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# Physicochemical and Bacteriological Assessment of Sachet Water Consumed in Jalingo Metropolis, Jalingo LGA Taraba State, Nigeria.

***[1]Azuchukwuene C. G., [2]Barau B. W., [3]Isaac Ernest, [4]Babylon P. and [5]Elkanah D. S.***

[1]Department of Environmental Health Science, Faculty of Health Sciences, Taraba State University, Jalingo, Nigeria.
[2]Department of Biological Sciences, Faculty of Sciences, Taraba State University, Jalingo, Nigeria
[3]Department of Chemical Sciences, Faculty of Sciences, Taraba State University, Jalingo, Nigeria.
[4]Department of Public Health, Faculty of Health Sciences, Taraba State University, Jalingo, Nigeria.
[5]Department of Nursing Science, Faculty of Health Sciences, Taraba State University, Jalingo.
Email: a.chimezie.godwin@gmail.com, +2348038725215
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**ABSTRACT:**

The consumption of potable water cannot be over-emphasized in the prevention of waterborne diseases. This study assessed the physical appearance, physicochemical, and bacteriological quality of sachet water consumed in the Jalingo metropolis, ten (10) sachet water samples (SW1 – SW10) were tested. All the sachet water samples could not meet the NAFDAC standard for the physical appearance of the sachet water packaging in Nigeria. All but one (SW8) sample met the international standards for drinking water, SW8 had a pH of 6.3 which slightly fall below the required pH of 6.5 – 8.0 as approved by WHO. Five out of ten of the water samples SW3, SW6. SW8, SW9 and SW10 were positive for coliforms with $3.6 \times 10^4$, $2.4 \times 10^4$, $1.9 \times 10^4$, $3.8 \times 10^4$ and $4.1 \times 10^4$ respectively and for faecal coliforms $2.9 \times 10^3$, $1.8 \times 10^3$, $2.3 \times 10^3$, $2.9 \times 10^3$ and $2.7 \times 10^3$ respectively. SW3 and SW9 samples both tested positive for *Escherichia coli.* The presence of coliforms in these water samples has violated the WHO drinking water standards and pose as threat to the public health. The regulatory agencies in Nigeria need to intensify the surveillance on sachet water manufacturing companies.

**Keywords:** *Escherichia coli*, Faecal Coliform, Total Coliform, Sachet water, Jalingo

## Introduction:

There is a popular saying that says “water is life”. Water is one of the most abundant compounds that every human depends on for its survival. Water is not only essential for life; it also remains a most important vector of illness and infant mortality in many developing countries and even in technologically more advanced countries (Edema *et al.,* 2011). Safe drinking water is a basic need for human development, health and well-being; it is an internationally accepted human right (WHO, 2001).

Despite its relative abundance, good quality drinking water is not readily available to man (Onweluzo and Akuagbazie, 2010). As we human depends on water for our survival, it is important we have it in its best form often termed “Portable Water”. Potable drinking water serve as an important pillar for primary prevention of diseases and it continues to be the foundation for the prevention and control of water borne diseases (WHO, 2010; Isa *et al.,* 2013).

The importance of drinking water supply in the socioeconomic life of a community cannot be overstated. Often, source and potability of water supply reflects on the health conditions of communities as microbiological contamination of water is the primary cause of disease outbreaks in many communities particularly in many developing countries (Isa *et al.,* 2015).

In many developing countries, availability of potable water becomes a problem when supply is interrupted frequently and shortages become the order of the day (Popoola *et al.,* 2007). The safety of drinking water in poor and deprived communities has in the last decade been in jeopardy as a result of the introduction of refuse and sewage into sources of water supply (Kwakye *et al.,* 2007: Adewoye *et al.,* 2015).

Universal access to safe drinking water, sanitation and hygiene has become essential for human health and well-being outcomes (Bismark *et al.,* 2019). According to Federal Ministry of Health Statistics, only about 30% of Nigerians have access to potable water while the United Nations estimated that about 1.2 billion people all over the world lack access to potable water (Abdullahi *et al.,* 2019) Although this topic has received much attention in the public health research and policy frameworks in the richer economies, service levels and research considerations are generally low in many low- and middle-income countries (LMICs) (Behnke *et al.* 2018).

