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# Water Quality of Selected Sachet Water Brands Sold in Sango-Ota, Nigeria

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**Abstract.** Clean and safe water drinking is essential for the attainment of the United Nations sustainable development goals. The study assessed the physical and chemical parameters of ten (10) brands of sachet water sold at Sango-Ota in Ogun State, Nigeria. The physical parameters (temperature, electrical conductivity (EC), total dissolved solids (TDS), total suspended solids (TSS), power of hydrogen (pH) and turbidity) and chemical parameters ((calcium (Ca), potassium (K), copper (Cu), manganese (Mn), zinc (Zn), magnesium (Mg), iron (Fe) and chloride (Cl)) of the sachet water samples were determined. The physical parameter tests were analysed using Hanna Instruments (Model HI 98130). The compliance of the physico-chemical parameters of the samples with the drinking water standard requirements of the World Health Organisation (WHO) and Nigeria Standard Drinking Water Quality (NSDWQ) was analysed. The pH values of the samples were within the range 6.5-8.5, in conformity with the WHO and NSDWQ standard for drinking water. The electrical conductivity ranged from 0.02 - 0.06  $\mu\text{S}/\text{cm}$ , falling within the permissible limit (1000  $\mu\text{S}/\text{cm}$ ) of WHO standard. The TDS of 0.01 - 0.03 mg/l were within the recommended permissible limit (1000mg/l) recommended by WHO. Similarly, the TDS, TSS and Turbidity were within the recommended permissible limits of the WHO. For the chemical parameters, the concentrations of K, Cu, Mn, Zn, Mg, Fe and Cl in the sachet water samples were within the WHO permissible limits of drinking water. However, some brands had their Ca concentrations above the WHO drinking water permissible limit. Generally, all the brands of sachet water samples studied were considered safe for drinking.

## 1. Introduction

Water is one of the major natural resources endowed mankind for the continued existence [1, 2]. However, access to a portable watercourse remained the basic need for all human beings [3]. It is needed to maintain the proper functioning of the human body. Little wonder, when ill persons get admitted in hospitals, normal saline solution (sterile water with sodium chloride) is usually administered to those who cannot take fluids orally and are in danger of being dehydrated. Water is also vital for personal hygiene.

Judging by the recent report from the World Health Organization and UNICEF[4], about 1 in 3 persons globally lack access to portable water. This lack of clean and safe drinking water is more challenging in many developing countries like Nigeria. The government water supply schemes serve only a few. People are, therefore, left with no other option than to source their water themselves. Some people source their water from streams, rivers, hand-dug wells or drilled borehole wells. Others purchased their drinking water from water vendors. Some of these vendors sell water using different sealed and unsealed containers. Cart-pushing vendors sell unsealed water in 25 litre or 50 litre containers, while some water vendors sell water in sealed plastic bottles and sachet (plastic) bags. This research work aims at assessing the quality of some of the selected brands of sachet water sold in Sango-Ota metropolis of



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Ogun State, Southwest, Nigeria using Hanna Instruments (Model HI 98130) in analysing the physical parameters. While Palintest Photometer 8000 was used in checking the level of chemical pollutants in the water samples.

## 2. Materials and Methods

This research obtained two samples of sachet water procured from ten different sources across Sango-Ota in Ado-Odo Ota Local Government Area, Ogun State, Nigeria, in order to assess the quality of the sachet water consumed in the study area. All the sachet water brands selected were registered under the National Agency for Food and Drug Administration and Control (NAFDAC) [5]. Their consumption is not limited to the study area.

