

ANALYSIS OF PHYSICOCHEMICAL PARAMETERS OF SOME PORTABLE WATER SOURCES DURING THE RAINING SEASON IN JOS SOUTH AND JOS NORTH LOCAL GOVERNMENT AREAS OF PLATEAU STATE, NIGERIA

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ABSTRACT

The aim of this study was to analyze the physicochemical properties of some potable water sources water. The results of analyses show the mean values of the parameters as follows: for temperature from Jos South and Jos North during the raining season. Water samples were collected from 6 communities in 2 local governments, Jos South and Jos North of Plateau North Senatorial Zone in the months of April 2018 and July 2018 for the season. The analyses were done according to standard methods for water examination and reported based on the WHO prescribed limit for potable drinking, 18.04^oC and 23.40^oC for Jos south and Jos North respectively. For pH, 7.02 and 7.97, for Jos south and Jos North respectively. For CO₂, 2.44 mg/L, and 4.80 mg/L for Jos south and Jos North respectively. For Total dissolved solids, 329mg/L and 204.8mg/L for Jos south and Jos North respectively. For conductivity, 579.4 μ S/cm and 120.6 μ S/cm for Jos south, and Jos North respectively. For turbidity, 2.62NTU and 10.994NTU for Jos south and Jos North respectively. For hardness, 80.4mg/L and 98.4mg/L for Jos south and Jos North respectively. Colour, odour and taste were physically observed and concluded to be unobjectionable as with WHO standard for potable water. Every parameter showed concentration not exceeding the WHO standard for potable drinking water which implies that water gotten in Jos South and Jos North Local Government Areas during the raining season is potable

Key words: Portable Water, Conductivity, Turbidity, pH and Total Dissolved Solid.

INTRODUCTION

Water is the second most important need for life to exist after air. As a result, freshwater is an essential societal requirement and it is consumed through domestic, industrial, agricultural and environmental withdrawals. The growing human population has an increasing demand for water, which has made this natural resource a scarce commodity in some part of Plateau State and Nigeria in general. Out of the total water available on earth, only 0.16 % is suitable for human use [1]. Approximately 880 million people still lack access to safe drinking water globally [2]. Thus a lot of the villagers still depend on surface and underground water for household purposes. Utilization of surface water for domestic purpose poses a huge health risk on the communities that rely on surface water due to lack of options for potable water.

In today world, the water use in household supplies is commonly defined as domestic water. This water is proceed to be safely consumed as drinking water and other purposes. Water quality and suitability for use are determined by its taste, odor, colour, and concentration of organic and inorganic matter [3]. Contaminants in the water can affect the water quality and consequently the human health. The potential sources of water contamination are geological conditions, industrial and agricultural activities, and water treatment plants.

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These contaminants are further categorized as microorganisms, inorganics, organics, radionuclide, and disinfectants [4].

Water quality is the condition of water, including its chemical, physical and biological characteristics, usually with respect to its suitability for a particular purpose (that is, drinking, swimming or fishing). Water quality is also affected by substances like pesticides or fertilizer that can negatively affect marine life when present in certain concentrations [5].

METHODOLOGY

Study Area Description

This research work was carried out on water from well and bore holes of Jos South and Jos North of Plateau State during the raining season. Plateau State is located in Nigeria's middle belt with an area of 30,913 km² (11,936sq m), the state has an estimated population of about three million people. It is located between latitude 9°51'30''N to 10°2'00''N and longitudes 8°48'00''E to 9°59'00''E. The state is named after the picturesque Jos Plateau, a mountainous area North of the state with captivating rock formations. Bare rocks are scattered across the grasslands, which cover the Plateau. The altitude ranges from around 1,200 meters (about 400 feet) to a peak of 1,829 meters above sea level in the Shere Hills range near Jos the state capital.

Figure I showed the sampling point where taken in Jos South and Jos North Local Government Areas of Plateau State, Nigeria. The Geographical Positioning System (GPS) was used to locate the sampling area to ensure consistency. Samples were taken from the well and bore hole in Jos South and Jos North Local Government of Plateau, Nigeria.

Selection of Sampling Points

The criteria of selecting sampling points were based on high population density areas due to commercial activities. Therefore it was significant to see the water parameters in order to evaluate its quality. Therefore 6 different locations in Jos South and Jos North were chosen based on designed criteria. These locations were Nyango, Gyel, Munchogopyenkap, Tudun Wada well I, Bore hole and Well II.

