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Research article

Evaluation of Water Quality and Coliform Load in Lafaru Stream, Abeokuta, Ogun State, Nigeria

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Abstract
Lafaru Stream is a vital water source for it surrounding communities, used for various domestic and agricultural purposes, despite concerns about potential contamination from nearby human settlements. The study investigates the water parameters and coliform bacterial load in Lafaru Stream, Abeokuta Ogun State, South West, Nigeria. Water samples were collected from ten stations (50 meters downstream). Water parameters and the bacterial loads were evaluated using standard methods. The result reveal that the water parameters except for pH in stations 01- 05, 07 and 08 ranging from 6.30-6.44 and temperature in stations 03-05 ranging from 24.50-24.80 ºC were in compliance with the world health organization (WHO) guidelines for drinking. Furthermore, five coliform bacteria namely *Enterobacter* sp., *Proteus* sp., *E. coli*, *Pseudomonas* sp. and *Salmonella* sp. were isolated from the stream with the highest bacterial load recorded in station 04 (108.00 CFU/100 mL). In conclusion, the study should that the stream is slightly acidic and fluctuating temperature but contains some pathogenic bacteria of environmental and public health concern.

Keyword: Bacterial Load, Lafaru, Stream, Water Quality

INTRODUCTION

Water is an essential resource for life and plays a vital role in public health, agriculture, industry, and domestic use. However, the quality of water resources, particularly in developing countries like Nigeria, is often compromised due to anthropogenic activities and inadequate waste management practices (Akinbola *et al*., 2025). In many rural and semi-urban areas, surface water sources such as rivers, streams, and lakes are used for drinking, cooking, washing, and other domestic purposes without adequate treatment (Famuyiwa *et al*., 2023). This poses a significant public health risk due to the presence of contaminants, including microbial pathogens, which can cause waterborne diseases.

Lafaru Stream which is located in Abeokuta, Ogun State, is a vital water source for the surrounding communities. It is used for various domestic and agricultural purposes, despite concerns about potential contamination from nearby human settlements and agricultural runoff (Umoren *et al*., 2024a). Evaluating the water quality and microbial load of the Lafaru Stream is crucial for assessing its suitability for use and identifying potential health risks.

Recent studies have shown that the water and microbial quality of surface water is often compromised due to the influx of pathogens from various sources (Ogunbanwo *et al*., 2018; Umoren *et al*., 2024b).

The presence of bacteria such as *Escherichia coli*, *Salmonella* sp., and *Staphylococcus aureus* in water bodies is indicative of fecal contamination and poor sanitation practices (Ogundipe *et al*., 2020). These bacteria can lead to outbreaks of diseases such as cholera, typhoid fever, and gastroenteritis, which remain significant public health concerns in Nigeria (Nwachukwu *et al*., 2019). In Abeokuta, rapid urbanization, poor sanitation practices, and a lack of adequate waste management infrastructure contribute to the deterioration of surface water quality, including Lafaru Stream (Ogundipe *et al*., 2020; Osifeso *et al*., 2025; Umoren *et al*., 2025).

Furthermore, the World Health Organization (WHO) and Nigerian drinking water standards emphasize the importance of maintaining good water quality by ensuring that microbial contaminants are below detectable limits to prevent waterborne diseases (WHO, 2018). However, due to lack of up-to-date data on the current bacterial load and water quality status of Lafaru Stream. It is essential to assess the bacterial load of Lafaru Stream for determining its safety for human use and providing recommendations for water treatment and sanitation improvement. This study aims to evaluate the water quality and bacterial load of the Lafaru Stream in Abeokuta, Ogun State, South West, Nigeria.

MATERIALS AND METHODS

Study Area

The study was conducted in Abeokuta, a historic city that serves as the administrative center of Ogun State in southwestern Nigeria. It is located at a longitude of 3.33°E and a latitude of 7.17°N. The city is easily accessible due to an extensive road network that connects it to larger cities, being approximately 80 kilometers north of Lagos. Abeokuta is contained within four local government areas of Ogun State: Abeokuta South, Abeokuta North, Odeda, and Obafemi/Owode. The city is situated in a humid tropical zone, with an average annual rainfall of 1,090.5 mm (Famuyiwa *et al*., 2025).

