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Assessment of the Quality of Sachet Water Consumed in Oju Metropolis (A Case Study of College of Education, Oju Campus)



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ABSTRACT

In this study, the Physico-chemical analysis of four brands of sachet water consumed in Oju metropolis was evaluated to compare their compliance with World Health Organization (WHO) and Nigerian Industrial Standard (NIS) threshold limits using standard analytical methods. The parameters evaluated include color, taste, odor, pH, chloride, potassium, calcium, electric conductivity, oxygen demand (OD), biological oxygen demand (BOD) and total dissolved solids (TDS) while coliform counts were equally determined for samples using standard methods. The results from the laboratory analysis showed that all samples were tasteless, colorless and odorless; most of the Physico-chemical parameters conform with WHO and NIS permissible limits except coliform count in which 100% of the sachet did not conform to the WHO threshold limits. The results of this study indicate that sachet drinking water produced or sold in Oju metropolis is relative to good quality for human consumption but there is a need to improve the biological treatment to perfect its portability.

INTRODUCTION

Access to safe drinking water is one of the keys to sustainable development and essential to food production, quality health and poverty reduction. Safe drinking water is essential to life and a satisfactory safe supply must be made available to consumers. Though Benue is blessed with plentiful water resources, not all residents in Oju metropolis have access to quality drinking water. The supply of piped water is defunct nowadays in Oju after the first waterworks by the administration of Chief John Egbe Enyi, Chairman, Oju in the 1980s. It was revived by the administration of Chief Hon. Godwin Owulo in 1999. The underground pipes were destroyed by the Tylley Gaydo & Co-construction Company during the construction of Otukpo-Oju-Yahe road in 2006. The tap water issue came to an abrupt end as there is no one to ask the construction company to repair the broken pipes (Egbodo, 2015).

Most communities in Oju did not have access to the said piped water, because it was running only from the River Oyongo through Uwokwu to the Main Oju town. A large population of the people of Oju has no access to improved water supplies. In the light of inadequate or lack of quality potable water supplies from the public sources, urban residents have resorted to both formal and informal sector providers to supply their water needs. The past decade has seen a dramatic increase in the consumption of borehole and, more especially, sachet water (plastic bagged drinking water) in Oju. The introduction of sachet water in Oju was to provide safe, hygienic, and affordable instant drinking water to the public and to curb the truckloads of water related-sicknesses in the country.

Before the emergence of sachet water in Oju, the people used to sell water either from a bucket with a single cup for all consumers or in hand-tied polythene bags with cups. Municipal authorities of Nigeria banned this to safeguard the health of the people. In an improved manner, some business entrepreneurs imported machines for filtering the water and putting them in sealed- sachets. Most manufacturers of Sachet water today in Nigeria use multicandle pressure filters that employ an active carbon filter that removes sand, rusts, metal sediments, algal films, and bacteria from the water.

The bags are closed using heat sealing machines. This is sold-out to retailers in quantities of 20 sachets in a bag and many in turn sell it out as iced-water either on the streets or in kiosks. In addition to drinking, sachet water serves the drinking needs of many Oju metropolis' dwellers.

While about 45% of Oju residents can afford sachet water, about 55% depending on the well and river water, only about 10% can afford the price of bottled water. Today, different types and brands of sachet water are readily available to the consumers on the streets, in the restaurants, food joints, and shops. According to the National Food and Drugs Administration and Control (NAFDAC) of Nigeria, there has been a tremendous increase in the production of sachet water culminating in over 200 registered producers and over 500 unregistered producers.

According to the NAFDAC, the majority of sachet water is produced under questionable hygienic environmental conditions, without approval and does not meet standards (Zakaria, 2012). Regardless of all these problems associated with sachet water, it is still considered wholesome for drinking purposes as compared to a river or well water or borehole if the industrial standards are followed. According to Al Saleh & Al Doush (1998) and Anne (2002), natural water may contain many different chemical constituents, which may be organic and inorganic.

