



## Assessment of Physicochemical Characteristics of Selected Borehole Waters in Oke-Oyi Community, Ilorin East Local Government Area, Kwara State

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**ABSTRACT:** The physicochemical parameters of seven different borehole waters in Oke-Oyi, Ilorin East Local Government Area, Kwara State, Nigeria were assessed to determine its suitability for human consumption. The parameters examined include temperature (28 - 29°C), conductivity (414 - 1603 µs/cm), pH (5.71 - 6.57), total hardness (20.2 - 67.3 mg/L). The concentrations of heavy metals determined are Zn (0.010 - 0.022 mg/L), Fe (0.002 - 0.120 mg/L), Cr (0.075 - 0.12 mg/L), Cu ( $3 \times 10^{-4}$  -  $2 \times 10^{-3}$  mg/L), Co (0.01 - 0.26 mg/L) and Mn (0.082 - 0.94 mg/L). There was no lead detected in two of the borehole water samples while those detected have low concentration range  $1 \times 10^{-5}$  -  $6 \times 10^{-5}$ . The results of physicochemical parameters obtained are within World Health Organisation (WHO) limits except for the pH that is slightly lower and the conductivity of OKY 1 that is slightly higher. © JASEM

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Water covers about 75% of the earth surface. It is found as surface water in streams, rivers, etc, and as ground water when locks up in the rock (Chandra *et al.*, 2012). Water is made of two elements, hydrogen and oxygen and is sometimes called “universal solvent” as it can dissolve many substances. Water is essential for many biochemical reactions in living cells. It’s also important in many industrial and manufacturing activities (Franks, 2000). Therefore, reliable water source is an essential material for establishing a stable and safe community (Waziri *et al.*, 2009; Kolo and Baba, 2004).

It’s a known fact that human health and survival is connected with the availability of clean water for drinking and purposes. Groundwater is the water present beneath the earth’s surface and also a fresh water source due to its lower tendency to be polluted in comparison with surface water and its large storage capacity (Idoko 2010; Abii and Nwabienvanne, 2007). It was estimated that about one third of the world’s population uses groundwater for drinking and nowadays more than half of the world’s population depends on groundwater for survival (Mohrir *et al.*, 2009). The anthropogenic disturbances have influence on the quality of groundwater. Groundwater quality degradation arises from variation of some quality parameters through the introduction or removal of certain substances (Ramesh *et al.*, 2001).

Trace metals are natural components of the earth crust and some are required in minute quantities for metabolism in organisms (e.g. arsenic, copper, iron, etc.) (Ward, 1995). The presence of toxic metals such as Pb and Cd in the environment has been of environmental concern. This is mainly due to their health implications as some are carcinogenic and non-essential to human body (Tyler, 1981). Trace metals are common environmental pollutants with

sources mainly from weathering of rocks (Merian, 1991). The concentration level of these metals in the environment has increased rapidly in the past few years as a result of human activities such as discharge of industrial and domestic wastes (Prater, 1975). Therefore, metal pollution comes from both natural and anthropogenic sources (Moore and Ramamoorthy, 1984).

This study is aimed at determining the physicochemical properties of selected borehole waters in Oke-Oyi Community, Ilorin East Local Government Area of Kwara State in order to ascertain the portability of the water and its quality for human use.

## MATERIALS AND METHOD

### Study Area



This study was carried out in Oke-Oyi Community, Ilorin East Local Government Area of Kwara State. This community is located in Kwara State, Nigeria at longitude 8° 35' 0" North and Latitude 4° 43' 0" East and is characterized by a tropical climate with two distinct seasons; wet and dry seasons. Monthly temperature ranges from 20 °C to 34 °C. Water samples were collected at seven different locations of Boreholes situated at Oke Oyi community. These

locations are denoted with Oky 1, Oky 2, Oky 3, Oky 4, Oky 5, Oky 6 and Oky7 respectively.

**Sample Collection and Preparation:** The water samples were collected into polythene bottles prewashed with detergent, diluted HNO<sub>3</sub> and distilled de-ionised water. Samples for heavy metal analysis were preserved by adding few drops of 1 Molar HNO<sub>3</sub> (Manilla and Frank, 2009). The samples were labeled and quickly transported to the laboratory in a cooler of ice for physicochemical analysis.

**Physicochemical Analysis: Determination of pH:** The pH of the water samples was carried out in-situ using digital pH meter standardized with buffer 4, 7 and 9 respectively. The pH meter's electrode was dipped into 100 cm<sup>3</sup> of a water sample and the reading was recorded (APHA, 1999). The procedure was repeated for the other samples.

