PHYSICO-CHEMICAL WATER QUALITY ASSESSMENT OF TWO RIVERS IN OGUN STATE, NIGERIA

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The purpose of this study was to evaluate the River Afa and River Owo's water quality in order to gather information that may be used in the near future to formulate control strategies. Water samples were collected from two sites (upstream and downstream) on the River Afa and from four stations located along the course of River Owo to covered both rainy and dry seasons. Twenty-two (22) important parameters were selected for physico-chemical water quality analysis. Samples collected were analysed using appropriate standard techniques. Generally, pH, TDS, alkalinity, acidity, hardness, and EC recorded higher mean values in River Afa than River Owo. However, Organic matter (OM) and total organic carbon (TOC) recorded higher mean values in River Owo. Nitrate and sulphate had higher mean values in River Afa compared with River Owo. The results were compared to World Health Organization (WHO) and Nigeria Standard for Drinking Water Quality (NSDWQ). As a result, most of the parameters examined were below the recommended safe drinking water threshold. However, the turbidity and surface water temperature were above WHO and NSDWQ standards. Comparison of data obtained between water quality parameters was made using cluster analysis at P≤0.05 and this revealed significant relationship among the parameters measured. The majority of the water quality parameters that were monitored in this study showed higher values in River Afa than in River Owo. Also, results of te monitored water quality parameters showed that both River Afa and River Owo water may pose danger to health if consumed untreated and requires further purification process to prevent imminent water-related diseases befallen the residents of the area.

Keywords: Anthropogenic; Health; River; Surface water; Pollution; Epidemics.

INTRODUCTION

Water is the most essential element for life, after air. This has led to a great deal of description of water quality in the scientific literature. The term "water quality" describes the properties of water that are chemical, physical, biological, and radioactive (Palansooriya et al., 2020; Shah et al., 2023). It is a measurement of the water's characteristics in relation to the needs of one or more biotic species and/or to any goal or demand of humans (Hassan-Omer, 2020). Life is impossible without water, which is one of the most essential elements of life (Algaon-odot et al., 2012). However, because of growing antienvironmental human activity as well as some natural processes, the quality of the surface water is steadily declining, endangering all life, including human life. The main factor behind the spread of numerous epidemics and certain catastrophic illnesses like cholera, typhoid, diarrhea, etc. is contaminated water (Tulchinsky, 2018). Many academics have investigated some facets of water

quality and the causes of its deterioration in an effort to develop a meaningful global control strategy (Nkhtar, 2021; Nguyen, 2023).

Changes caused by the rapid development, construction (road and residential), abattoir activities, transportation, population growth, and massive amounts of industrial and plastic waste have influenced the area surrounding River Afa. Additionally, spiritual activities have added to the already dangerous situation. On the other hand, River Owo is located in a more secluded area distant from the effect of urbanization but often used as a means of transportation (using boat) to connect the settlements scattered along its course. River Afa often experiences lower current compares to River Owo because of blockages from plastic wastes and water hyacinth. The purpose of this study was to evaluate water quality of River Owo and River Afa's using physicochemical parameters in order to gather information that may be useful in the near future for developing control strategies.

MATERIAL AND METHODS

Study Area

This study was conducted on Rivers Afa and Owo. in Ogun State, Nigeria. River Afa is located It is situated at an elevation of 37 meters above sea level in Mopol Area of Ayetoro, Ogun State within the latitude 6°34'00"N to 6°34'07"N and longitude $2^{\circ}45'00''E$ to $2^{\circ}45'04''E$. The river (a tributary of River Niger) took its source from Guinea Highlands in Guinea. It flows into Niger Delta in Nigeria and emptied into Atlantic Ocean via the Gulf of Guinea. It primarily serve the purpose of irrigation and fishing. Close to the river is an ongoing construction works (road and residential). In addition, the water serves te active abattoir and block industry situated along its bank. The Owo River is one of the watersheds south of the Ogun River Basin in southwest, Nigeria. Its connection to the Lagos Mainland, where it provides water supply for Ishasi Waterworks, may account for some of its peculiarities. It covers the geographic range of latitudes 6°27'23" to 6054'22" and longitudes 3°16'60" to 3°4'6". The watershed contains 156 villages and a size of about 1170.68 km². Despite changes brought about by urbanization over time, agricultural activities continue to be the primary form of human activity in the basin. In particular, bathing, transportation, and spiritual consuming are done along these rivers.

