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Quality Assessment of Portable Water Sourced from Various Locations within Yenagoa Metropolis of Bayelsa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The indispensability of water cannot be over emphasized being an essential resource upon which life thrives. Good quality water is critical to a healthy living. Thus, the aim of this study was to evaluate the quality of portable water obtained from different locations within the City of Yenagoa, Bayelsa State. Two categories of borehole water; Treated Borehole Water Sample (TS) and the Untreated Borehole Water Sample (US) were randomly sourced from eight locations within Yenagoa. Analysis was performed on the samples to determine their physicochemical, chemical

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and microbiological qualities using standard procedures. While the pH values reported for the TS and US sourced from Opolo and Swali were within the WHO acceptable limit, the value recorded on the turbidity of US fetched from Onopa, Opolo, Okaka and Amarata were in tandem with the stipulated WHO value for turbidity of drinking water. The temperature reported for all samples was deviant to the stipulated WHO standard for water meant for drinking. On the Total Solid reported for the samples, only the values reported for TS sourced from Onopa, Opolo, and Etegwe were in line with the WHO standard for TS in drinking water. The concentration of Ca, K, and Na reported for US sample sourced from Okaka were higher than those reported for water samples fetched from other sources studied. However, the concentration of Mg in the US sourced from Kpansia was higher than that reported for other samples, while the presence of *E. coli* and coliform was scanty. In conclusion, it can be deduced from these findings, which qualities of the US were in line with the WHO stipulation even though more samples from TS and US were either below or above the recommended values.

Keywords: Physicochemical; microbiological; quality; water; Yenagoa.

1. INTRODUCTION

The indispensability of water to life cannot be over emphasized, evident by the fact that its essentiality to life is rated next to oxygen. It is considered an essential nutrient for humans and a calorie-free option for hydration which also aids in thermoregulation, lubrication, shock absorption, digestion, as well as a carriage system for nutrients and waste products in the human body [1]. Aside the critical roles it plays in the body, the quality of water available for human consumption cannot be trivialized as it is the fulcrum upon which its vitality rests [2].

Water quality or portability is defined by its chemical, biological and physical properties with respect to safe consumption. It primarily depends on the indigenous ecosystem and geology as well as human activities [3]. Statistical evidence shows that an estimated 1.0-1.2 billion persons lack access to portable water globally [4] a phenomenon which is most pronounced in developing countries [5].

Scarcity of portable water is a hydra headed monster that threatens the quality of life and health of the inhabitants of several cities in Nigeria since the past four decades [6]. It drives the outbreak of diseases such as cholera, diarrhea, dysentery, and typhoid [7]. The Niger Delta which encapsulates Beyelsa State alongside other South-South States is not exonerated of this problem, evident by the reported rise in the outbreak of cholera, dysentery, typhoid and diarrhea in the region orchestrated by a decrease in the availability of portable water [8].

The cost of providing portable water for the people of Beyelsa State is solely on the resource strained government of the state which is not financially buoyant to holistically install water facilities across the length and breadth of the state [9]. Therefore, efforts to mitigate shortage of portable water by Bayelsa State government should be focused more on localities where the need for portable water is intense, identifiable through research efforts that probe the quality of water available to the inhabitants of the state.

2. METHODOLOGY

2.1 Study Area

Yenagoa, an industrially developing city is the capital of Bayelsa State, Nigeria. It is situated on 6^{o} 16'03" E longitude and 4^{o} 55'18" N latitude at an elevation of 8 m (26 ft) above sea level. The city has an estimated population of 352,285 persons (Wikipedia, 2020). It is endowed with creeks which are mainly supplied by the Nun River.

2.2 Sampling

A total of sixteen (16) water samples were randomly collected from two water sources identified as treated sources (TS) and untreated sources (US) across the eight study locations. Samples were collected in thoroughly washed plastic containers. The samples which were tightly covered were conveyed in a cooler to ensure a constant temperature. The samples were collected in batches, based on sample location proximity at a time due to the number of samples to be collected, the storage capacity of the cooler, mode of transportation and distance to the laboratory for bacteriological and physicochemical analysis.

2.3 Physico-Chemical Analysis

Physico-chemical properties of the water samples; temperature, colour, odour, and taste were determined at the field owing to their unstable nature.

2.4 Temperature

An alcohol-in-glass thermometer was inserted into a water sample in a beaker. The thermometer was allowed to retain its position until the alcohol thread attains a constant reading on the calibration. The value at the constant level was then recorded as the temperature of the sample [9].

2.5 Colour

Exactly 50 mL of Water sample was introduced into the left compartment of a Nessler tube. This was followed by the selection and fitting of colour disc into the compartment which was rotated until a colour match was obtained and the corresponding value on the color compartment noted [9].

