

PHYSICO-CHEMICAL ANALYSIS OF SELECTED BOREHOLE WATER SAMPLES OF IJEBU -ODE, NIGERIA

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ABSTRACT

The study was carried out to assess the Physicochemical Parameters of selected Borehole water in Ijebu-Ode, Ogun State, Nigeria. Borehole water samples were randomly collected in 100ml plastic bottles from a location in each of the ten(10) wards of Ijebu-Ode namely; Isoko(ward 1), Odo Esa(ward 2), Itantebo(ward 3), Ijada-Imepe I (ward 4), Ijada-Imepe II (ward 5), Porogun I (ward 6), Porogun II (ward 7), Ijase-Idepo (ward 8), Odo-Egbo/Oliworo(ward 9) and Isiwo(ward 10). A handheld Garmin 72 GPS (Global Positioning System) was used to determine the geographic location of each of the selected boreholes. The samples were taken to Multi-Disciplinary Central Research Laboratory, University of Ibadan to test for physico-chemical parameters. The results were compared with drinking water standard prescribed by WHO (World Health Organization) and NAFDAC (National Agency for Food, Drugs Administration and Control). Results shows that the temperature ranged from 28.6°C to 30.8°C, pH at 3.6 to 6.652, conductivity ranged from 25 to 256µs/cm, total dissolved solids ranged from 17.67 to 450mg/l, total soluble solids values are within 0.5 and 19mg/l, chloride ranged from 7.5 to 206mg/l while turbidity and total hardness ranges from 0.01 to 4.8 and 25 to 351.05mg/l respectively. The sampled borehole water was found odorless and colorless. Virtually, all the physico-chemical parameters tested for are found to be within the WHO and NAFDAC standard limit for drinking water making it suitable for human consumption. It is therefore recommended that borehole water in Ijebu-Ode should be routinely monitored to ascertain its suitability for drinking and other purposes

Keywords: Physico-chemical parameters, Borehole waters, Ijebu-Ode.

1.0 Introduction

The quality of water is of vital concern for mankind since it is directly linked with human welfare. According to Ranjana (2010), the quality of public health depends to a greater extent on the quality of groundwater. Though groundwater quality is believed to be quite good compared to surface water, its quality is the sum of natural: geology of the

environment and anthropogenic influences: withdrawal, land use change, and solid waste dumping (Chapman, 1996). Water quality parameters reflect the level of contamination in water resources and show whether water is suitable for human consumption. Contaminated water is unacceptable due to health effects, poor taste and aesthetic value

to consumers (Suthra et al., 2009). Physico-Chemical and Micro-biological parameters of water indicate the safety of potable water (Macdonald and Kay, 1986) and their analysis is important for public health and pollution studies (Kot et al., 2000). Physico-chemical parameters include; temperature, pH, colour, turbidity, Total Dissolved Solids (TDS), Electrical Conductivity, odour, taste, transparency, alkalinity, etc. Groundwater in its natural state tends to be relatively free from contaminants in most areas. Because it is a widely used source of drinking water, pollution becomes a great challenge. Pesticides and herbicides are major contributors to water pollution (Ojutiku, 2016). Fertilizer such as nitrate is harmful even small quantities in drinking water. Zhang et al.(1996) in their research on nitrate pollution of groundwater in Northern China reported that in vegetable producing areas and farm yards, nitrate content in ground and drinking water were measured at 300 mgNO₃/L far much beyond the acceptable level of 50 mgNO₃/L. Rain can also leach pollutants from city dumps into ground water supplies. Heavy metal such as mercury, lead, chromium, copper and cadmium together with other household chemicals can all be concentrated in ground water supplies. Carey et al, (1996) examined the leaching of copper, chromium and arsenic through free draining in New Zealand soils and found that 2%w/v solution containing cupric, dichromate and arsenic ions leached through surface and sub-surface horizons of two free draining. Sadiq et al. (1994) discovered arsenic chemistry in groundwater aquifer; underneath an industrial complex in Eastern Province of Saudi Arabia and their findings were that arsenic concentrations in groundwater samples varied between 0.18 and 11.14 µg/L depending on sampling locations. Liquid and solid wastes from septic tanks, sewage plants and animal feedlots may contain bacteria, viruses and

