Physicochemical Quality of Sachet and Bottled water consumed in Alvan Ikoku Federal College of Education, Owerri, Imo State

[1*]Nwaka, B.U., [2]Ogueri, E.O., [1]Usoh, C.I.

[1]Department of Physics, Alvan Ikoku Federal College of Education, Owerri, Imo State
[2]Department of Health Education, Alvan Ikoku Federal College of Education, Owerri, Imo State
Corresponding author: Nwaka, B.U

--**ABSTRACT**--
In Nigeria, the production of sachet and bottled water for drinking has been on the increase that few dealers of the products may have been involved in sharp and unlawful practices leading to poor physicochemical water qualities. Temperature, pH, turbidity, total dissolved solids (TDS), electrical conductivity (Ec) of commonly consumed sachet and bottled water in Alvan Ikoku Federal College of Education, Owerri, Imo State were determined, using standard analytical procedures. Thirty two (32) water samples comprising of eight (8) samples each from Eva bottled water, Alvana Table bottled water, Izzy sachet water and kechy sachet water were systematically selected in order to ascertain the safety of the drinking water according to World Health Organization, (WHO) and Nigerian Standard for Drinking Water Quality (NSDWQ) standards. Findings showed that all the samples analyzed are (replaced with were) within the WHO and Nigerian Standards, indicating that fear of poor quality should not be entertained. It appears from the results of the analyses that bottled water are given special treatment than sachet water which could be the reason for their being relatively more classy than sachet water. It is recommended that other physicochemical and bacteriological analyses be carried out as a follow up to this study.
Keywords: Physicochemical water quality, WHO, NSDWQ, sachet water, bottle water
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I.   INTRODUCTION

Sachet and bottled water are commercially treated water, manufactured, packaged and distributed for sale in sachet, usually 60 centiliter (cl) sachet or in plastic containers of 60 cl, 75 cl and 1.5 Litre (L) respectively, intended for human consumption. In most cases, borehole water connected to tap is the major source of water for sachet or bottled water production. Technological advancement in Nigeria and beyond has made sachet and bottled water production one of the fastest growing industries. It is almost impossible to have drinking water in its pure state. The decrease in our daily water intake affects the efficiency of cells and other body activities.

In Alvan Ikoku Federal College of Education (AIFCE), Owerri, Imo State, borehole water obtained from groundwater sources is the main source of water for drinking and other purposes. The resulting sachet and bottled water sold to the populace of the institution may have come from polluted shallow groundwater table that intercepts pit latrines and soak away pits, pollution arising from agricultural activities, industrial activities and geochemistry of the environment. Since drinking water has played a significant role in the transmission of human diseases, such as typhoid fever, cholera, infectious hepatitis, bacillary and amoebic dysenteries and many varieties of gastro – intestinal disease, there is need to carry out a preliminary investigation on some physicochemical qualities of sachet and bottled water soled and consumed in and around the institution to find out if they comply with the local and international guidelines for drinking water quality.

The study is(delet) aimed at assessing if the sachet and bottled water consumed in AIFCE, Owerri Imo State is physically and chemically fit for drinking according to the guidelines for drinking water quality suggested by World Health Organization (WHO), and Nigerian Industrial Standard (NIS).

The objectives of the study intended to:
(1) determine the temperature, pH, turbidity total dissolve solids (TDS) and electrical conductivity (Ec) of Izzy and kechy sachet water commonly sold in and around the institution.
(2) determine the temperature, pH, turbidity total dissolve solids (TDS) and electrical conductivity (Ec) of Alvana and Eva bottled water commonly sold in and around the institution.

The study will create awareness needed for the users of the products to decide whether to continue in the consumption of the products or not. It will assist agencies and organizations responsible in controlling drinking water qualities in Nigeria to take proactive measures in ensuring strict compliance to the drinking water guidelines.

Though researches had been carried out on physicochemical drinking water qualities in different parts of Nigeria and beyond, however few works related to sachet and bottled water qualities were sited. Onweluzo and Akuagbazie (2010) in Nsukka town reported that sachet water showed wider pH range than bottled water and compliance of TDS, conductivity pH with WHO and NAFDAC standards.