2.6 Odour

A clean, odourless bottle was half filled with a water sample and a stopper was put in place. Then, the sample was shaken vigorously for 3 seconds before the odour was quickly observed and recorded [9].

2.7 Analysis of Water Samples

The water quality parameters were analyzed insitu viz: pH, turbidity, total dissolved solid using multimeter. While total suspended solid, bicarbonate, alkalinity, total hardness, calcium, potassium, magnesium and sodium were determined as described by APHA [9].

2.8 Microbiological Parameter Analysis

Bacteriological analysis of E. coli was pin the manual of the US food and drug administration-Bacteriological Analysis (FDA-BAM). Exactly 500 mL of each water sample was properly mixed1 mL of sample was obtained from the 500 mL and introduced into 9 mL of EE Broth which was subsequently incubated at 37°C for 24 h under aerobic condition. This was followed by the streaking of a loopful of the enriched culture from EE broth onto LEMB Agar prior to incubation at 37^{o}C for 24 h under aerobic condition. Presumptive *E. coli* colonies on LEMB Agar appear as dark centered and flat, with or without metallic sheen. In order to obtain a pure culture, the presumptive E. coli was were picked and streaked onto nutrient agar and subsequently incubated at 37°C for 24 h under aerobic condition. Confirmation of pure culture was achieved with the aid of gram staining, *E. coli* latex agglutination test and biochemical tests (indole production, utilization of citrate and lactose production) [10].

3. RESULTS AND DISCUSSION

Water is an essential resource required by all living organisms for growth and survival. Water meant for drinking is classified as portable, a nomenclature which it owes to its quality. Table 1 shows the Physicochemical and microbiological parameters of portable water samples from Yenagoa, Bayelsa State indicating that the pH value reported for Swali (US1), Opolo (TS6) and Akenfa (TS8) was within the WHO stipulated standard for portable waters. This is consistent with the finding of Ben-Eledo et al. [2017 which showed that Epie Creek i.e. from Akenfa to Biogbolo ranged from 6.27-6.53 for spartial distribution, while the value recorded for the turbidity of water sample obtained from Onopa (US2), Amarata (US3), Okaka (US4), Opolo (US6) and Etewgwe (US7) were in tandem with the World Health Organization's standard for portable water. The Total Solid (TS) recorded for samples from Onopa (TS2), Opolo (TS6) and Etegwe (TS7) are reportedly in line with the WHO'S recommendation. The Total suspended Solid (TSS) reported on the samples was not in conformity with the WHO standard. However, the temperature recorded for the samples (TS and US) was not same as recommended by World Health Organization's standard for portable water. The amount of potassium reportedly present in the samples was lower than recommended value by the WHO. Microorganisms are ubiquitous in nature and the type of microorganisms found within a given environment is a function of sources of contaminants, environmental conditions such as pH, and temperature. *E. coli* and total coliform was reportedly absent in most samples but however was scantly observed on the US1 and TSI obtained from Swali, Etegwe and Akenfa. The presence of coliforms is an indicator to the presence of microbes includes *E. coli*, Faecal Staphylococci i.e *Streptococcus faecalis*, *Clostridium perfringens* etc. This could be attributed to the fact that toilet system is situated close to ground water sources (i.e submergible pump head). Typically, these organisms are used

Table 1. Physicochemical and microbiological parameters of portable water samples from Yenagoa, Bayelsa State

Location	Sample code	pH	Turbidity (NTU)	Temp	HCO_3	CO_3	Hardness	TS	TSS	TDS	Ca	K	Na	mg	*E. coli*	Total coliform
Swali	TS1	5.6	3	27	9	0	33	1500	1197	303	14.5	1.4	5.6	4.5	0	1
	US1	6.5	6	27	6.9	0	39	500	198	302	16.7	2.5	7.6	5.4	1	3
Onopa	TS2	6.4	3	27	11.9	0	50	1000	1200	300	19.7	1.4	9.8	7.4	0	0
	US2	5.4	5	27	8.9	0	59	500	198	302	20	2.6	8.7	9.5	0	0
Amarata	TS3	6.3	4	27	17.8	0	95	1500	1197	303	20	1.5	8.8	18.2	0	0
	US3	5.2	5	27.5	15.9	0	105	500	197	303	21.5	2.6	9.8	20.3	0	0
Okaka	TS4	4.6	3	27	12	0	40	1500	1198	302	23.2	3.7	13	4.1	0	0
	US4	5.2	5	26.5	14.9	0	45	500	196	304	27.8	4.7	13.6	4.2	0	0
Kpansia	TS5	5.5	4	27	15.9	0	105	1500	697	303	18.8	3.4	9	20.9	0	0
	US5	4.5	4	27	13.9	0	110	500	199	301	20	4	10	21.9	0	0
Opolo	TS6	6.5	4	26	15.7	0	30	1000	697	303	6.9	0.6	2.2	5.9	0	0
	US6	5.6	5	27	14.9	0	45	500	198	302	7.4	1.2	4.7	9.1	0	0
Etegwe	TS7	5.5	4	27	5	0	30	1000	698	302	8.2	0.8	2.5	5.3	0	2
	US7	4.2	5	27.5	2.9	0	35	500	199	301	8.6	1.2	4.5	6.4	0	5
Akenfa	TS8	6.5	4	26	16.9	0	18	500	200	300	11.5	0.9	5.2	1.6	0	1
	US8	5.2	4	27	16.9	0	25	500	199	301	13.7	1.5	6.5	2.7	0	3
	Mean	5.54	4.25	26.91	12.46	0.00	54.00	81250	541.75	302.00	16.16	2.13	7.59	9.0	0.25	0.95
	WHO	6.5-8.5	5	28	NS	150	NS	1000	75	NS	NS	20	NS	NS	NS	NS