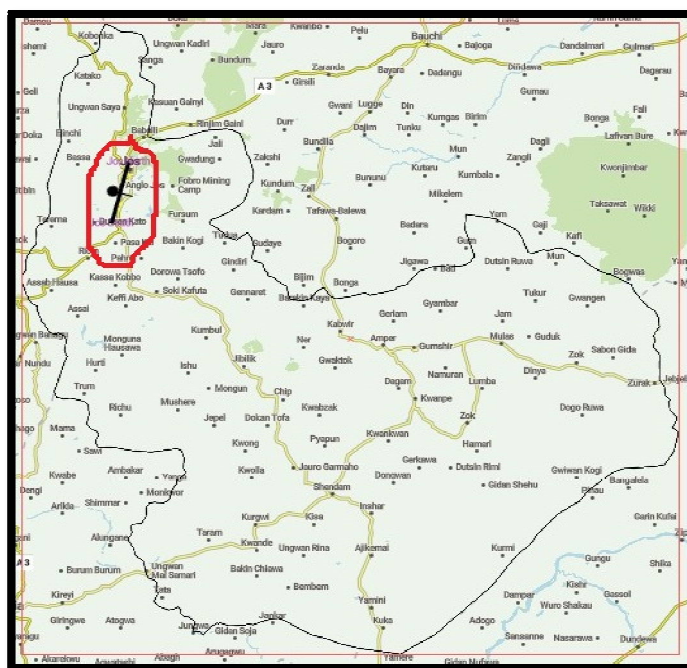


Figure I: The map of sample location in Jos South and Jos North Local Government Areas in Plateau State (Source: Nigeria Geological Survey Agency, 2009)

Sample Collection

Sterile 1L bottles were used to collect surface water samples from Jos South and Jos North. Water samples were transported on ice to the Chemistry laboratory at the University of Jos and were processed within 6 hours of collection. These samples were collected during the month of August, 2018. The analysis was performed in triplicate for every sample point.

Analytical Instruments

On-Site Analysis: On site analyses of *pH*, conductivity and turbidity and temperature were carried out at the site of sample collection following the standard protocols and methods using different calibrated standard instruments [6]. The *pH* of the water samples was measured by using a *pH* meter (model H198130 HANNA). The *pH* meter was calibrated, with three standard solutions (*pH* 4.0, 7.0 and 10.0), before taking the measurement. The value of each sample was taken after submerging the *pH* probe in the water sample and holding for a couple of minutes to achieve a stabilized reading. After the measurement of each sample, the probe was rinsed with deionized water to avoid cross contamination among different samples. Temperature is the degree of hotness or coldness of a body measured on a scale. Temperature of water samples were taken using thermometer in degree centigrade

The conductivity of the samples was measured using a conductivity meter (mode HI 98130 HANNA). The probe was calibrated using a standard solution with a known conductivity. The probe was submerged in the water sample and the reading was recorded after the disappearance of stability indicator. After the measurement of each sample, the probe was rinsed with deionized water to avoid cross contamination among different samples. The turbidity of the water samples was measured using a turbidity meter (model 2100P Turbidimeter, [7]). Each sample was poured in the sample holder and kept inside for a few minutes. After achieving the reading stability, the value was recorded.

Laboratory Analysis: The measurements of TDS in water sample were carried out according to the standard methods [2] by the filtration process. Therefore, the accuracy and precision of following methods are well approved and cited in the scientific literature. A fixed volume of water sample was poured on a pre-weighted glass fiber filter of a specified pore size before starting the vacuum filtration process. The filter was removed after the completion of the filtration process and placed in an aluminum dish in an oven at 100^{0C} for 2-3 hours to completely dry off the remaining water. The TDS of the water samples were determined by gravimetric method after filtration the filtrate was heated in oven at above 100^{0C} until all the water was completely evaporated. The remaining mass of the residue represents the amount of TDS in a sample.

Statistical Analysis of Data

Data for physico-chemical properties of potable water samples were recorded and analysed for temperature, *pH*, color, odour, CO₂, TDS, conductivity, turbidity, hardness and taste of the water samples. Means were calculated from the results of the analysis of the three samples per sampling point. Water quality results were compared with the World Health Organization drinking water standards.

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RESULTS

Physiochemical Parameters of Water harvested in the Rainy Season

TABLE 1: Water Analysis results for JOS SOUTH samples

Parameter	Unit	JS-I	JS-II	JS-III
Temperature	°C	13.3	12.8	27.8
pH		7.3	6.7	7.2
Colour		*	*	*
Odour		*	*	*
CO ₂	mg/L	2.4	2	3.2
TDS	mg/L	543	293	184
Conductivity	µS/cm	776	417	371
Turbidity	NTU	2.5	1.39	3.06
Hardness	mg/L	63	102	34
Taste		*	*	*