Lafaru Stream is a notable water body located within the Abeokuta metropolis, the capital city of Ogun State, Nigeria. It serves as an important water source for local residents, particularly for domestic and agricultural purposes (Umoren *et al*., 2024a). Despite its significance, Lafaru Stream faces various environmental challenges, primarily due to urbanization, human activities, and the growing pressure from waste disposal practices in Abeokuta (Akinyemi *et al*., 2019; Osifeso *et al*., 2025). The stream is shallow, with varying widths and depths along its course. It passes through both rural and urban areas, which exposes it to runoff and contaminants from domestic sources. The stream's water quality fluctuates depending on the season, with higher water volumes and flow rates during the rainy season and reduced flow during the dry season (Adeboye *et al*., 2021; Umoren *et al*., 2025).

Table 1: Description of sampled stations and coordinates

Station	Coordinates
ST01	7.1380317,3.3558815
ST02	7.1375367,3.3554463
ST03	7.1375951,3.3557155
ST04	7.1375951,3.3557156
ST05	7.1375951,3.3557157
ST06	7.1375951,3.3557158
ST07	7.1375951,3.3557159
ST08	7.1375951,3.3557160
ST09	7.1375951,3.3557161
ST10	7.1375951,3.3557162

Sampling Procedure

Ten (10) water samples were collected using a 1L plastic bottle pre-treated with 5% nitric acid (HNO_3) overnight each from ten (10) stations, 50 meters downstream. During sampling, all necessary precautions were taken into consideration to avoid contamination. The temperature and pH of the samples were determined *in situ*. labelled appropriately and transported in an ice pack to the Chemical Science Research laboratory of Pure Sciences, Abeokuta, Ogun State, Nigeria for further analysis.

Quality Control

All chemicals used were of Analytical grade and reagent blanks were made following the specifications to evaluate the reagents' purity. To ensure the highest level of instrument accuracy, the water quality meter and laboratory equipment were checked and calibrated according to the manufacturer's specifications and instructions (Famuyiwa *et al.*, 2023; 2025). Additionally, complete aseptic method was adopted during the microbial work.

Physicochemical Analysis of Water samples

The physicochemical quality of the water samples was carried out using standard methods (Famuyiwa *et al.*, 2023; Osifeso *et al*., 2025). The pH of each sample was determined using a handheld pH meter. Temperature and pH were measured *in situ*. After standardizing the apparatus with standard buffer solutions of varying pH, the sample pH was immediately taken. Total dissolved solids, salinity and electrical conductivity were determined using a handheld digital water quality meter. Total acidity and total alkalinity were determined using titrimetric methods.

Total Acidity was carried out according to the following procedure: dilute sodium hydroxide (NaOH) was titrated against 100 mL of water sample in an Erlenmeyer flask using 2 drops of phenolphthalein as an indicator. A pink coloration indicated the endpoint then the titre value was recorded.

$$Titre\ value/_{Volume\ of\ sample\ (100\ mL)} \times 1000$$

Total Alkalinity was carried out according to the following procedure: dilute hydrochloric acid (HCl) was titrated against 100 mL of water sample in a conical flask using phenolphthalein and methyl orange as an indicator. A peach coloration was obtained indicating the endpoint.

$$Titre\ value/_{Volume\ of\ sample\ (100\ mL)} \times 1000$$

Coliform Examination in Water Samples

Membrane filtration

The membrane filtration technique was adopted in the research for coliform eaxination (Foster and Pinedo, 2016). Exactly 50 mL of the water samples was passed through a nitrocellulose membrane filter (0.45µm), then the membrane was subjected to inoculation on gar plates.

Total Coliform Count and Isolation

MacConkey agar was used as the differential culture medium: MacConkey agar was prepared as described by the manufacturer. The membrane was inoculated into previously poured sterilized prepared media in triplicates and then the plates were incubated at 35ºC for 24 hours (Cheesbrough, 2006; Foster and Pinedo, 2016). Total coliform count was determined by visual counting using a magnifying lens furthermore, distinct colonies were sub-cultured by streak method to obtain a pure culture, then subjected to Gram's staining, specialized media and biochemical tests for isolate identification. The total coliform density was calculated and expressed as CFU per 100 mL of the water sample.

$$Coliform\ Density = \frac{Number\ of\ colonies\ on\ membrane\ \times 100}{Volume\ (50\ mL)\ of\ sample}$$

Data Analysis

Data was subjected to statistical package for social sciences (SPPS) for descriptive statistics and Microsoft (MS) Excel for data visualization. The Tukey *post-hoc* test was employed to determine the significance between the stations while p- value was set at 0.05 (Umoren *et al*., 2025b).