Table 2. Sensory qualities of portable water samples from Yenagoa, Bayelsa State

Location	Sample Code	Colour	Odour
Swali	TS1	5	Odor Free
	US1	5	Odor Free
Onopa	TS2	5	disagreeable
	US2	5	disagreeable
Amarata	TS3	5	disagreeable
	US3	5	disagreeable
Okaka	TS4	15	Fishy
	US4	15	Fishy
Kpansia	TS5	15	Odor Free
	US5	15	Odor Free
Opolo	TS6	5	disagreeable
	US6	5	disagreeable
Etegwe	TS7	15	disagreeable
	US7	15	disagreeable
Akenfa	TS8	15	disagreeable
	US8	15	disagreeable
	Mean	10.00	
	WHO	15	

to environmental pollution [11]. Table 2 shows the sensory qualities (odour and odour) of portable water samples from Yenagoa, Bayelsa State showing that the values reported for both samples (TS and US) obtained from Okaka, Kpansia, Etegwe and Akenfa conformed to the WHO recommended value. However, a contrary observation was made on samples obtained from other locations. The observation recorded on the pH, turbidity, total solid on the samples obtained from the aforementioned locations could be attributed to the nature and intensity of industrial activities taken place in the locations which would translate to a level of pollution notably soil pollution and consequent impact on the underground water.

4. CONCLUSION

The outcome of this study reveals that the qualities established for the Untreated Sample (US) were in tandem with the WHO's standard despite the fact that Treated Sample (TS) and Untreated Sample (US) were either below or above the recommended values.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Jéquier E, Constant F. Water as an essential nutrient: the physiological basis of hydration. European Journal of Clinical Nutrition. 2010;64(2):115-23.
2. Greenough G, McGeehin M, Bernard SM, et al. The potential impacts of climate variability and change on health impacts of extreme weather events in the United States. Environmental Health Perspective. 2001;109(2):191-8.
3. Johnson DL, Ambrose SH, Bassett TJ, Bowen ML, Crummey DE, Isaacson JS, Johnson DN, Lamb P, Saul M, Winter-Nelson AE. Meanings of environmental terms. Journal of Environmental Quality. 1997;26:581-589
4. Nkamare MB, Ofili AN, Adeleke AJ. Physico-chemical and microbiological assessment of borehole water in Okutukutu, Bayelsa State, Nigeria. Advances in Applied Science Research. 2012;3(5):2549-2552.
5. Ohimain E1, Angaye TCN, Okiongbo, K. Removal of iron, coliforms and acidity from groundwater obtained from shallow aquifer using trickling filter method. Journal of Environmental Science and Engineering. 2013;2:549-555.
6. Ekong F, Jacob A, Ebong S. Water resource management in the Niger Delta Region of Nigeria: The role of physical planning, International Review of Social Sciences and Humanity. 2012;3(1): 51-56.
7. Angaye TCN, Zige DV, Izah SC. Microbial load and heavy metals properties of leachates from solid wastes dumpsites in the Niger Delta, Nigeria. Journal of Environmental Treatment Techniques. 2015; In Press.

8. Westerling K. The 13 Biggest Challenges Facing the Water Industry; 2013.
9. Vivian N B, Lovet TK, Sylvester CI, Benjamin OE. Water quality assessment of Epie Creek in Yenagoa Metropolis, Bayelsa State, Nigeria. Archives of Current Research International. 2017;8(2):1-24.
10. Frederick Adzitey, Nafisah Sumaila and Courage Kosi Setsoafia Saba. Isolation of *E. coli* from drinking water sources for humans and farm animals in Nyankpala Community of Ghana. Research Journal of Microbiology. 2015;10(3):126-131.
11. Tariwari CNA, Elijah IO, Cosboy EM. The potability of groundwater in Bayelsa State, Central Niger Delta Nigeria: A review. Journal of Environmental Treatment Techniques. 2015;3(2):134-142.

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