Water sample collection and processing Sampling and in-situ determinations

In order to determine the physico-chemical properties of the water, samples were taken and stored in one-liter (1 L) plastic containers that had been carefully cleaned, rinsed with a 50% nitric acid solution, and then rinsed with distilled water. The container was submerged in river water to a depth of around 30 cm, with its face towards the flow of water. To avoid air entrapment, the water was gathered, filled to full, sealed, and shipped to the laboratory on ice right away. Water samples were taken from the River Afa at two different locations-upstream and downstream. Additionally, water samples were taken from each of the four sites that are spread out along the River Owo. The sampling was done quarterly from December, 2021 to November, 2022 and included both wet and dry seasons. In situ, the temperature was measured with a mercury-in-glass thermometer. The thermometer was shielded from the sun's rays, and the findings were given in degrees Celsius. A pH meter (Hanna, H198190) was used to measure the water's pH on-site. Prior to collecting readings, the pH meter was calibrated using a buffer solution with a known pH.

Laboratory analysis

Turbidity, total dissolved solids (TDS), total suspended solids (TSS), Electrical conductivity (EC), alkalinity, acidity, hardness, dissolved oxygen (DO) concentration, BOD₅, COD, True colour, Apparent Colour, Organic carbon (OC), organic matter (OM), calcium (Ca²⁺), magnesium (Mg²⁺), sulphate (SO₄²), nitrate (NO3), phosphate (PO₄³), and chloride (Cl) were analysed in the laboratory using standard methods of APHA, 2014.

Using a laboratory conductivity meter (EZ-9909SP), the electrometric approach was used to determine conductivity and TDS. Titrimetric method with phenolphthalein was used to test for acidity. The iodometric method was used to measure the DO and BOD₅. Silver chloride was used in the argentometric titration method to measure the chloride content. Using the colorimeter approach, the levels of true colour, apparent colour, nitrate, phosphate, and sulphate were determined. Using an EDTA conjoining Eriochrome BlackT indicator, the hardness, calcium, and magnesium of the water were measured by titration (APHA, 2014). Using a bromocresol green-methyl red indicator, alkalinity was quantified as CaCO3 through titration. Using a spectrophotometer, turbidity was measured. TSS was then collected gravimetrically through filtering and oven drying. Samples were collected in triplicate and the mean result was used. Descriptive (Range and mean) and inferential (Analysis of variance, ANOVA and cluster analysis) analysis of the data collected were using Excel and Paleontological Statistics statistical tools.

RESULTS

Tables 1 and 2 summarized the descriptive and ANOVA statistics of the physicochemical parameters of the Rivers Afa and Owo. In River Afa (Table 1), the mean temperature of the water samples collected at locations A and B (upstream and downstream) varied between 26.5 °C and 28.1 °C, while in River Owo (Table 2), it ranged between 25.10 °C and 26.50 °C. In the River Afa, turbidity significantly ($p \le 0.001$ increased at the upstream during the sampling period. Apparent colour, DO, BOD, alkalinity, TDS, TSS, COD, OM, OC, and EC had the mean value at the upstream while other parameters recorded the peak mean value at the downstream. In River Owo, Water temperature recorded lower mean value at station 2 with most of other parameters not showing a regular pattern as the mean values fluctuate among stations. Meanwhile, True colour and acidity tend to decrease from station 1 to station 4. High pH was also recorded at station 4 with the least pH recorded at station 2.

In general, River Afa has greater mean values of pH, TDS, alkalinity, acidity, hardness, and EC than River Owo. In River Owo, the mean levels of total organic carbon (TOC) and organic matter (OM) were greater (Table 3). Table 3 also compares River Owo's pvysicochemical characteristics with the WHO (2011) limit. Most of the mean values for chemical parameters were within WHO (2011) limit.