parasites that can contaminate ground water. Acid mines drainage from coal and metal mines can contaminate both surface and ground water. The acid water draining from long abandoned mines and factory effluents often kills fish and plants. Pinta (1998) noted the Minammata case where effluents from a nearby factory were found to contain HgS and which led to bio-concentration in fish and subsequently taken by fishermen; this led to health complications among the consumers of such fishes. Radioactive waste is also both an existing and a very serious potential source of ground water pollution. Generally, not all sources of ground water pollution are man-made; naturally occurring minerals within rocks and soil may contain elements such as arsenic, selenium, mercury and other toxic metals. Physicochemical parameter has been used to assess water bodies' health. In Africa, Nigeria in particular, there are existing laws governing the water ways, but yet these laws are not properly enforced, thus, leading to decrease in the quality of water bodies as a result of various anthropogenic activities within the riparian and other communities (Ojutiku et al, 2016). This study assessed the physic-chemical parameters of borehole water in Ijebu-Ode, Nigeria so as to determine its quality and suitability for human consumption.

1.1 Conceptual Framework

The utility of water is limited by its quality which may make it unsuitable for particular purposes. Assessment of water quality is therefore an important aspect of water resources survey. Available data on water quality of water is generally stable overtime as it is predominantly determined by chemical composition of the rocks serving as aquifers. Water quality depends on the physical, chemical and bacteriological composition of water (Ikechukwu and Okonkwo,2012). The quality of water is an indication of the natural and artificial conditions and processes

occurring upstream of the part that is sampled for quality determination. The composition of the precipitation falling on the drainage area sets the initial chemical quality of the water but this is soon changed by interaction with vegetation, soils and impervious surfaces. In a completely natural situation, the changes can be detected by increased concentration of dissolved and suspended materials resulting from the solution of aerosols previously deposited on vegetation and impervious surfaces. Evaporation and the suspension of particulate matter, both organic and inorganic, is picked up by the water as it flows over the surface. Normally, the natural addition of dissolved and suspended materials does not adversely affect future beneficial uses of the water in the receiving stream because many of these impurities enhance the desirable qualities of water for specific end uses. Some natural influences may however impair stream water quality for domestic use when surface runoff passes through densely wooded area or marshy lands, the water may acquire a partial colour or may be highly coloured and acidic because of the presence of humic acid (WHO, 1993).

The chemical, physical and bacterial characteristics of groundwater determine its usefulness for various purposes. Chemical analysis of groundwater includes the determination of the concentrations of inorganic constituent. The analysis also includes measurement of pH and specific electrical conductance. Temperature, colour, turbidity, odour and taste are evaluated in a physical analysis. Bacteria analysis generally consists of tests to detect the presence of coli form organisms. The determination of groundwater quality for human consumption is important for the well-being of the ever increasing population (Ishaku, 2011). The supply of good quality water is one of the important component of groundwater protection and conservation strategies and

therefore useful in the planning and management of groundwater. Groundwater quality depends on the quality of recharged water, atmospheric precipitation, inland surface water and subsurface geochemical processes (Reza and Singh, 2010). The authors further stressed that temporal changes in the origin and constitution of the recharged water, hydrologic and human factors may cause periodic change in groundwater quality. Water pollution not only affects water quality but also threatens human health, economic development, and social prosperity (Milovanovic, 2007). Hence, evaluation of groundwater quality status for human consumption is important for socio-economic growth and development and also to establish data base for planning future water resource development strategies. Water Quality Index (WQI) is an important technique for demarcating groundwater quality and its suitability for drinking purposes (Tiwari and Mishra, 1985).

2.0 Materials and Method

2.1 Study Area

The study area, Ijebu-Ode is one of the ancient and urban centers in Nigeria, located on Latitude 6.2°N and 7.8°N and Longitude 3.0°E and 5.0°E. It has a warm tropical pattern with the raining season starting from March and ending in November, followed by dry season. The mean annual rainfall varies from 128cm in the southern parts of the area to 105cm in the northern areas. The average monthly temperature ranges from 23°C in July to 32°C in February. The vegetation of study area is characterized by mangrove swamp ecosystems which form part of the rich fauna and flora of the state. The geographical landscape comprises extensive fertile soil suitable for agriculture, and savannah land in the north western part of the area, suitable for cattle rearing. There are also vast forest reserves, rivers, lagoons, rocks, mineral

deposits and oceanfront and blessed with many mineral deposits in the list includes

bitumen, kaolin, phosphate, bauxite, granite, limestone, crude oil etc.