RESULTS

Water parameters of the stream

The water parameters for the stream are shown in Table 2. The pH ranged from 6.28- 6.57. The lowest pH was recorded in station 01 (6.28) while the highest in station 09 (6.57). The pH values in seven of the stations were slightly lower than the recommended WHO, 2018 standard (6.5-8.5). Temperature ranged from 24.5–26.67ºC, the lowest temperature was recorded in station 04 (24.5ºC) while the highest in station 09 (26.67ºC). The stations have a temperature value except for stations 03 -05, within the WHO, 2018 standard (25-29ºC). Electrical conductivity (EC) level ranged from 178.33 – 189.00 µS/c m.

The lowest EC was recorded in station 02 (178.33 µS/cm) while the highest in station 09 (189.00 µS/cm). The EC level across the stations were within the WHO, 2018 standard (1000 µS/cm). The TDS level ranged from 90.00 – 94.33 mg/L. The lowest TDS level was recorded in station 05 (90.00 mg/L) while the highest TDS was recorded in both stations 09 and 10 (94.33 mg/L). The TDS level across the stations were within the WHO, 2018 standard (<600mg/L).

The salinity level ranged from 90.00 – 94.67 mg/L. The lowest salinity level was recorded in Station 02 (90.00 mg/L) while the highest was in Station 09 (94.67 mg/L). The salinity level across the stations were within the WHO, 2018 standard (100 mg/L).

The level of total alkalinity ranged from 10.00 – 13.33 mg/L. The lowest total alkalinity was recorded in station 10 (10 mg/L) while the highest was in station 01 (13.3 mg/L). The total alkalinity values across the stations were within the WHO, 2018 standard (200 mg/L). The total acidity ranged from 5.67 and 7.67 mg/L. The lowest total acidity was recorded in station 6 (5.67 mg/L) while the highest was in both stations 04 and 07 (7.67 mg/L).

Table 2: Descriptive statistics of the water parameter

Parameter	Stations	Mean	Std. Deviation	Std. Error	Minimum	Maximum
pH	ST01	6.28	0.05	0.03	6.24	6.33
	ST02	6.33	0.10	0.06	6.26	6.44
	ST03	6.44	0.16	0.09	6.33	6.62
	ST04	6.42	0.19	0.11	6.28	6.63
	ST05	6.30	0.02	0.01	6.28	6.32
	ST06	6.52	0.11	0.07	6.43	6.65
	ST07	6.38	0.09	0.05	6.29	6.47
	ST08	6.37	0.08	0.05	6.29	6.45
	ST09	6.57	0.11	0.06	6.46	6.68
	ST10	6.50	0.07	0.04	6.43	6.57
	WHO, 2018	6.5-8.5				
Temperature (°C)	ST01	25.63bc	0.15	0.09	25.50	25.80
	ST02	25.17ab	0.21	0.12	25.00	25.40
	ST03	24.53a	0.06	0.03	24.50	24.60
	ST04	24.50a	0.10	0.06	24.40	24.60
	ST05	24.80a	0.36	0.21	24.40	25.10
	ST06	26.60d	0.40	0.23	26.20	27.00
	ST07	26.17cd	0.35	0.20	25.80	26.50
	ST08	26.57d	0.31	0.18	26.30	26.90
	ST09	26.67d	0.35	0.20	26.30	27.00
	ST10	26.20cd	0.10	0.06	26.10	26.30
	WHO, 2018	25 – 29				
Electrical Conductivity (µS/cm)	ST01	184.00bcd	1.73	1.00	183.00	186.00
	ST02	178.33a	2.08	1.20	176.00	180.00
	ST03	181.33abc	0.58	0.33	181.00	182.00
	ST04	184.00bcd	1.00	0.58	183.00	185.00
	ST05	180.67ab	2.08	1.20	179.00	183.00
	ST06	185.00bc	1.00	0.58	184.00	186.00
	ST07	184.00bc	1.00	0.58	183.00	185.00
	ST08	183.33abcd	2.08	1.20	181.00	185.00
	ST09	189.00d	1.00	0.58	188.00	190.00
	ST10	186.00d	3.61	2.08	182.00	189.00
	WHO, 2018	1000				