Anions concentrations

Table 1 demonstrates how chloride, nitrate, sulphate and phosphate values of the water samples, as obtained from River Afa, ranged among stations. All water samples had chloride (Cl) concentrations below the 250 mg/L WHO limit (Table 3). Table 1 records the nitrate and sulphate had the mean value at the upstream. While in River Owo, Phosphate mean value was steady with a drop at station 2. Nitrate and sulphate had higher mean values in River Afa compared with River Owo with higher phosphate mean value recorded in River Owo (Table 3).

Cations concentrations

Table 1 shows that the magnesium values in the River Afa water samples ranged from 0.20 to 2.00 mg/L. Magnesium recorded higher mean value upstream in River Afa wile in River Owo, magnesium significantly ($p \le 0.05$) decreased from station 1 to station 4 (Table 2). During the study period, River Afa's calcium readings likewise varied, ranging from 10.50 to 35.61 (Table 1) while in River Owo the highest mean value for calcium was recorded at station 2 (Table 2) Although River Afa's mean levels for calcium and magnesium were greater than River Owo's, they were still below the WHO (2011) limit (Table 3).

Table 1: Physico-chemical properties variation among the stations of River Afa.

	Downstrea	m	Upstream			
Parameters	Range	Mean±SEM	Range	Mean±SEM	F	р
Water Temperature						
(°C)	27.00 - 28.10	27.50 ± 0.24	26.50 - 2.50	27.50 ± 7.72	0.55	0.53
Turbidity (NTU)	22.90 - 26.20	24.50 ± 4.20	29.50 - 40.90	25.20 ± 6.44	0.42	0.001
App.Colour Pt- Co	216.47 - 230.1	223.30 ± 30.27	242.40 - 470.2	356.30 ± 60.37	0.36	0.36
T. Colour (Pt-Co)	79.60 - 101.07	90.40 ± 12.06	68.20 - 82.80	41.40 ± 22.46	0.31	0.37
DO (mg/L)	0.30 - 2.40	1.40 ± 0.49	40.00 - 208.00	5.20 ± 0.49	0.24	0.67
BOD (mg/L)	2.00 - 7.00	4.50 ± 1.05	94.20 - 147.00	4.80 ± 1.55	0.03	0.86
COD (mg/L)	2.40 - 5.60	4.00 ± 1.18	0.40 - 1.20	0.80 ± 1.48	0.05	0.84
TDS (mg/L)	171.90 - 264.00	218.00 ± 128.09	2.40 - 8.00	524±157.49	0.92	0.44
TSS (mg/L)	75.70 - 86.00	80.90 ± 28.10	8.00 - 1.60	120.6 ± 30.50	2.18	0.28
рН	5.56 - 6.60	6.10 ± 0.25	5.84 - 6.50	6.20 ± 0.25	0.02	0.89
Acidity (mg/L)	24.00 - 76.00	50.00 ± 9.61	22.00 - 50.00	36.00±12.71	0.22	0.68
Alkalinity (mg/L)	106.00 - 184.00	145.00 ± 16.02	120.00-145.00	148.00 ± 19.62	0.004	0.95
Hardness (mg/L)	58.40 - 89.80	74.10±11.76	92.20- 24.80	63.40±13.76	0.11	0.77
EC (µS/cm)	296.00 - 440.00	368.00±251.50	140.00- 346.00	873.00 ± 261.54	0.90	0.44
OC (mg/L)	0.80 - 5.10	3.00 ± 1.00	1.50 - 6.00	3.80 ± 1.30	0.06	0.82
OM (mg/L)	1.408.83	5.10 ± 2.10	2.80 - 10.30	6.40 ± 2.24	0.05	0.83
Nitrate (mg/L)	4.00 - 4.0	4.30±1.18	3.90 - 8.90	6.40 ± 1.18	0.65	0.50
Sulphate (mg/L)	2.60 - 10. 70	4.70±0.47	11.50 - 17.90	18.20 ± 3.47	0.18	0.71
Phosphate (mg/L)	0.30 - 0.30	0.30 ± 0.00	0.30 - 0.30	0.30 ± 0.00	0.00	0.00
Chloride (mg/L)	56.70 - 85.10	70.90 ± 8.06	42.50 - 43.00	42.50±10.03	3.92	0.18
Calcium (mg/L)	20.10 - 35.61	27.90 ± 5.00	10.50 - 34.10	22.30 ± 5.99	0.15	0.30
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Magnesium (mg/L)	0.20-2.00	1.10 ± 0.40	1.70-2.00	1.8 ± 0.43	0.67	0.49

