

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

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 and microbiological qualities using standard procedures. While the pH values reported for the TS and US sourced from Opdo and Swali were within the WHO acceptable limit, the value recorded on the turbidity of US fetched from Onopa, Opdo, 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, Opdo, and Etegwé 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

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 Bayelsa 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 [6].

The cost of providing portable water for the people of Bayelsa 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.

Methodology

Study area

Yenagoa, an industrially developing city is the capital of Bayelsa State, Nigeria. It is situated on $6^{\circ} 16'03''$ E longitude and $4^{\circ} 55'18''$ 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). The city is endowed with creeks which are mainly supplied by the Nun River.

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 with tightly covered were put 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.

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.

Temperature

An alcohol-in-glass thermometer was inserted into the water samples 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.

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.

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.

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 (1975), Ademoroti (1996).

Microbiological parameter analysis

Water samples were conveyed to the laboratory in sterilized bottles for analysis which was performed using Multi-tube fermentation technique/MPN method. The samples were inoculated in 10 mL tubes containing Macconky broth and Durham tubes. They were subsequently incubated at 37°C for 24 to 48 h. The presence of bacteria was confirmed following colour a change from violet to yellow observed on the broth. A conformation test was further carried out to authenticate the observations made

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

Result 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), Opdo (TS6) and Akenfa (TS8) was within the WHO stipulated standard for portable waters, while the value recorded for the turbidity of water sample obtained from Onopa (US2), Amarata (US3), Okaka (US4), Opdo (US6) and Etegwewe (US7) were in tandem with the World Health Organization's standard for portable water. The Total Solid (TS) recorded for samples from Onopa (TS2), Opdo (TS6) and Etegwewe (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. 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, Etegwewe 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.

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