Total Dissolved Solid (mg/L)	ST01	92.67^{cd}	0.58	0.33	92.00	93.00
	ST02	90.33^{ab}	0.58	0.33	90.00	91.00
	ST03	90.67^{abc}	0.58	0.33	90.00	91.00
	ST04	92.67^{cd}	0.58	0.33	92.00	93.00
	ST05	90.00^{a}	1.00	0.58	89.00	91.00
	ST06	92.00^{ab}	1.73	1.00	90.00	93.00
	ST07	92.00^{abc}	0.00	0.00	92.00	92.00
	ST08	92.33^{bcd}	0.58	0.33	92.00	93.00
	ST09	94.33^{d}	0.58	0.33	94.00	95.00
	ST10	94.33^{d}	0.58	0.33	94.00	95.00
	WHO, 2018	<600				
Salinity (mg/L)	ST01	92.67^{c}	0.58	0.33	92.00	93.00
	ST02	90.00^{a}	0.00	0.00	90.00	90.00
	ST03	90.67^{ab}	0.58	0.33	90.00	91.00
	ST04	92.67^{c}	0.58	0.33	92.00	93.00
	ST05	90.33^{a}	0.58	0.33	90.00	91.00
	ST06	93.00^{cd}	0.00	0.00	93.00	93.00
	ST07	92.00^{bc}	0.00	0.00	92.00	92.00
	ST08	92.67^{c}	0.58	0.33	92.00	93.00
	ST09	94.67^{e}	0.58	0.33	94.00	95.00
	ST10	94.33^{de}	0.58	0.33	94.00	95.00
	WHO, 2018	100				
Total Alkalinity (mg/L)	ST01	133.3	1.53	0.88	120.0	150.0
	ST02	123.3	1.15	0.67	110.0	130.0
	ST03	130.0	2.65	1.53	100.0	150.0
	ST04	106.7	3.06	1.76	80.0	140.0
	ST05	120.0	2.65	1.53	90.0	140.0
	ST06	103.3	1.15	0.67	90.0	110.0
	ST07	123.3	1.53	0.88	110.0	140.0
	ST08	123.3	1.15	0.67	110.0	130.0
	ST09	113.3	2.08	1.20	90.0	130.0
	ST10	100.0	1.73	1.00	90.0	120.0
	WHO, 2018	200				
Total Acidity (mg/L)	ST01	60.0	1.73	1.00	40.0	70.0
	ST02	60.0	1.00	0.58	50.0	70.0
	ST03	73.3	1.53	0.88	60.0	90.0
	ST04	76.7	1.15	0.67	70.0	90.0
	ST05	70.0	1.00	0.58	60.0	80.0
	ST06	56.7	1.15	0.67	50.0	70.0
	ST07	76.7	0.58	0.33	70.0	80.0
	ST08	70.0	1.00	0.58	60.0	80.0
	ST09	60.0	1.73	1.00	50.0	80.0
	ST10	63.3	2.31	1.33	50.0	90.0
	WHO, 2018	-				

Mean with different superscript along the column are significantly different at $p<0.05$

Total Coliform

The total coliform load and isolates from each of the stations were presented in Table 3. It revealed that the coliform load in the stream ranges from 28.00–131 CFU/100 mL. The highest bacterial load was recorded in station 06 while the lowest was in station 07. Five bacterial species such as (*Enterobacter* sp., *Proteus* sp., *E. coli, Pseudomonas* sp. and *Salmonella* sp.) were isolated from the stream. The highest number of bacterial species was recorded in ST06 (04) while the lowest was in ST 01- 03 and ST 08-10 (01).