	Station 1		Station 2		Station 3		Station 4			
Parameters	Range	Mean	Range	Mean	Range	Mean	Range	Mean	Ц	d
Water Temperature (°C)	26.5 - 27.00	26.00	25.10 - 26.00	25.8	26 - 26.50	26.00	26.5 - 27.00	26.00	0.67	0.30
Turbidity (NTU)	11.10 - 26.50	18.80	11.80 - 29.44	20.62	11.10 - 15.20	13.41	5.26 - 7.90	6.58	1.10	0.84
App.Colour Pt- Co	256.00-431.80	231.80	389.00 -499.00	316.00	188.50 -289.0	198.50	179-380.6	280.60	1.62	0.44
T. Colour (Pt- Co)	287.70-303.02	295.36	130.90 -268.40	199.65	89.30 -213.58	151.44	112.61-242.90	177.75	1.22	0.41
DO (mg/L)	1.60 - 1.10	1.35	2.4 - 0.40	1.40	3.60 -0.50	2.05	2.0 -0.60	1.30	0.12	0.94
BOD (mg/L)	2.00 - 3.20	2.60	2.0 - 4.40	3.20	3.20 -20.00	2.60	4.0 -1.20	2.60	0.08	0.96
COD (mg/L)	4.00 - 10.40	7.20	4.80 - 4.00	4.4	7.20 - 4.00	5.60	0.8 -1.60	1.20	1.96	0.29
TDS (mg/L)	88.90 - 330	209.45	59.40 - 132.00	95.70	63.70 -138.00	100.85	64.8 -144.0	104.40	0.63	0.62
TSS (mg/L)	159.00-279.00	179.00	37.0 - 86.2	57.6	37.00 - 67.80	44.50	5.0 -26.60	14.60	0.62	0.34
hq	5.20 - 6.30	5.75	5.32 - 6.60	5.96	5.16 - 6.40	5.78	5.26 -6.90	6.08	0.05	0.98
Acidity (mg/L)	20.00 - 68.00	44.00	20.00 - 62.00	41.00	14.00 - 44.00	29.00	10.0 -58.00	34.00	0.10	0.95
Alkalinity (mg/L)	30.00 - 36.00	33.00	30.00 - 38.00	34.00	32.00 - 60.00	46.00	30.0-30.00	30.00	0.00	0.00
Hardness (mg/L)	47.90 - 47.73	47.81	52.54 - 28.91	40.72	41.77-30.76	36.26	33.12-37.78	35.45	0.73	0.58
EC (µS/cm)	143.30-550.00	346.65	99.10 - 220	159.55	105.6 - 230.0	167.8	107.6-240.0	173.80	0.60	0.64
OC (mg/L)	3.66 - 7.8	5.73	4.39 -3.94	4.16	6.59-3.00	4.79	0.73-1.57	1.15	2.02	0.23
OM (mg/L)	6.30 - 13.43	9.86	7.56 - 6.80	7.18	11.35-5.16	8.25	1.26-2.72	1.99	2.02	0.25
Nitrate (mg/L)	2.20 - 4.28	2.14	1.50 -5.18	3.34	1.91 - 2.15	1.62	0.85-2.15	1.85	0.19	0.51
Sulphate (mg/L)	10.60 - 26.17	18.38	1.00 -13.52	7.26	10.2 - 27.63	18.91	0.3-22.17	11.23	0.44	0.74
Phosphate (mg/L)	0.32 - 0.32	0.32	0.32 - 0.31	0.31	0.32 - 0.31	0.32	0.32-0.30	0.32	0.19	0.89
Chloride (mg/L)	42.50-32.61	37.55	56.70 - 28.36	42.53	42.5 - 28.36	35.43	28.4-21.27	24.83	0.99	0.73
Calcium (mg/L)	9.80 - 12.73	11.26	20.90 - 11.25	16.079	14.20 -11.99	13.09	10.52-14.9	12.71	0.51	0.69
Magnesium (mg/L)	5.70 - 3.87	4.78	0.10 - 0.18	0.144	1.50 - 0.18	0.844	0.1-1.664	0.88	9.51	0.03