Ackah et al. (2012) established in some urban town of Ghana that sixteen percent (16%) of sachet water samples fell above pH, TDS, conductivity and turbidity standards for drinking water quality using analytical procedures for water quality.

Murtala et al. (2014) using purposive sampling technique investigated 20 sachet drinking water samples collected in 20 sachet drinking water packaging plants in Kastina Urban Area. The samples were collected in dry and wet season in the year 2013 and analyzed. The obtained results showed that average values of pH, Ec, turbidity for the sachet water samples analyzed in dry and wet seasons were within the acceptable limits set by WHO (2011) for safe drinking water.

Martins and Chikezie (2014) carried out quality assessment of five (5) sachet water brands marketed in Bauchi Metropolis of Nigeria and reported that for all the physical characteristics monitored, there was no statistical significant difference which signifies that all the companies follow the same or similar method of treatment and packaging. All values of physical characteristics were lower than the NIS, SON and WHO.

Yusuf et al. (2015) studied physicochemical qualities of 21 brands of sachet water packaged within Zaria Metropolis to compare their compliance with World Health Organization and Nigeria Industrial Standard (NIS) with threshold limit using standard analytical methods. The overall results showed that the sachet water produced in the study area were relatively safe for drinking according to the WHO and NIS standard.

Sawere and Uwagwue (2016) analyzed 15 bags of 500ml sachet water samples sold in Delta State Polytechnic, Ozoro for physicochemical parameters. The pH, TDS, and Ec values were measured using Jenway Model, pH meter, TDS, and conductivity meter. The results revealed mean values of pH, TDS and conductivity were below the WHO guidelines. Scarcity of data and information in AIFCE had necessitated the investigation of physicochemical qualities of sachet and bottled water sold in and around the vicinity.

II.   MATERIALS AND METHODS

The Study Area/Site
The study was carried out in Alvan Ikoku Federal College of Education, Owerri, and Imo State, Nigeria. Geologically the area is made up of sedimentary rock which are made up of shales, sandstones and limestone lithology (Oparaocha *et al.,* 2010) The study area lies between latitude 5^0 29′ 0″ N and 5^0 31′ 0″ N and Longitude 6^0 59′ 0″ E and 7^0 1′ 0″ E.

Sample Collection
Two (2) sachet and two (2) bottled water brands were investigated. These drinking water were identified as the commonly consumed among students, staff, and people living and working within the AIFCE. They are (replace with were) earlier mentioned as Eva bottled water, Alvana table bottled water, Izzy sachet water, and Kechy sachet water. The water brands were purchased from different shops within the campus from which eight (8) water samples each of the brand were collected with 200ml containers using stratified random sampling technique to give a total of thirty two (32) water samples used for the analyses.

Sample Preparation
Water samples were brought to the laboratory for preparation and analyses within forty – eight (48) hours after sample collection. All the samples were acidified using 5 ml of concentrated trioxonitrate (V) acid (HNO_3) in order to avoid adsorption of heavy metals by the container walls and to prevent microbial activities.

Physical and Chemical Analyses of Sachet and Bottled Water
Temperature, pH, turbidity, TDS, and Ec were analyzed using standard analytical technique and recorded for each brand of sachet and bottled water used for the study.

Temperature (^{o}C)
Temperature of all the sachet and bottled water samples were determined in the laboratory using digital thermometer. The probe was dipped into the container of water samples and read at steady mark in ^{o}C and recorded

pH
All the samples were measured for pH in the laboratory using pH meter with censor probe. Calibration was done with standard buffer solution of pH which ranged from 4.0 to 9.0. The probe was dipped into the water container until stable readings were obtained and recorded.

Turbidity (NTU)
A turbidimeter was used to determine the turbidity of all the sachet and bottled water used for this study. Measurement was done in Nephelometric Turbidity Unit (NTU) and recorded.

Total Dissolved Solids, TDS (mg/L)

TDS was determined with TDS meter. The electrode was rinsed with deionised water followed by the water sample. The rinsed electrode was allowed to stabilize in the sample for 1 minute after which the TDS value was read directly in mg/L.