The latter may be derived from the rocks and soil through which water percolates or over which it flows, while the organic components are derived from the breakdown of plant materials or from algae and other microorganisms that grow in the water or sediments. Chemicals used in water treatment, from industrial sources and agricultural activities may introduce contaminants in final water (Zakaria, 2012; Dibua, Esimone, & Ndianefo, 2007; Hunter, & Burge, 2000 and Oyeku, Omowumi, Kupoleyi & Toye, 2001).

While a lot of studies have been done to assess the physicochemical as well as the microbiological quality of sachet water in other local governments in Nigeria, no study has been conducted in Oju on the safety of sachet water vended in Oju. This present study will be done to provide information on aspects of the physicochemical quality of sachet water consumed as well as clarify concerns about its safety to Consumers.

Water quality guidelines form the basis for judgment of acceptability of public water supplies and the most referred is the World Health Organization (WHO). These regulations prescribe the Physico-chemical and microbiological characteristics (Cruickshank, 1968; Greenberg, 1998 and Guilot & Lecters, 1993 and Ikem, Oduyungbo, Egiebor, & Nyavor 2002).

Table No. 1: Physico-chemical Characteristics of Potable Water

Parameter	Maximum permitted level (mg/l)	
	Packaged	Unpackaged
Colour	3.0 TCU ^a	15.0 TCU ^a
Taste	Unobjectionable	Unobjectionable
Odour	Unobjectionable	Unobjectionable
Temperature	Ambient	Ambient
Turbidity	5.0 NTU ^b	5.0 NTU ^b
pH 6.5-8.5	7.0-8.0	
conductivity	1000µs/cm	1000µs/cm
Chloride	100	250
Fluoride	1.0	1.0
Copper	1.0	1.0
Iron	0.03	0.05
Nitrate	10	10
Nitrite	0.02	0.02
Manganese	0.05	0.1
Magnesium	0.20	0.20
Zinc	5.0	5.0
Total dissolved solids	500	500
Hardness (as CaCO ₃)	100	150
Hydrogen sulphide	0.01	0.01
Sulphate	100	100

Source: NAFDAC (2004)

a = True Colour Unit, b = Nephelometric Turbidity Unit.

Table No. 2: Microbiological Characteristic (Cfu/ml)

Parameter	Maximum Permitted Levels
Total Coliform Count	10
Fecal Coliform Count	0

Source: NAFDAC (2004).

The objective of the Study

The objective of this study is to investigate the physicochemical and microbiological qualities of various sachet water brands consumed in Oju metropolis for drinking and domestic purposes considering the accepted standards.

Significance of the Study

The widening gap between developed and developing nations in terms of overall development and wealth creation could be traced to the acquisition and utilization of scientific skills and principles. For Nigeria to close this gap with priority and vigor, the results of this study should serve as useful tools to policymakers, stakeholders, students, teachers, scientists, technologists and community men and women for a careful examination of sachet water brands before consumption. Specifically, this study will be vital to Oju LGA and Nigeria at large in the following ways:

- i. The study will serve as an eye-opener to the people of Oju on the safe water to be consumed as meeting the industrial portable water standards with particular reference to physicochemical and microbiological characteristics of the water.
- ii. The study will educate the people of Oju on the particular brand(s) of sachet water that is safe for domestic use. This will go along the water to reduce the high levels of water-related diseases such as diarrhea, cholera, dysentery among others.
- iii. The results of the study will serve a boost to the government and regulatory agencies on food and drugs to sanction sachet water manufacturers if standard procedures are not followed.

iv. The study will serve as a starting point for students, teachers, and researchers for similarly further research work.

v. The study will expose the manufacturers of sachet water to the standard procedure the sachet water undergoes through before reaching the final consumer as approved by the NAFDAC.