Table 2: Physico-chemical properties variation among the stations of River Owo.

 Table 3: Comparison of mean values of River Afa and River Owo with WHO Guildelines for drinking water.

Parameters	River Afa	River Owo	WHO	NSDWQ
Water Temperature (mg/L)	27.28	26.90	25	Ambient
Turbidity NTU	24.88	14.86	5	5
Apparent. Colour (Pt- Co)	289.8	374.95	-	15
True. Colour (Pt- Co)	65.87	206.04	-	-
DO (mg/L)	1.08	1.53	5.0-10.0	
BOD (mg/L)	4.85	2.75	6	5
COD (mg/L)	4.40	4.60	10	-
TDS (mg/L)	370.98	127.60	250-500	500
TSS (mg/L)	116.50	89.50	500	500
рН	6.13	5.89	6.5 - 8.5	6.5 - 8.5
Acidity(mg/L)	43.00	3.00	-	-
Alkalinity (mg/L)	146.60	35.75	200	-
Hardness (mg/L)	68.72	63.40.07	250	150
EC (μ S/cm)	620.50	211.95	1000	1000
OC (mg/L)	3.34	3.96	-	5
OM (mg/L)	5.76	6.83	-	-
Nitrate (mg/L)	5.41	1.37	10	50
Sulphate (mg/L)	16.44	13.96	250	100
Phosphate (mg/L)	0.32	0.32	0.5	-
Chloride (mg/L)	56.71	35.10	250	250
Calcium (mg/L)	25.09	13.29	-	75
Magnesium (mg/L)	1.46	1.67	50	0.20

The seasonal variation in physicochemical water quality parameters of River Afa and River Owo is represented in figure 1 and 2 below. River Afa recorded higher concentration of chloride, calcium, sulphate, EC, hardness, alkalinity, acidity, and DO during the rainy season while turbidity apparent colour, true colour, BOD, TDS and nitrate had their peak during the dry season. On the other hand, River Owo had the concentration of OM, Phosphate, nitrate, turbidity, COD, pH, BOD, DO and Magnesium to be higher during the rainy season. However, EC, TDS, acidity, alkalinity, calcium, TSS, apparent colour, true colour, sulphate, chloride and hardness recorded higher mean value during the dry season.

The average physico-chemical characteristics of water samples from two Ogun State rivers are shown in Figure 3. Electrical conductivity (EC), total alkalinity (TA), total dissolved solid (TDS), total hardness (TH), total suspended solid (TSS), biological oxygen demand, acidity, nitrate, sulphate, chlorine, calcium, and turbidity mean values were higher in River Afa than in River Owo, whereas apparent color, true color, and organic matter recorded higher mean values in River Owo. These are the average mean values derived from the results. River Afa had significantly higher level of turbidity, TDS, TSS, alkalinity, hardness, conductivity, chloride and calcium levels compared to River Owo while the apparent colour and true colour of River Owo significantly different from the values recorded in the River Afa.

Relationship between physico-chemical parameters

Cluster analysis CA of the physicochemical water quality parameters based on te sampling stations

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was done to illustrate the relationship among parameters. In River Owo, two significant ($p \le 0.05$) clusters were identified. COD, OC, OM, turbidity, chloride, nitrate, EC, TDS, magnesium, TSS, True colour, hardness formed a cluster while other parameters formed the second cluster. Also, River Afa, the parameters were grouped into two significant clusters. DO, water temperature, magnesium, BOD, turbidity, Apparent colour, TSS, nitrate, TDS, EC, sulphate, pH, alkalinity, acidity, hardness, calcium, COD, OC, OM formed a cluster while magnesium, True colour, phosphate and chloride formed the second cluster.