**Temperature measurement:** The temperature of the water was taken immediately the sample was collected on site. Mercury in glass thermometer was dipped into 100 mL of water sample and was left for few minutes after which the temperature was recorded (APHA, 1999). The procedure was repeated for other samples.

**Determination of conductivity:** This was done using a conductivity meter. The meter's electrode was immersed into 20 mL of the water samples until a stable reading was recorded.

**Determination of total hardness of water:** 2 mL of buffer 10 was added to 50 cm<sup>3</sup> of the water sample in a conical flask and stirred for homogeneity. 3 drops of eriochrome black T indicator was added and a pink colouration was observed. The sample was then titrated against 0.1 M EDTA until a blue colouration was observed. The titre value obtained was multiplied with 44.892 as the approved conversion factor and the total hardness was expressed in mg/L. The same procedure was repeated for the other six samples (Adelunle *et al.*, 2007).

**Heavy metal determination:** Atomic absorption spectrometry was carried out using Alpha 4 Atomic

Absorption Spectrometer (PM 8251 single pen recorder) to determine the concentration of heavy metals present in the water samples. 100 mL of each sample was heated and 10 mL of 1 M nitric acid was added while the heating continues until the volume is reduced to 10 mL. Thereafter, the solution was filtered into a clean beaker and made up to 100 mL with distilled water in a volumetric flask and subsequently packed into a sample container (plastic) for AAS.

## RESULTS AND DISCUSSION

The temperature of all the borehole waters collected ranged between 28 and 29<sup>o</sup>C (Table 1). These values are similar to those obtained by Ukpong and Okon, (2013) and Chukwu (2008) and are within the permissible limit of WHO for natural ground water that could be used for human consumption.

The pH of all the water samples (Table1) is below the WHO limit for drinkable water (Ukpong and Okon 2013), except that of OKY 1 which is within the WHO limit. The obtained pH values show that the borehole waters are slightly acidic and could be due to underground pollution caused by agricultural practices in the area.

The result of the conductivity (Table 1) shows that the conductivities of all the water samples are within permissible limit of WHO except for OKY 1 (Istifanus *et al.*, 2013; Olalekan *et al.*, 2015). However, it is observed that the mobility of ions in solution is slightly high in all the water samples. This is not surprising as the flow of water would be proportional to the concentration of the hydrogen ions in the water.

The result of the hardness test (Table 1) for all the water samples shows that all the borehole waters are soft according to WHO limit for drinkable water.

The result of heavy metals Pb, Zn, Fe, Cr, Cu, Co and Mn (Table 2) assessed on all the water samples reveal that heavy metal concentration determined are within the WHO permissible limit for potable water.

**Table1:** Physicochemical Parameters of the Water Sample

SAMPLE	Temperature (°C)	pH VALUE	Conductivity (µS/CM)	Total Hardness (mg/L)
OKY 1	29	6.57	1603	67.3
OKY 2	29	5.96	838	38.1
OKY 3	28	5.90	595	20.2
OKY 4	29	5.83	1274	38.1
OKY 5	28	5.79	775	35.9
OKY 6	28	5.71	414	29.2
OKY 7	29	5.97	1156	35.9

**Table2:** Heavy Metal Concentration of the Water samples

SAMPLE	LEAD (mg/L)	ZINC (mg/L)	IRON (mg/L)	CHROMIUM (mg/L)	COPPER (mg/L)	COBALT (mg/L)	MAGNANESE (mg/L)
OKY 1	0.00001	0.020	0.020	0.075	0.002	0.01	0.082
OKY 2	0.00004	0.010	0.003	0.075	0.0003	0.05	0.094
OKY 3	NIL	0.016	0.002	0.10	0.0003	0.01	0.14
OKY 4	0.00001	0.020	0.003	0.10	0.0003	0.12	0.12
OKY 5	0.00002	0.020	0.003	0.12	0.0003	0.25	0.12
OKY 6	0.00006	0.012	0.120	0.10	0.0004	0.26	0.14
OKY 7	NIL	0.022	0.120	0.10	0.0003	0.26	0.94

**Conclusion:** The assessment of physicochemical parameters reveals that all the water samples are not hard water. The study also reveals that the heavy metal concentrations determined are within the permissible limit of WHO for human consumption. The pH of the water samples are slightly lower than the WHO standard and could be due to underground pollution caused by agricultural activities in the area. The borehole waters only need minor treatment such as addition of  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  for stabilizing the pH, and therefore suitable for human consumption.

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