Electrical Conductivity, Ec (µs/cm)

Electrical conductivity was determined with conductivity metre as described by APHA (1998). The probe of the instrument was rinsed first with distilled water and following rising with each water samples. The measurement was done at 25°C when the probe was allowed to stay in the water samples for about 1 minute before recording the readings in micro siemens per centimeter (µs/cm). The results of all the measurements were presented in **Tables 3.1, 3.2, 3.3, and 3.4** for Eva bottled water, Alvana Table bottle water, Izzy sachet water and Kechy sachet water. The analyses were carried out in the Department of Chemistry, Alvan Ikoku Federal College of Educatio,(Education for correct spelling) Owerri, Imo State.

RESULTS

Temperature

Tables 3.1, 3.2, 3.3 and 3.4 showed the range of values of Eva bottled water for temperature measurement from 24.7 to 28.4 ^{o}C with mean result 26.73±1.189 ^{o}C . Alvana bottled water ranged from 27.3 to 29.4 ^{o}C with mean of 27.94±0.711 ^{o}C. Izzy sachet water ranged from 25.4 to 28.6 ^{o}C with mean value of 26.94±1.299 ^{o}C and kechy sachet water which ranged from 26.5 to 28.5 ^{o}C with mean value of 27.43±0.870 ^{o}C. In general, the highest mean temperature was found in Alvana Table bottled water while the lowest was found in Eva bottled water.

pH

Tables 3.1, 3.2, 3.3 and 3.4 showed the pH range of values of Eva bottled water from 6.8 to 7.7 with mean result of 7.16±0.292. Alvana bottled water ranged from 6.8 to 7.6 with mean of 7.08±0.297. Izzy sachet water ranged from 7.3 to 8.1 with mean value of 7.61±0.328 and kechy sachet water which ranged from 6.8 to 7.5 with mean value of 7.13±0.220. In general, the highest mean pH was found in Izzy sachet water while the lowest was found in Alvana Table bottled water.

Turbidity

Tables 3.1, 3.2, 3.3 and 3.4 showed the turbidity range of values of Eva bottled water from 0.8 to 2.2 NTU with mean result of 1.46±0.512 NTU. Alvana bottled water, ranged from 0.8 to 2.3 NTU with mean of 1.61±0.664 NTU. Izzy sachet water ranged from 1.9 to 2.5 with mean value of 2.25±0.239 NTU and kechy sachet water ranged from 2.5 to 2.9 with mean value of 2.69±0.194 NTU. In general, the highest mean turbidity was found in Kechy sachet water while the lowest was found in Eva bottled water.

Total Dissolved Solids (TDS)

Tables 3.1, 3.2, 3.3 and 3.4 showed the TDS for Eva bottled water ranged from 28.41 to 28.61 mg/L with mean result of 26.24±1.811 mg/L. Alvana bottled water ranged from 31.34 to 43.24 mg/L with mean of 35.22±4.318 mg/L. Izzy sachet water ranged from 51.51 to 57.14 mg/L with mean value of 54.03±1.994 mg/L and kechy sachet water which ranged from 60.65 to 73.61 mg/L with mean value of 69.05±4.979 mg/L. In general, the highest mean TDS was found in Kechy sachet while the lowest was found in Eva bottled water.

Electrical Conductivity (Ec)

Tables 3.1, 3.2, 3.3 and 3.4 showed the Ec for Eva bottled water ranged from 47.26 to 61.12 mg/L with mean result of 54.49±4.742 mg/L. Alvana bottled water ranged from 62.86 to 86.92 mg/L with mean of 70.59±9.057 mg/L. Izzy sachet water, which ranged from 103.47 to 114.58 mg/L with mean value of 108.44±4.013 mg/L and kechy sachet water ranged from 121.68 to 146.89 mg/L with mean value of 137.50±9.417 mg/L. In general, the highest mean Ec was found in Kechy sachet while the lowest was found in Eva bottled water.