MATERIALS AND METHODS

Area of the Study

The research was conducted in the college of education, Oju campus in Oju Local Government Area of Benue State, Nigeria. There are twenty-three Local Government Areas in Benue State categorized into three political zones, zone A, B, and C respectively. Oju Local Government Area is in Zone C which comprises nine Local Government Areas. Oju LGA is located in the North-central part of Nigeria. It gained full divisional status on the 3rd of February, 1976.

It is situated between latitude 6.859⁰ North and longitude 8.382⁰ East with the annual temperature of about 27⁰C (81⁰F), and the Time zone of WAT (UTC + 1) (Egbodo, B. A., 2015). According to the researcher, the climate is hot and humid and reflects a bimodal rainfall pattern with a mean annual rainfall of about 1,300 mm. The relative humidity can be as high as 95% in the mornings of wet seasons and as low as 21% in the afternoon of the dry seasons. The local government has a population of 168, 491 in the 2006 census. The area is 1,283km² with a density of 131.3inh./km². It is bounded in the West by Obi LGA, Ebonyi and Cross River States in the South, Konshisha LGA in the North, and Vandekya LGA in the East.

Sampling and Analysis

Four Sachet water brands were selected at random with particular attention to popular brand names commonly consumed in Oju. These will be denoted as B1 – B4. Samples were stored under the same condition and the analysis was conducted within two weeks. Samples from each factory were collected just immediately after production, labeled, and transferred to the following laboratories: Water Laboratory department in Water Board, Makurdi, Water Treatment Unit in Benue State University, Makurdi and Water Treatment Unit, University of Agriculture, Makurdi for analysis.

Analysis for the following parameters was carried out: pH, total hardness, BOD, calcium, chloride, magnesium, iron, sulfate, DO, TDS, EC, turbidity and coliform count using standard laboratory techniques. The results obtained were compared with the secondary data got from publications of the World Health Organization (WHO) and Nigerian Industrial Standard to ascertain conformity with the national and international guidelines.

Table No. 3: Various Sachet Water Brands Samples to be analyzed

S/No.	Brand Name	NAFDAC Reg. No
1.	A & G	D1- 1816L
2.	Joevi	B1-6482L
3.	Deco	01-4352L
4.	Aqualux	A1-2720L

Table No. 4: Physico-chemical analysis four brands of sachet water

S/ N	Name of the company	pH	Electric conductivity (Ec)	Turbidity (NTU)	Chlorine (mg/l)	Calcium (mg/l)	Potassium (mg/l)	(TDS) (mg/l)	(BOD) (mg/l)	(OD) (mg/l)
1	A & G	7.55	0.100	0.600	0.50	3.30	3.00	62.6	0.3	0.6
2	Joevi	6.75	0.170	0.523	1.25	4.70	6.50	100.6	0.4	0.7
3	Deco	7.18	0.090	2.830	0.45	5.10	2.50	38.8	0.9	1.3
4	Aqualux	7.33	0.100	0.266	0.50	2.10	3.00	62.5	0.3	0.7

Source: Authors' findings 2019

Table No. 5: Results of coliform count for the sachet water using the most probable number (mpn) no. of 5 tubes giving a positive reaction

S/N	Samples	10ml	1ml	0.1ml	Mpn/100ml
1	A & G	2	0	0	5
2	Joevi	1	0	1	8
3	Deco	1	0	0	2
4	Aqualux	3	0	0	2

Source: Authors' findings 2019

RESULTS AND DISCUSSION

The result of the physicochemical analysis and coliform count for the four brands of sachet water using the most probable number (mpn) is presented in Tables 4 and 5 above respectively.

Result of physical analysis (RPA)

The result of the physical analysis shows that the samples were colorless, odorless and tasteless. Turbidity which measures cloudiness is within the acceptable value of WHO and NIS of less than 5NTU.