The samples were kept in a refrigerator at 4°C for twenty-four hours prior to the analysis at the Environmental Laboratory of Covenant University. The brands were denoted by A, B, C, D, E, F, G, H, I and J, while 1 and 2 were used to indicate the two different samples. Physical analysis like odour, taste and colour were determined using physical observations. The temperature, electrical conductivity (EC), total dissolved solids (TDS) and pH of the water samples were determined using the Hanna Multiparameter Instrument (model HI 98130) under room temperature (27°C), while the turbidity was determined using a turbidity meter. Filtration method was used to determine the total Suspended Solids (TSS) present in the samples. Calcium (Ca), Potassium (K), Copper (Cu), Manganese (Mn), Zinc (Zn), Magnesium (Mg), Chloride (Cl) and Iron (Fe) were analysed using a Palintest Photometer 8000.

A part of each of the samples was poured into different beakers and a well-calibrated pen-type Hanna multiparameter instrument was dipped into the samples. The device was suspended for the tip not to touch the base of the apparatus for an accurate reading. When the device reading became stable, it was recorded. The TSS was determined by filtration method. A little portion of each sample was poured into a beaker and weighed (initial reading,  $D_0$ ). Filter paper of size 110 mm diameter was folded properly into a conical flask. The sample was then poured into the filter paper. When the filtration process was completed, the filtrate was poured back into the beaker and weighed. This last reading was recorded as the final reading ( $D_1$ ). The difference in initial ( $D_0$ ) and final reading ( $D_1$ ) was taken as the TSS (see Equation 1).

$$D_0 - D_1 = \text{TSS} \quad (1)$$

The turbidity test was carried out using a turbidity meter. A turbidity test tube was selected, filled with the sample to the 10 ml mark and inserted into the turbidity meter. When the reading became stable, the result was recorded.

Using the Palintest Photometer 8000, calcium (Ca), potassium (K), copper (Cu), manganese (Mn), zinc (Zn), magnesium (Mg), chloride (Cl) and iron (Fe) were analysed. The water samples were filtered to obtain a clear solution. For each of the elements analysed, two (2) 10 ml test tubes were rinsed with distilled water, filled with the water sample and the palintest water test tablets or reagents was added. For the determination of the concentrations of calcium, potassium, copper, manganese, zinc, and chloride, readings were taken directly from the photometer. In contrast, those of magnesium and iron were determined after their solutions were left to stand for the specified time (using a stopwatch) to allow for full colour development. Also, the safety precautions observed during the experimental work was in line with [6].

## 3. Results and Discussion

The results for the determination of the odour, taste, colour, pH, TDS, EC, temperature, TSS and turbidity of the selected sachet water samples are shown in Table 1.

**Table 1.** Physico-chemical parameters of selected sachet water brands in Sango-Ota

ID	Odour	Taste	Colour	pH	TDS (mg/l)	EC ( $\mu$ S/cm)	Temperature ( $^{\circ}$ C)	TSS (mg/l)	Turbidity (NTU)
A1	Odourless	Tasteless	Colourless	8.08	0.03	0.06	25.5	0.01	0.35
A2	Odourless	Tasteless	Colourless	8.05	0.03	0.06	28.8	0	0.35
B1	Odourless	Tasteless	Colourless	7.71	0.02	0.05	25.3	0	0.31
B2	Odourless	Tasteless	Colourless	7.64	0.02	0.05	28.9	0.01	0.25
C1	Odourless	Tasteless	Colourless	7.31	0.01	0.05	30.3	0.01	0.16
C2	Odourless	Tasteless	Colourless	6.98	0.01	0.03	30.5	0.01	0.29
D1	Odourless	Tasteless	Colourless	6.62	0.01	0.03	25.9	0	0.23
D2	Odourless	Tasteless	Colourless	6.65	0.01	0.03	25.5	0	0.24
E1	Odourless	Tasteless	Colourless	6.42	0.02	0.03	25.7	0.01	0.18
E2	Odourless	Tasteless	Colourless	5.97	0.01	0.02	25.4	0.01	0.28
F1	Odourless	Tasteless	Colourless	6.06	0.02	0.04	26	0	0.25
F2	Odourless	Tasteless	Colourless	6.07	0.02	0.04	26	0	0.28
G1	Odourless	Tasteless	Colourless	6.74	0.01	0.02	26.6	0	0.25
G2	Odourless	Tasteless	Colourless	6.8	0.01	0.03	26.6	0	0.16
H1	Odourless	Tasteless	Colourless	7.07	0.03	0.05	26.3	0.01	0.25
H2	Odourless	Tasteless	Colourless	7.08	0.03	0.05	26.4	0.01	0.22
I1	Odourless	Tasteless	Colourless	5.74	0.02	0.05	23.5	0.01	0.02
I2	Odourless	Tasteless	Colourless	5.84	0.02	0.05	23.5	0.01	0.02
J1	Odourless	Tasteless	Colourless	6.6	0.02	0.04	22.9	0	0.11
J2	Odourless	Tasteless	Colourless	6.54	0.02	0.05	29.6	0	0.06
WHO	Odourless	Tasteless	Colourless	6.5- 8.5	1000	1000	-	-	5
NSDWQ	Odourless	Tasteless	Colourless	6.5- 8.5	1000	1000	-	25	-