Table 3.1: Statistical Results of Temperature, pH, Turbidity, TDS, and Ec of 8 Eva bottled water samples with NAFDAC number: 01 – 0492

Physicochemical Qualities	Minimum	Maximum	Mean	Standard Deviation	WHO (2011)	NSDWQ (2007)
Temperature (^{o}C)	24.70	28.4	26.73	1.189	25 – 30	25 – 30
pH	6.8	7.7	7.16	0.292	6.5 – 8.5	6.5 – 8.5
Turbidity(NTU)	0.8	2.2	1.46	0.512	5.0	5.0
TDS (mg/L)	28.41	28.61	26.24	1.811	500	500
Ec (µs/cm)	47.26	61.12	54.49	4.742	1000	1000

Table 3.2: Statistical Results of Temperature, pH, Turbidity, TDS, and Ec of 8 Alvana Table bottled water samples with NAFDAC number: B1 – 0355L

Physicochemical Qualities	Minimum	Maximum	Mean	Standard Deviation	WHO (2011)	NSDWQ (2007)
Temperature (^{o}C)	27.3	29.4	27.94	0.711	25 – 30	25 – 30
pH	6.8	7.6	7.08	0.297	6.5 – 8.5	6.5 – 8.5
Turbidity(NTU)	0.8	2.3	1.61	0.664	5.0	5.0
TDS (mg/L)	31.34	43.24	35.22	4.318	500	500
Ec (µs/cm)	62.86	86.92	70.59	9.057	1000	1000

Table 3.3: Statistical Results of Temperature, pH, Turbidity, TDS, and Ec of 8 Izzy Sachet Water Samples with NAFDAC number: A1 – 7523L

Physicochemical Qualities	Minimum	Maximum	Mean	Standard Deviation	WHO (2011)	NSDWQ (2007)
Temperature (^oC)	25.4	28.6	26.94	1.299	25 – 30	25 – 30
pH	7.3	8.1	7.61	0.328	6.5 – 8.5	6.5 – 8.5
Turbidity(NTU)	1.9	2.5	2.25	0.239	5.0	5.0
TDS (mg/L)	51.51	57.14	54.03	1.994	500	500
Ec (µs/cm)	103.47	114.58	108.44	4.013	1000	1000

Table 3.4: Statistical Results of Temperature, pH, Turbidity, TDS, and Ec of 8 Kechy Sachet Water Samples with NAFDAC number: C1 – 5447L

Physicochemical Qualities	Minimum	Maximum	Mean	Standard Deviation	WHO (2011)	NSDWQ (2007)
Temperature (^oC)	26.5	28.5	27.43	0.870	25 – 30	25 – 30
pH	6.8	7.5	7.13	0.220	6.5 – 8.5	6.5 – 8.5
Turbidity(NTU)	2.5	2.9	2.69	0.194	5.0	5.0
TDS (mg/L)	60.65	73.61	69.05	4.979	500	500
Ec (µs/cm)	121.68	146.89	137.50	9.417	1000	1000

III.   DISCUSSION

The mean temperatures for Izzy and Kechy sachet water were relatively closer; similar to the results obtained in Eva and Alvana bottled water and were in good agreement with WHO and Nigerian Standards. Mean pH for Izzy sachet water was found highest of four brands while the lowest results was obtained in Kechy sachet. All the four water brands showed neutral pH and comply with WHO and Nigerian Standards. The mean turbidity for Izzy and Kechy sachet water were higher when compared with Eva and Alvana bottled water; which implies that Eva and Alvana bottled water are better water quality in terms of turbidity than Izzy and Kachy sachet water. Mean TDS for Izzy and Kechy sachet water were higher when compared with Eva and Alvana bottled water, however all the water brand analyzed comply with WHO and Nigerian Standards. In addition, the mean Ec for Izzy and Kechy sachet water were higher when compared with Eva and Alvana bottled water but all were found lower than WHO and Nigerian Standards. The TDS and Ec results obtained in this study is an indication that water samples are not saline.

Comparing the physicochemical analyses carried out in this study with some similar reported work in the literature, it is observed that the results comply with some works (replace some works with some studies) elsewhere (Adiotomre and Agbale, 2015; Mohammed, 2015; Sawere and Uwagwue, 2016). This may be due to variation in water treatment carried out by manufacturer as well as variation of local geology of different environment. The overall results showed that the sachet and bottled water studied in this work are safe for drinking according to the WHO and NSDWQ standard.