Production and distribution of drinking water, the sachet water (‘pure water’ as mostly referred to), to urban dwellers have, therefore, emerged to make up the clean or safe drinking water deficit (Stoler *et al.,* 2012; Adewoye *et al.,* 2013). Sachet packaged drinking water is very common in Nigeria. It is

often found as a major source of water at food canteens and sold by many food vendors in the country (Adiotomre and Agbale, 2015). Sachet Water is the most popular commercial source portable water in Nigeria cities today. The safety of drinking water is a worldwide public health concern (Daniel and Daudu, 2016).

Water-related diseases continue to be one of the major health problems globally, with an estimated 3.4 million water-related deaths per year (which represent 4% of all deaths) and 5% of health loss due to disability (Ojedabo *et al.,* 2023). The most common and widespread health risk associated with drinking is contamination, either directly or indirectly, by human or animal excreta and the microorganisms contained in feces (Suthar *et al.,* 2008: Olaoye and Onilude 2009).

The sale of packaged water has exploded all over the world in recent years, largely as a result of public perception that it is safe, tastes better, and has a better quality compared to raw tap water (Abdullah *et al.,* 2015).

In Jalingo, the generation and utilization of sachet water are expanding at a really high rate because the presumed portable water supply by the government agency is limited to a few settlements considering the population growth people depend on alternative portable water supply. Be that as it may, persistent reconnaissance of its quality at retail premises isn't being carried out. This may lead to the utilization of destitute quality sachet water. There has also been a developing concern approximately the Physicochemical and microbiological quality of the items. In this manner, this ponder evaluated the physicochemical and microbiological quality of locally bundled water sold for open utilization in Jalingo, Nigeria. This project aims to determine the physicochemical and bacteriological characteristics of sachet water sold in the Jalingo metropolis, Jalingo LGA, Taraba State, Nigeria.

## Materials and Method

### Study Area

This research work shall be carried out in the Jalingo local government area (LGA) of Taraba State, Nigeria. Jalingo Metropolis roughly lies between latitudes $8^0$ 47' to $9^0$ 01'N and longitudes $11^0$ 09' to $11^0$ 30'E. It has a boundary with Lau Local Government Area in the North, Yorro Local Government Area in the East and Ardo Kola Local Government Area in the South and West. The total land area of Jalingo is approximately 195km$^2$. Jalingo Metropolis has a population of 139,845 people according to the 2006 population census, with a projected growth rate of 3% (Shawulu *et al.,* 2008). Jalingo town lies on gently sloping land that leads to the great Muri plains and between 305m to 610m above sea level (Oruonye and Ahmed 2016).

### Sample Collection

Ten (10) brands of sachet water (SW1 – SW10) were randomly collected in different parts of the Jalingo metropolis, Jalingo LGA, Taraba State, Northeastern, Nigeria in bags within 48 hours of production and stored in a room at ambient temperature. All samples were bought from the retail points in Jalingo and taken to the Chemical Sciences Laboratory as well as the Department of Biological Sciences Laboratory of Taraba State University, Jalingo for Physicochemical and bacteriological analyses of the water samples respectively.

### Physicochemical Characteristics of Sachet Water Collected in Jalingo Metropolis

The physical appearance which includes labeling, and information on samples was observed and recorded, The Physical characteristics of each of the sachet water samples (SW1 -SW10) were analyzed and recorded as well as the chemical characteristics of the sachet water samples, and the physical characteristics tested for are: Conductivity, Total dissolved solids, Temperature, and total suspended solids/turbidity. The chemical characteristics tested for each sachet of water samples are PH, chloride, total hardness, calcium, and magnesium determination. All the physicochemical characteristics of all the sachet water samples tested were compared to WHO-acceptable standards. Abdullahi *et al.* (2019) methods for determining the physicochemical characteristics of water were adopted for these analyses.