Figure 1: Seasonal variation in physicochemical water quality parameters of River Afa.



Figure 2: Seasonal variation in physicochemical water quality parameters of River Owo



Figure 3: Average physicochemical properties of water samples from River Afa and River Owo.



Figure 4: Relationship between physico-chemical parameters (A – River Owo; B – River Afa).

DISCUSSION

In Ogun State, Nigeria, the physico-chemical characteristics of the Rivers Afa and Owo were investigated in this study. The results showed that the mean values of the following parameters were higher in River Afa than in River Owo: pH, nitrate, sulphate and chlorine, calcium, magnesium, turbidity, electrical conductivity (EC), total alkalinity (TA), total dissolved solid (TDS), total hardness (TH), total suspended solid (TSS), biological oxygen demand (BOD), and acidity. On the other hand, River Owo had greater mean levels of DO, COD, phosphate, apparent color, true

color, and organic matter (OM) than River Afa. Seasonally, the two revers recorded higher mean values for TSS, TDS, apparent colour, true colour during the dry season.

The water samples' temperature is one of the crucial physico-chemical factors taken into account. The two rivers' average water temperatures in this study were 27.28 °C, and 26.69 °C, which is above the WHO's recommended limit. The study's temperature data for the water samples is common to tropical surface waters (Adesakin *et al.*, 2020; Omoboye *et al.*, 2022). In the

study area, ambient temperature typically ranges from a comfortable 25 °C to a warm 32 °C. In water, the amount of free, non-compound oxygen is known as dissolved oxygen, or DO. Given that it affects the creatures that live in a body of water, it is a crucial criterion for evaluating the quality of the water. When fertilizers and organic materials from sewage discharges, runoff from land, and industrial wastewater increase, the amount of oxygen in water often decreases (Mena-Rivera et al., 2017). The study's findings indicate that DO is deficient in bot rivers as both findings fell short of the WHO-established threshold of 5.0-10.0 mg/L indicating a higher population of bacteria present in water samples, which used more dissolved oxygen. The temperature of the water affects the amount of dissolved oxygen in it, according to Adesakin et al. 2020. Also, given that warm water dissolves less oxygen than cold water, and a higher temperature also means that metabolism will be aided in aquatic animals, thereby making them to consume more energy, the higher water temperature in the River Afa may have contributed to the lower DO readings. The higher levels seen in River Owo might potentially have resulted from enhanced water currents brought on by boating and swimming during the sampling times. Furthermore, these results are consistent with those of earlier studies (Yogendra et al., 2013; Ashish and Yogendr, 2009).

The amount of oxygen in the water that aerobic organisms need is measured by values of BOD, which indicates how much organic material has been biodegraded. The existence of organic contamination is also shown by the higher levels in the River Afa compared to the River Owo. This may be because the waterbody is located within Lagos State, which has a dense population and busy roads, through which organic wastes may be introduced into the body of water. Higher BOD readings in River Afa may have also been caused by the existence of an operational abattoir that continuously dumps waste into the river. The number of organic molecules in water can often be estimated indirectly using the chemical oxygen demand (COD) method (Kumar et al., 2011). It indicates that the discharge of household sewage and industrial effluent is causing the water quality to deteriorate (Gupta et al., 2003). In this study, River Owo had higher COD values than River Afa. This could be the consequence of comparatively minor organic pollution brought on by sewage waste from nearby human areas.