IV.   CONCLUSION AND RECOMMENDATION

Some Physical and chemical characteristics of sachet and bottled water commonly sold in Alvan Ikoku Federal College of Education, Owerri, Imo State have been carried out using standard techniques. The temperature, pH, turbidity, TDS and Ec results showed bottled water are of better quality to sachet water. All the samples analyzed are (replace are with were) within the WHO and Nigerian Standards, suggesting that the fear of health risk should not been entertained in the use of sachet and bottled water brands.

As a result of the findings, it is recommended that manufacturers of sachet and bottle water should keep to WHO and Nigerian Standards so as to maintain the good health of the populace and that sachet and bottled water should be given equal water treatment during production before sales to the consumers. It is also recommended that other physicochemical and bacteriological analyses be carried out as a follow up to this work (replace work with studies) in order to be aware of the health situation of people who consume these products.

REFERENCES

[1].   Ackah, M., Anim, A.K., Gyamfi, E.J., Acquah, J., Nyarko, E.S., Kpattah, L., Brown, S.E., Hanson, J.E.K., Fianko, J.R., Zakaria, N. (2012). Assessment of the quality of sachet water consumed in urban township of Ghana using physic – chemical (correct spelling physico – chemical) indicators: A preliminary study. Advances in Applied Science Research, 3 (4), 2120 – 2127.

[2].   Adiotomre, K.O. & Agbale, N.R. (2015). Comparative analysis of sachet water samples sold in Benin City, Edo State, Nigeria. International Journal of Innovative Environmental Studies Research, 3 (3), 22 – 25.

[3].   APHA (1998). Standard Methods for the Examination of Water and Waste Water. American Public Health Association, Washington, D.C.

[4].   Martins, O.I. & Chikezie, A. (2014). Quality assessment of various sachet water brands marketed in Bauchi Metropolis of Nigeria. International Journal of Advances in Engineering & Technology, 6 (6), 2489 – 2495.

[5].   Mohammed, A. & Al – Sulaiman (2015). Study on physicochemical properties of domestic bottled drinking water brands in Saudi Arabia. Life Science, 5 (3), 168 – 171.

[6]. Murtala, Mohammed Ruma., Aziza Mohammed. Ali Badr., Soliman, Abd – Alsattar Khater., Mohammed, El – tantawi (2014). Assessment of some physicochemical parameters levels in sachet drinking water and its effects on human health in Kastina Urban Area, Nigeria. Science world Journal, 9 (1), 19 – 27.

[7]. NSDWQ, (2007). Nigerian Standard for drinking water quality approved by Standard organization of Nigeria (SON) Governing Council: Nigerian Industrial Standard (NIS 554: 2007)

[8]. Onweluzo, J.C. and Akuagbazie, C.A. (2010). Assessment of the quality of bottled and sachet water sold in Nssuka Town. Agro – Science Journal of Tropical Agriculture, Food, Environment and Extension, 9 (2), 104 – 110.

[9]. Oparaocha, E.T., Iroegbu, O.C., Obi, R.K., (2010). Assessment of quality of drinking water sources in the Federal University of Technology, Owerri, Imo State. Journal of Applied Biosciences, 32, 1964 – 1976.

[10]. Sawere, B.T. & Uwagwue, A. (2016). Physicochemical analysis of the quality of sachet water marketed in Delta State Polytechnic Ozoro. International Research Journal of Advanced Engineering and Science, 1 (3), 66 – 70.

[11]. WHO, (2011). World Health Organization Guidelines for Drinking Water Quality, Fourth Edition, Geneva, ISBN 9789241548151, NLM Classifications: WA 675

[12]. World Health Organization, WHO, (2006). Guidelines for Drinking Water Quality, volume 1, 3rd edition, WHO press Switzerland.

[13]. Yusuf, Y.O., Jimoh, A.I., Onaolapo, ER.O. and Dabo, Y. (2015). An assessment of sachet water quality in Zaria Area of Kaduna State Nigeria. Journal of Geography and Regional Planning, 8 (7), 174 – 180.