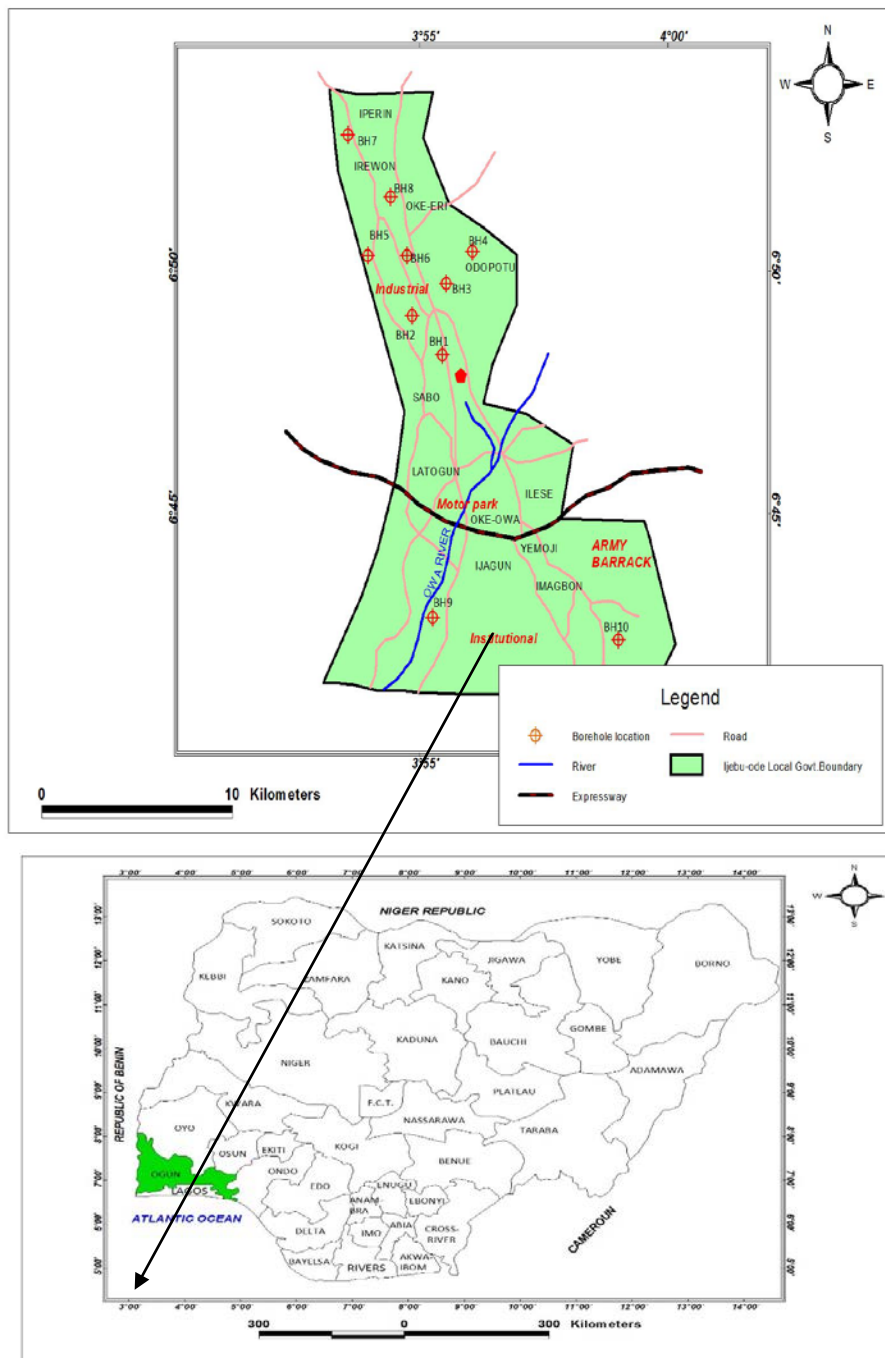


Figure 1 Location map of the study area with the sampling points

2.2 Water Sampling

Water samples were collected in 100ml plastic bottles from ten (10) selected boreholes, one (1) from each of the ten (10) wards in the study area with their coordinates recorded using a handheld Garmin 72 GPS (Global Positioning System). See table 1 below. The samples were appropriately labeled and put in an ice-packed cooler. Samples were immediately transferred to Multi-Disciplinary