Result of chemical analysis (RCA)

The chemical analyses show that the pH level for all the samples falls within the accepted range, the same goes for the potassium level for all the samples. The calcium level for all the samples also falls within the confines of the WHO and NIS standards. The dissolved oxygen for all the samples is lower than that of the WHO and NIS. The result of pH value falls within the WHO and NIS limit of 6.5 - 8.5. The result obtained for the chloride (Cl⁻) ion as contained in Table 4 was observed to be relatively low when compared to the WHO and NIS maximum value of (5) mg/L. The importance of chlorine in drinking water cannot be overemphasized. It gives a measure of protection against any contamination which may occur. The low state of this ion in these water samples according to Adetunde and Glover (2010) implies that they cannot be kept for a long period before consumption because there are chances of them being polluted. Levels of the mineral elements sodium, potassium and calcium in the samples studied are within acceptable limits of (125-250mg/L). The level of electric conductivity is also within the WHO and NIS limit of (< 1000dsm), likewise the total dissolves solids (TDS).

Result of biological analysis (RBA)

The biological parameter analyzed includes oxygen Demand (OD) and biological Oxygen Demand (BOD). The results of BOD and OD are all within the WHO and NIS limits of <10 and <5 respectively. The results show that none of the four (4) samples analyzed for coliform count meet up with the WHO standard for drinking water but all of the sachet water meet up with NIS of 10 coliform counts. It means that all the water samples contain coliforms. This implies that

there could be some health implications pending on the type of coliform found and even the coliform found could be due to the poor sanitary nature of the places of production.

Discussion of Physical Analysis (DPA)

This research work analyzed the physical properties of some sachet water purchased from the study areas even though their consumption is not limited to these areas. All the companies were NAFDAC approved. The assessment of organoleptic attributes (color, taste, and odor) showed all the samples to be clear with no taste or smell. These determine the aesthetic value (i.e. pleasantness, palatability and acceptability of the water) (Denloye, 2004). These are expected as many of the industries get their water supply from boreholes and pass it through industrial and micro-filters, this finding also agrees with the result of Denloye (2004). Turbidity which measures cloudiness is within the acceptable value of WHO and NIS of less than 5NTU.

Discussion of Chemical Analysis (DCA)

The pH values of most samples were found to fall between 6.4 - 8.1, which agrees with the report of Alhassan et al. (2008). This shows that almost all the samples fell within the WHO and NIS acceptable limits (6.5 - 8.5). The analysis of exchangeable cations (potassium and calcium) shows that their concentrations fall within acceptable limits of WHO and NIS (< 200mg/l) for Calcium and (<10) for potassium, this is similar to the report of Alhassan et al. (2008). Potassium is a major mineral of the intracellular and extracellular fluid respectively. They are responsible for the maintenance of the body fluid osmolarity and are also important for nerves and muscle function. Calcium is the major mineral cations of the bones. It is required for impulse transmission, blood clotting, and mediation of hormonal signals, muscular contraction, and function as a cofactor in many enzymes. The result of dissolved oxygen (DO) is also in line with the WHO standard. This is similar to the findings of Adediji & Ajibade (2005) that the concentration of DO in groundwater from hand pump equipped wells in West African sub-region is usually between 0.7 and 4.5 mg/L.

Discussion of Biological Analysis (DBA)

The BOD values were also within the WHO and NIS standards (10mg/L). This result is in line with the findings of Edema et al (2011). The results of the coliform count show that none of the

four samples analyzed meets up with the WHO standard of zero (0) for drinking water, as all the water samples contain coliforms range of 2 – 49.

CONCLUSION

The study was carried out to assess the physical, chemical and biological properties of sachet water in Oju Local Government Area of Benue State. A total of four samples were selected for the analysis. The results from the laboratory analysis showed that most of the physical, chemical and biological parameters conform with WHO and NIS standards except coliform count which did not conform to the WHO standard. The overall results showed that the sachet water produced in the study area was relatively safe for drinking according to the World Health Organisation standards for potable water. The biological analyses of coliform count show that all the samples are biologically unfit based on the WHO standard. Since the biological quality of water is a hidden attribute that impacts seriously on public health, it is important to note that the various sachet water packaged in the study area could have some health implications depending on the type of coliform found and there is, therefore, the need to improve on their biological treatment.

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