Table 3: Descriptive statistics of coliform load in stations

Stations	Isolated bacteria	No of Bacterial Species
ST01	*Enterobacter* sp.	01
ST02	*Proteus* sp.	01
ST03	*Proteus* sp.	01
ST04	*E. coli, Pseudomonas* sp.	02
ST05	*E. coli, Salmonella*	02
ST06	*E. coli, Proteus* sp., *Pseudomonas* sp., *Salmonella* sp.	04
ST07	*E. coli, Enterobacter* sp.	02
ST08	*Proteus* sp.	01
ST09	*Enterobacter* sp.	01
ST10	*Proteus* sp.	01

Table 4: Coliform isolates from the sampled stations

	Stations									
	Station 01	Station 02	Station 03	Station 04	Station 05	Station 06	Station 07	Station 08	Station 09	Station 10
Mean (n=3)	50.00	31.00	78.00	108.00	101.00	131.00	28.00	35.00	41.00	35.00
Std. Dev	11.31	15.56	48.08	5.66	1.41	1.41	2.83	9.90	7.07	24.04
Minimum	42.00	20.00	44.00	104.00	100.00	130.00	26.00	28.00	36.00	18.00
Maximum	58.00	42.00	112.00	112.00	102.00	132.00	30.00	42.00	46.00	52.00

DISCUSSION

Generally, the water parameters in the stations from the streams are mostly acidic and a slightly low temperature in some of the stations while other parameters are within the WHO standard (WHO, 2018). In Nigeria, particularly in urban settings, surface waters are frequently utilized as the most convenient method for waste disposal (Ologbosere *et al*., 2016). The findings from the study indicated a slightly low water pH and temperature. The pH of the is the measure of the acidity and alkalinity of the stream (Umoren *et al*., 2024a). This acidic nature recorded in some of the stations can be linked to the presence of organic acids, and hydrolysing salts (WHO, 2018), while pH may not pose direct health risks, its impact on human physiology is noteworthy (Famuyiwa *et al*., 2023; Umoren *et al*., 2024a). The temperature of a stream is the degree of coldness and hotness of the stream. Only few of the stations recorded a slightly low temperature which can be linked to the ambient temperature at the sampling time (Umoren *et al*., 2024b).

The sampled stations contained markers of faecal pollution such as total coliforms (*Enterobacter* sp., *Proteus* sp., *E. coli, Pseudomonas* sp. and *Salmonella* sp.) and the presence of these organisms were indicative of the fact that the stream waters were unfit for human consumption and should undergo thorough treatment before drinking. This is consistent with the reports of Agwu and Avoaja (2013) in Aba, Abia State. Bello *et al*. (2023) in Ondo state and Ologbosere *et al*. (2016) Benin city, Nigeria. The organisms observed in this research hold significant importance for public health. *E. coli* is typically found in the intestines of many humans and animals. It can lead to both intestinal and extra-intestinal infections, including septicemia, diarrhea, urinary tract infections, and neonatal meningitis in both humans and livestock (Savin *et al*., 2021).

This bacterium is frequently associated with multiple antimicrobial resistances (Bello *et al*., 2019) and is among those isolated from animal-derived foods such as pigs, cattle, and poultry (Gregova *et al*., 2021). *P. aeruginosa* is commonly found in water, soil, plants, and animals. It primarily causes infections in individuals with weakened immune systems but rarely causes infections in healthy people (Sharma *et al*., 2019; Jurado-Martín *et al*., 2021). It has been classified as one of the top ten hospital "superbugs," due to its numerous antimicrobial-resistant strains that lead to severe health issues (Pinto *et al*., 2021; Vetrivel *et al*., 2021).

CONCLUSION

The study investigates the water parameters and bacterial load in Lafaru Stream, Abeokuta, Ogun State, Nigeria. The study indicate that these parameters largely fall within the recommended guidelines set by the World Health Organization (WHO), suggesting a generally stable aquatic environment. Furthermore, a troubling array of five distinct bacterial species was isolated from the stream, including *Enterobacter* sp., *Proteus* sp., *Escherichia coli, Pseudomonas* sp. and *Salmonella* sp. These findings highlight the presence of pathogenic bacteria that pose significant environmental and public health risks, underscoring the need for continual monitoring and assessment of this vital waterway. It is therefore recommended that to improve water quality, reduce contamination, and protect public health and the environment, there should be (i.) implementation of waste management systems by the local authorities (ii) monitoring and regulation of domestic discharges and (iii) regular monitoring of water quality and bacteriological status of from the stream

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