A1-J2 was used to denote sample ID of the selected sachet water brands.

The physical analysis of the sachet water samples studied showed that all the brands were colour, odour and taste free, which conforms with the World Health Organisation [7] and Nigeria Standard Drinking Water Quality (NSDWQ) [8] standards for drinking water.

The pH of a given water sample is the measure of hydrogen ions ( $H^+$ ) in the water, and it is measured on a scale of 1-14. If the pH of the sample is between 0 - 7, the water is said to be acidic. However, if the pH is at 7, it is neutral. A pH between 7 - 14 is considered basic. The pH of the brands D, E, F, G, I and J can be described as being slightly acidic ( $<7$ ), while the pH of the brand H is neutral. The pH of the brands A, B and C can be described as slightly basic. However, the pH of all the brands was within the range of acceptable pH (6.5 – 8.5) recommended by the WHO [7] and NSDWQ [8] drinking water quality standards.

The TDS of the brands ranged from 0.01-0.03 mg/l and are within the recommended permissible limits specified by the WHO [7]. This also indicates that all the values are within the acceptable limit of 500 mg/l recommended by the NSDWQ [8].

The figures of Electrical conductivity (EC) of the samples tested ranges from 0.02 - 0.06  $\mu$ S/cm, these were is inline with [8-10]. Using physical testing method, the EC of the given samples also gave a clarity, which mean the water is portable for consumption. The EC in all the sachet water samples analysed were below the maximum limits of 1000  $\mu$ S/cm stated by NSDWQ [8].

The TSS figures recorded ranges from 0 – 0.01 mg/l, these falls within the maximum limits of NSDWQ [8] of 25 mg/l. This indicates that all the TSS values of the samples were within the recommended limits of WHO [7] and NSDWQ [8].

Turbidity is attributed to cloudiness of water due to variety of particles present in drinking water. The turbidity of the twenty (20) samples under investigation fall within the maximum limits of WHO turbidity standard of portable water of 5 Nephelometric Turbidity Unit (NTU). According to [9-11] the sources of turbidity includes; sewage solids, silt and sand washings, clay particles, organic and biological sludges or industrial discharges.

The results for the determination of the chemical constituents in the selected sachet water samples are presented in Table 2.