*Not Detected

Where: JS-I - Nyango Well JS-II-Gyel Well JS-III- Munchogopyeng well

TABLE 2: Water Analysis results for JOS NORTH samples

Parameter	Unit	JN-I	JN-II	JN-III
Temperature	°C	28.6	25.1	19.9
pH		8.15	8.2	7.9
Colour		*	*	*
Odour		*	*	*
CO ₂	mg/L	6.6	6.9	3.1
TDS	mg/L	183	191	256
Conductivity	µS/cm	84	81	104
Turbidity	NTU	13.5	12.12	6.3
Hardness	mg/L	89	72	131
Taste		*	*	*

*Not Detected

Where; JN-I- Tudun Wada Well JN-II- Tudun Wada Borehole
JN-III-Tudun Wada Well (II)

TABLE 3: Comparative Analysis results for JOS SOUTH and JOS NORTH

Parameter	Unit	JOS SOUTH	JOS NORTH	WHO
Temperature	°C	18.04±7.04	23.4±6.81	30
Ph		7.02±0.58	7.97±0.53	6.5-8.9
Colour		*	*	
Odour		*	*	Unobjectionable
CO ₂	mg/L	2.44±0.50	4.8±2.16	
TDS	mg/L	329±154.01	204.8±31.57	1000
Conductivity	µS/cm	579.4±180.44	120.6±79.31	8-10,000
Turbidity	NTU	2.62±0.73	10.994±2.94	50
Hardness	mg/L	80.4±34.11	98.4±24.32	500
Taste		*	*	Unobjectionable

*Not Detected

All values, except for WHO, are represented as mean ± Standard deviation of all sampled areas in Jos South and Jos North Local Government Areas of Plateau State

DISCUSSION

The mean values for rain water temperatures for Jos South and Jos North are 18.04°C and 23.4°C respectively. The values reported in this work are within the range recommended by WHO (30°C)[8] reported similar result (21.0°C) for rivers Inachalo and Niger in Idah, Kogi State, while [9] reported 25.3°C. Although, there is seasonal fluctuation in well water temperature values, this may be due to function of the climatic conditions at a particular geographical location and period

The mean values for rain water pH for Jos South and Jos North are 7.02 and 7.97 respectively. The two local governments are within the range of 6.5-8.9, recommended by WHO (1996) for drinking water. Although the values indicate that the well water samples are slightly basic, it is in agreement with what was reported by other researchers in similar study [10]. The mean values for rain water TDS for Jos South and Jos North are 329 mg/L and 204.8 mg/L respectively which are lower than the recommended value of WHO specification limits (1000 mg/L) for drinking water [10]. The values also differ from that reported by [11]. They reported a value of 1048.67 mg/L, which could be due to differences in organic matter that remains as residue in the well water.

The conductivity mean values for Jos South (579.4 µs/cm) and Jos North (120.6 µs/cm) are within the WHO maximum permissible limits (8-10,000 µs/cm) for drinking water. However, the values obtained were higher than values reported in the streams, wells and bore-hole water in Nasarawa Eggon local government area of Nasarawa State, Nigeria by [11]. This may be due to differences in geochemical conditions and soluble ions in the locations analyzed and weather condition.

The mean turbidity value obtained for Jos South (2.62 NTU) and Jos North (10.994 NTU) are lower than WHO maximum permissible level, 50 NTU. The turbidity of water depends on the quantity of solid matter present in the suspended state. It is a measure of light emitting properties of water and the test is used to indicate the quality of waste discharge with respect to colloidal matter.

The mean values of rain water hardness for Jos South and Jos North are 80.4 mg/L and 98.4 mg/L respectively. The values of total hardness for the two Local Government Areas are within the WHO specification limits for drinking water, 500mg/L.

[12] stated that pure water is colourless; hence any water with characteristic colour insinuates contamination. The result of the physico-chemical analysis of the harvested rainwater samples indicates clear water in all the Local governments during the rainy season. Hence the water samples met the recommended standards put forward by the World Health Organization for drinking water. The Odour and taste of the water samples also met the recommendation of the World Health Organization for drinking water.

CONCLUSION

The values of water quality parameters such as Temperature, pH, Color, Odour, CO₂, TDS, Conductivity, Turbidity, Hardness, and Taste of the water samples from all samples collected from different residential in Jos South and Jos North of Plateau State in Nigeria were found to be within the recommended limits of WHO.

Therefore, the quality of tap drinking water is good in residential areas of Jos South and Jos North of Plateau State in Nigeria.

Acronyms and Abbreviations

µs/cm – Micro siemens per centimeter

CO₂ – Carbon (IV) oxide

GPS – Geographical Positioning System

Mg/L – Milligram per liter

NTU – Nuphelometric turbidity units

°C – Degree centigrade

pH – Potency of hydrogen

TDS – Total dissolved solids

WHO – World Health Organization

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interests regarding the publication of this paper.

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