### Bacteriological Analyses of Sachet Water Collected in Jalingo Metropolis.

The Bacteriological characteristics of all samples (SW1 – SW10) of the sachet water were tested for total coliforms, faecal coliform, and the presence of *Escherichia coli* (thermotolerant coliform) was tested for. In carrying out the above tests on each water sample, the methods of (Addo *et al.,* 2019) were adopted. Serial dilutions of $10^{-1}$ to $10^{-4}$ were prepared by measuring 1 mL of the sample into 9 mL of sterilized distilled water. One mL aliquots from each of the dilutions were inoculated into 5 mL of MacConkey Broth with inverted Durham tubes and inoculated at 35$^o$C for total coliforms and 44$^o$C faecal coliforms for 18–24 hours. Each of the water samples was analyzed in triplicates and the average was recorded. In determining the presence of *Escherichia coli*, a drop was transferred into a 5 mL test tube of Tryptone water and inoculated at 44$^o$C for 24 hours. A drop of Kovac's reagent was then added to the tube of Tryptone water. All tubes showing a red ring colour development after gentle agitation, which denoted the presence of indole, were recorded as presumptive for thermotolerant coliforms (E. coli).

## Results and Discussion

The National Agency for Food, Drug Administration and Control (NAFDAC) requires that all the labeling of food and drugs must be informative and accurate. This information required on labeling includes the producer's name, Contact information, Batch number, Nutritional information, Expiration

date (Best before date), Manufacturing date, and NAFDAC registration number (Abdulahi *et al.*, 2019). The physical appearance of the sachet water consumed in Jalingo metropolis indicates they all have a product name as well as manufacturer address written on the package, however only one (SW6) had its manufacturer's date, expiry date as well as batch number, only one (SW8) had no National Agency for Food and Drugs Administration Control (NAFDAC) registration number, none of the sampled sachet water had its mineral composition written on it. None of the samples of sachet water (SW1 - SW10) complied with the NAFDAC requirements as seen in Table 1.

**Table 1: Physical Appearance Sachet Water sold in Jalingo**

| Sample | Product Name | Manufacturers Adress | Manufacturing Date | Expiry Date | Batch Number | NAFDAC Registration Number | Mineral Composition |
|---|---|---|---|---|---|---|---|
| **SW1** | + | + | - | - | - | + | - |
| **SW2** | + | + | - | - | - | + | - |
| **SW3** | + | + | - | - | - | + | - |
| **SW4** | + | + | - | - | - | + | - |
| **SW5** | + | + | - | - | - | + | - |
| **SW6** | + | + | + | + | + | + | - |
| **SW7** | + | + | - | - | - | - | - |
| **SW8** | + | + | - | - | - | + | - |
| **SW9** | + | + | - | - | - | + | - |
| **SW10** | + | + | - | - | - | + | - |

From the results displayed in Table 2, The temperature of the samples ranged from $24.8^0$C to $28.9^0$C, these temperatures are within the ambient temperature. The Total Dissolved Solutes (TDS), Conductivity, and Turbidity of the ten samples SW1 – SW10 analyzed all are within the World Health Organization's required standards for drinking water.

**Table 2: Physical Characteristics of Sachet Water Sold in Jalingo**

| Sample | Temperature (ºC) | TDS (mg/l) | Conductivity (µs/cm) | Turbidity (NTU) |
|---|---|---|---|---|
| SW1 | 28.7 | 106.5 | 211.4 | 0.1 |
| SW2 | 25.7 | 119.6 | 237.4 | 0 |
| SW3 | 25.4 | 87.4 | 173.5 | 0 |
| SW4 | 26.7 | 97.4 | 193.3 | 0 |
| SW5 | 27.0 | 96.4 | 191.3 | 0 |
| SW6 | 28.4 | 123.4 | 244.9 | 0 |
| SW7 | 27.5 | 102.8 | 204.0 | 0 |
| SW8 | 26.3 | 87.5 | 173.8 | 0 |
| SW9 | 28.9 | 65.9 | 130.8 | 0 |
| SW10 | 24.8 | 92.6 | 183.8 | 0 |
| WHO | Ambient | 500 | 1000 | 5 |