**Table 2.** Elemental test of the selected sachet water brands in Sango-Ota

ID	Calcium (Ca) (mg/l)	Potassium (K) (mg/l)	Copper (Cu) (mg/l)	Manganese (Mn) (mg/l)	Zinc (Zn) (mg/l)	Magnesium (Mg) (mg/l)	Iron (Fe) (mg/l)	Chloride (Cl) (mg/l)
A1	124	2.1	<0.00	<0.000	0	<0.0	<0.00	21
A2	231	1.8	0.88	0.003	<0.00	<0.0	0.01	3.4
B1	342	1.6	0.06	0.001	0.38	<0.0	<0.00	0
B2	349	2.2	0.34	<0.000	<0.00	<0.0	<0.00	5.4
C1	270	1.2	<0.00	<0.000	<0.00	<0.0	<0.00	<0.0
C2	153	2.3	<0.00	<0.000	<0.00	<0.0	<0.00	<0.0
D1	269	<0.0	<0.00	0	<0.00	<0.0	<0.00	22.5
D2	69	6.7	<0.00	<0.000	<0.00	<0.0	<0.00	0
E1	34	9	0.58	0	0.05	<0.0	0.06	25.5
E2	99	2.5	<0.00	0.003	0.01	<0.0	<0.00	5.7
F1	63	1.9	0	<0.000	0.05	0	0.02	42
F2	122	4	<0.00	0.001	<0.00	<0.0	<0.00	32
G1	188	1.8	<0.00	0.001	<0.00	<0.0	0.02	32
G2	79	1.3	<0.00	0.002	<0.00	<0.0	<0.00	14.5
H1	*ND	5	0.02	0	<0.00	<0.0	<0.00	2.2
H2	40	7	<0.00	<0.000	0.21	<0.0	0.01	20
I1.	83	5	0.42	<0.000	<0.00	<0.0	<0.00	1.5
I2	85	2	0.72	0	0.03	<0.0	<0.00	15.5
J1	81	2	0.38	<0.000	<0.00	<0.0	<0.00	6.7
J2	44	ND	0.94	0.003	<0.00	<0.0	<0.00	1.1
WHO	200	12	5	0.03	5	100	1	250
NSDWQ	200	12	5	-	3	-	0.3	250

\*ND- Not Detected

A1-J2 was used to denote sample ID of the selected sachet water brands.

Elements tested are; Calcium, Potassium, Copper, Manganese, Zinc, Magnesium, Iron and Chloride. The calcium concentrations in the water samples from Table 2 ranges from 34 – 349 mg/l. However, the permissible limits for calcium in drinking water is 200 mg/l, according to the WHO [7]. The presence of calcium ions in water samples tend to hardened the water and may not be suitable for consumption. Because the calcium salts precipitates from water causes high levels of calcium ions which tend to promote scale formation in water systems (Palintest Photometer 8000 manual). Meanwhile, brand B has its calcium concentration exceeding the permissible limit.

The potassium concentrations in the sachet water samples ranges from 0 - 9.0 mg/l, which were within the permissible limit of 12 mg/l stated by the WHO [7]. The daily consumption of potassium is a vital element for human growth. As such, the daily recommended requirement of potassium should be greater than 3000 mg WHO [7].

The concentration of copper in the water samples ranges from 0 - 0.94 mg/l, these were within the stipulated permissible limits of 5 mg/l specified by the WHO [7]. Therefore, the presence of copper occurs naturally, only in minute quantity (few micrograms per litre) in drinking water [12].

The concentration of manganese in the samples ranges from 0 - 0.003 mg/l and it complies with the WHO [7] standard of drinking water quality. Manganese occurs mostly due to distributions of ores and rocks. It has no particular toxicological effect [7]. Similarly, the concentrations of zinc (0 - 0.38 mg/l), magnesium (0.0 mg/l), iron (0 - 0.06 mg/l), and chloride (0 - 42.0 mg/l) were all far less than the permissible limits of the WHO [7] and NSDWQ [8] standard of portable water quality.

#### 4. Conclusions

The results of the physical properties tests on the various samples indicate that all the brands of water tested were colour, odour and taste free. Also, the pH, TDS, EC, temperature, TSS and turbidity of all the brands were within the permissible limits of the WHO (2017) drinking water. The chemical properties of the brands were within the permissible limits of WHO except samples A2, B1, B2, C1 and D1 that had calcium concentration exceeding the WHO permissible limits, the concentrations of potassium (K), copper (Cu), manganese (Mn), zinc (Zn), magnesium (M), iron (Fe) and chloride (Cl) were within the WHO [7] drinking water standards requirements. Consequently, we recommend that the ten (10) brands of sachet water studied were safe for public consumption.

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