2: Reasons for use of sachet water (multiple response)

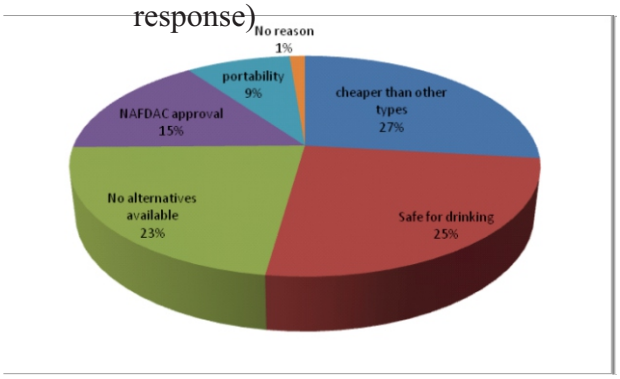
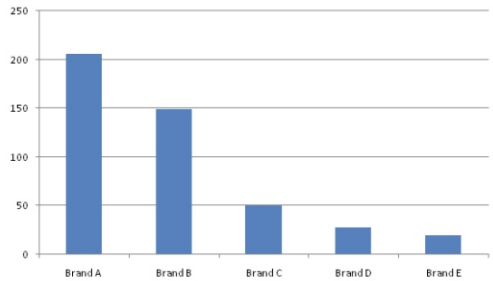


Figure 3: Preferred sachet water brands



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