Central Research Laboratory located in the University of Ibadan for the analysis of physico-chemical parameters. Physico-chemical parameters analyzed include; Water Temperature(WT), Hydrogen ion concentration (pH), Odour, Colour, Conductivity, Chloride, Total Dissolved Solids(TDS), Total Soluble Solids(TSS) and Hardness.

Table 1 sampled boreholes, wards/location, GPS coordinates and the type of borehole.

Location/wards	Borehole No.	GPS Coordinates		Type
		X	Y	
Ward 1 (Isoko)	BH1	6.81085 ⁰ N	3.92268 ⁰ E	Private
Ward 2 (Odo-Esa)	BH2	6.81403 ⁰ N	3.92361 ⁰ E	Public
Ward 3(Itantebo)	BH3	6.82068 ⁰ N	3.91904 ⁰ E	Public
Ward 4 (Ijada-Imepe I)	BH4	6.81296 ⁰ N	3.91775 ⁰ E	Public
Ward 5 (Ijada-Imepe II)	BH5	6.81218 ⁰ N	3.91290 ⁰ E	Private
Ward 6 (Porogun I)	BH6	6.81940 ⁰ N	3.91384 ⁰ E	Public
Ward 7 (Porogun II)	BH7	6.82289 ⁰ N	3.91286 ⁰ E	Public
Ward 8 (Ijase-Idepo)	BH8	6.82169 ⁰ N	3.92158 ⁰ E	Public
Ward 9 (Odo-Egbo/Oliworo)	BH9	6.82010 ⁰ N	3.92372 ⁰ E	Private
Ward 10 (Isiwo)	BH10	6.42396 ⁰ N	3.58901 ⁰ E	Private

Source: Field Survey, 2016

2.3 Laboratory Analysis for Physico-chemical parameters

The analyses of the water samples to determine the physico-chemical parameters were carried out at the Multi-Disciplinary Central Research Laboratory, University of Ibadan and results presented in Table 2.

Table 2 Analysis of the Physico-Chemical Parameters of the ten (10) sampled Boreholes

Borehole	Bh ¹ Iporogun 1	Bh ² Itantebo	Bh ³ Ijada	Bh ⁴ Idebo	Bh ⁵ Iporogun 2	Bh ⁶ Imepe	Bh ⁷ Isiwo	Bh ⁸ Isoko	Bh ⁹ Idi-osa	Bh ¹⁰ Odo- egbo
Ph	5.50	6.34	6.16	3.6	6.51	6.52	5.24	4.90	5.34	6.22
Temp(⁰ C)	28.6	29.8	29.8	29.7	30.4	30.3	30.7	30.6	30.8	30.7
Odour	U	U	U	U	U	U	U	U	U	U
Colour	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear
Conductivity (μ s)	151	256	160	164	193	123	84	25	121	128
Chloride (mg/l) ⁻¹	9	86.9	7.5	155	53	98	111	25	206	196
Total Soluble Solid (TSS)- (mg/l)	0.5	2	3.7	19	18	12	9	0.5	0.5	2.6
Hardness (ppm)	36	25	247.7	107.2	35.7	168.32	154.40	95.1	351.05	87.92
Turbidity	0.01	0.15	0.23	0.01	0.01	2		0.03	4.8	0.01
Total Dissolved Solid (mg/l)	17.67	107	18.33	66.33	79	91.3	19.09	450	323	98.5

Source: Multi-disciplinary Central Laboratory, University of Ibadan, Nigeria, 2016.