pH is an important parameter that affects a lot of chemical and biological processes. When assessing water supply and treatment, this water quality assessment metric is crucial (U.S. EPA, 2024). The findings indicate that the pH of all the water samples from the two rivers in the Ogun State communities was slightly below the 6.5-8.5 range that the WHO recommends. There was a minor acidity to the water samples. The pH value recorded in this study is less than the 6.69 ± 0.1 range recorded by Usoro et al., 2013 in Iko River. Low pH, or acidity, in a water body can lead to several negative effects, including increased toxicity of heavy metals, corrosion of pipes and infrastructure, and harm to aquatic life. The amount of substances in water that allow it to neutralize acidity is measured as total alkalinity. The WHO states that 200 mg/L of total alkalinity in water is the permissible level. Water samples from both rivers satisfied this criterion. The study's findings show that the total alkalinity of the samples from the River Owo was incredibly low. This could be because of introduction of acidic wastes into River Owo from the watershed area. Furthermore, Water purity can be evaluated with suitable tools, one of which is electrical conductivity (EC). Our findings indicate that the water samples' electrical conductivity was within the WHO-established acceptable range of 1000 μ S/cm. Reduced conductivity in the River Owo suggests that less amount of dissolved inorganic compounds in ionized form from the surface catchment of the water body (Adesakin et al. 2020).

The water samples' EC matches the conclusions of Adesakin *et al.* (2020) and Olubanjo *et al.* (2019). Total dissolved solids (TDS) are the inorganic and trace amounts of organic matter that are present in water as a solution. With the exception of the upper course of the River Afa, where the value of TDS was somewhat higher than the limit, the range of TDS in water samples from this study was far below the WHO limit. Zige *et al.* (2018) linked urban runoff, less industrial effluent, remoteness, and sewage to low TDS of water samples; nevertheless, all of these factors might have contributed to the higher value seen in River Afa coupled with its significant turbidity level. The overall hardness of natural waters is largely influenced by the presence of dissolved calcium and magnesium salts (Onojake and Abrakasa, 2012). Water hardness can be divided into four categories, according to Diersong (2009): mild (0-60 mg/L), moderate (60-120 mg/L), hard (121-180 mg/L), and very hard (> 180 mg/L). Given that the results fell between 35.5 and 47.82 mg/L, the water samples from the River Owo are therefore soft. River Afa's levels, on the other hand, fall into the moderate range of 34.46 to 92.16 mg/L. All water sample from both rivers met the WHO's 250 mg/L maximum for total hardness. This was consistent with research conducted by Raji et al. (2015) on the physicochemical characteristics of surface water collected from Nigerian River Sokoto. In addition, the significant level of magnesium at River Owo may be attributed to the discharge from the activities from the catchment area.

The measurement of total suspended solids (TSS) in water is crucial for determining its quality. Solids may include algal growths, which is a sign of extremely high levels of eutrophication. Compared to River Owo, River Afa has greater TSS levels. This is a measure of the amount of washings that are released from the abattoir and the unpaved road near the sampling locations. The results of the study show that the TSS in the water samples from both rivers was lower than the 500 mg/L WHO threshold. The average phosphate and nitrate readings across all test sites were generally below the 250 mg/l WHO guideline level (2006), indicating that the material might not be toxic to people or animals. Digestive problems may result from very elevated phosphorus levels. In both rivers, PO_4^- values were comparatively high. The amount of phosphate may result from a variety of sources, including defecation and wastewater from household activities. Given that the majority of metallic sulphate are soluble in water, it is likely that sulphate may seep from top soil into surface and subsurface water. According to the WHO standard (2011), the water samples in the research regions are below the allowable limit (250 mg/l). The higher values recorded for TSS, TDS, apparent colour, true colour during the dry season for both rivers may be attributed to the effect of the construction activities around river Afa and the transportation on River Owo coupled with dust that always accompany dry season. In addition, the dilution effect of rain ad reduced during the dry season.

CONCLUSION

This study has shown that most of the water quality parameters monitored during the course this study recorded higher values in River Afa than in River Owo and Some of the mean values for parameters from River Afa especially dissolved oxygen were lower than the recommended limits by World Health Organization (WHO). This is an indication that the quality of water from River Owo is better than what was obtainable from River Afa and also shows that both River Afa and River Owo water may pose danger to health if consumed untreated and requires further purification process to prevent imminent waterrelated diseases befallen the residents of the area.

AUTHORS' CONTRIBUTIONS

Omoboye, Helen Y. collected samples, analysed water samples and wrote the manuscript. Aduwo, Adedeji A. analysed data and supervised the research work.

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CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest related to this article.

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