Table 3 shows the chemical characteristics of the water samples analyzed, The pH of all but one of the water samples is within the WHO's approved standards for drinking water, the pH of SW8 is 6.3 which is slightly below the approved standard of 6.5, Every other sample had a pH between 6.5 and 8.5 which is within the approved standards. The chlorine content of the water samples was between 12.9mg/l and 27.3mg/l which is below the approved chlorine content of drinking water of 250mg/l. The Magnesium and Calcium content of the samples was within the WHO's standard with minimum and maximum results as 12.05mg/l and 19.20mg/l for Magnesium content and 19.64mg/l and 39.11mg/l for Calcium and all the results are within the WHO's standards of maximum of 30mg/l and 75mg/l for Magnesium and Calcium respectively. The total Harness of the water samples was within the consumable limits as set by the WHO.

**Table 3: Chemical Characteristics of Sachet Water sold in Jalingo**

| Sample | pH | Chlorine (mg/l) | Magnesium (mg/l) | Calcium (mg/l) | Total Hardness (mg/l) |
|---|---|---|---|---|---|
| SW1 | 7.4 | 13.7 | 12.65 | 35.12 | 68 |
| SW2 | 6.7 | 15.5 | 14.92 | 29.32 | 49 |
| SW3 | 7.6 | 13.4 | 12.05 | 34.10 | 87 |

| | | | | | |
|---|---|---|---|---|---|
| SW4 | 7.1 | 12.9 | 16.24 | 28.30 | 64 |
| SW5 | 6.9 | 14.6 | 15.32 | 19.64 | 72 |
| SW6 | 6.9 | 13.4 | 19.20 | 27.60 | 51 |
| SW7 | 7.8 | 19.7 | 16.47 | 33.45 | 68 |
| SW8 | 6.3 | 17.2 | 18.30 | 39.11 | 84 |
| SW9 | 7.8 | 27.3 | 17.65 | 27.35 | 74 |
| SW10 | 7.6 | 16.8 | 14.28 | 29.32 | 66 |
| WHO | 6.5-8.5 | 250 | 30 | 75 | 150 |

The bacteriological analyses of all the sachet water samples presented in Table 4 shows that five of the water samples were positive for the presence of coliforms indicating contamination from faecal sources and these findings agree with the findings of Addo *et al.*, 2019 who found 50% of the tested sachet water samples tested positive for Total coliforms as well as faecal coliforms. Out of the tested samples, SW3 and SW9 indicated the presence of *Escherichia coli.*

**Table 4: Bacteriological quality of sachet water sold in Jalingo**

| **Sample** | **Total Coliform/100ml** | **Faecal coliform/100ml** | ***E. coli*/100ml** |
|---|---|---|---|
| SW1 | Nil | Nil | Nil |
| SW2 | Nil | Nil | Nil |
| SW3 | $3.6 * 10^4$ | $2.9 * 10^3$ | Presence |
| SW4 | Nil | Nil | Nil |
| SW5 | Nil | Nil | Nil |
| SW6 | $2.4 * 10^4$ | $1.8 * 10^4$ | Nil |
| SW7 | Nil | Nil | Nil |
| SW8 | $1.9 * 10^4$ | $2.3 * 10^3$ | Nil |
| SW9 | $3.8 * 10^4$ | $2.9 * 10^4$ | Presence |
| SW10 | $4.1 * 10^4$ | $2.7 * 10^3$ | Nil |
| WHO | 0 | 0 | 0 |

## Conclusion:

Consumption of sachet water in Nigeria is not uncommon and Jalingo is not left out in the list of cities where major water for consumption is the sachet water popularly called “Pure Water”. Analysis of the sachet water sold in Jalingo shows faecal contamination which indicates a compromise in drinking water standards and as a result, poses a threat to public health and therefore could lead to a water-borne diseases outbreak in Jalingo.

The water sources need an adequate level of treatment before pushing them out for public consumption and regulatory agencies saddled with the responsibilities of surveillance of these manufacturing companies need to intensify their duties.

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