3.0 Results and Discussion

The results of this study as presented in table 5 shows that the water temperature of the sampled boreholes was between 28.6⁰C-30.8⁰C which is within the acceptable limit by WHO(table4) and NAFDAC(table3). The pH values of the sampled boreholes were within the desirable limits for human consumption except BH1, BH4, BH7, BH8 and BH9. Generally, lower level of pH can lead to skin irritation due to corrosiveness. The result further revealed that the sampled borehole waters are odorless and colourless.Two(BH7&8) out of the ten (10) boreholes sampled have conductivity values below the standard limit revealing that majority of the sampled boreholes water are conductive to electricity (table4). The total dissolved solids (17.67-323mg/l) which is the amount of inorganic substances (salts and minerals) likewise the total soluble solids(0.5-19mg/l) in the sampled water are below the permissive limits prescribed by the World Health Organization (WHO) and National Agency for Food, Drug Administration and Control (NAFDAC) while the value of chlorine(7.5 and 206mg/l)⁻¹), turbidity (0.01-4.8) and total hardness (25-351.05mg/l) are also within the standard limit.

Table 3: NAFDAC standard for physico-chemical parameters

Parameters	NAFDAC LIMITS
Colour	15
Turbidity	-
pH	6.5-8.5
TDS	500
Conductivity	N.S
Total Alkalinity	-
Iron	100
Chromium	-

Nitrate	-
Temperature	30°C
Copper	-
Fluoride	-

Source: NAFDAC (2001)

Table 4 WHO Standrd for physio-chemical parametres

Parameters	Permissible Limits (by WHO)
Temperature	30°C
Odour	Unobjectionable/odorless
PH	6.5-8.5
Hardness	500mg/l
Total Dissolved Solids	1500mg/l
Turbidity	5NUT
Conductivity	120YS/cm ³
Chlonide Ion	250mg/l
Alkalinity	100mg/l
Colour	15TCU
Appearance	Clear
Bacteriological	
Coliform	Nil/100ml
E.Coli	Nil/100ml

Source: WHO (2011)

Table 5 Analysis of the Physico-chemical Parameters of the ten (10) sampled Boreholes compared with World Health Organisation (WHO) and National Agency for Food, Drug Administration and Control (NAFDAC) Standard for drinkable water.

Borehole	Bh ¹ Iporogun 1	Bh ² Itantebo	Bh ³ Ijada	Bh ⁴ Idebo	Bh ⁵ Iporogun 2	Bh ⁶ Imepe	Bh ⁷ Isiwo	Bh ⁸ Isoko	Bh ⁹ Idi-osa	Bh ¹⁰ Odo- egbo	WHO	NAFDAC
Ph	5.50	6.34	6.16	3.6	6.51	6.52	5.24	4.90	5.34	6.22	6.5-8.5	6.5-8.5
Temp(°C)	28.6	29.8	29.8	29.7	30.4	30.3	30.7	30.6	30.8	30.7	30°C	30°C
Odour	U	U	U	U	U	U	U	U	U	U	U	U
Colour	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	Clear	NS	15
Conductivity (µs)	151	256	160	164	193	123	84	25	121	128	120ys/cm	N.S
Chloride (mg/l) ¹	9	86.9	7.5	155	53	98	111	25	206	196	250	N.S
Total Soluble Solid (TSS)- (mg/l)	0.5	2	3.7	19	18	12	9	0.5	0.5	2.6	20	20
Hardness (ppm)	36	25	247.7	107.2	35.7	168.32	154.40	95.1	351.05	87.92	500	N.S
Turbidity	0.01	0.15	0.23	0.01	0.01	2		0.03	4.8	0.01	5	5
Total Dissolved Solid (mg/l)	17.67	107	18.33	66.33	79	91.3	19.09	450	323	98.5	1500	500

Source: Multi-disciplinary Central Laboratory, University of Ibadan, Nigeria, 2016

Conclusion and Recommendation

Physico-chemical parameters of the selected sampled borehole water result revealed that virtually all the parameters are within the recommended acceptable limit showing that they are less polluted and highly suitable for human consumption. It is therefore recommended that more effort should be put

in place towards maintaining the present quality status of the sampled borehole water in Ijebu-Ode area by carrying out constant monitoring and assessment of the boreholes to ascertain its suitability for drinking and other purposes.

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