Nigerian Journal of Pharmaceutical and Applied Science Research,
Vol.15 (2): 92-99; June 2026 ISSN: 2971-737X (Print); ISSN: 2971-7388.
Available at www.nijophasr.net https://doi.org/10.60787/nijophasr-v15-i2-642

Bacteriological Quality Assessment of Community Well Water in Selected Areas of Ogun State, Nigeria

[1*]Olufemi L. Okunye, [2]Oluwaseun E. Adewole, [3]Comfort B. Kotun, [4]Ayedun J. Seun, [5]Omosalewa H. Adewoyin, [6]Brendan I. Chijioke, [7]Titilayo T. Kolade and [8]Peter O. Ajayi

[1]Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria.
[2]Department of Microbiology, Faculty of Science, University of Ilesa, Ilesa Osun state, Nigeria.
[3]Department of Biological Sciences and Biotechnology, College of Pure and Applied Sciences, Caleb University, Imola, Lagos State, Nigeria.
[4]Department of Biological Science, Yaba College of Technology, Yaba, Lagos, Nigeria Peter O. Ajayi
[5]Department of Environmental and Occupational Health Faculty of Public Health. University of Medical Sciences, Ondo, Ondo state, Nigeria.
[6]Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria. Titilayo T. Kolade[7]
[8]Department of Pharmaceutical Microbiology, Faculty of Pharmacy, Olabisi Onabanjo University, Ogun State, Nigeria

Article info: Volume 15, Issue 2, June 2026; Received: May 15, 2026; Reviewed: May 23, 2026, Accepted: June 6, 2026; Published: June 15, 2026; *DOI: 10.60787/nijophasr-v14-i2-642*

ABSTRACT

***Background*:** Safe drinking water is essential for human health; however, contamination of community wells by pathogenic microorganisms remains a major public health concern in many developing countries. This work was aimed to determine the bacteriological quality of well water from some selected communities; Ikenne, Lemme and Idi-Aba in Ogun state.

Methods: Twelve well water samples collected from selected communities in Ogun State, Nigeria, were analyzed for pH and bacteriological quality using standard microbiological techniques including total viable count, Gram staining, selective culture methods, and biochemical characterization.

***Results*:** The depth of the wells ranged from 7.2 to 15.0 m, while pH values ranged from 3.5 to 13.2. Escherichia coli was isolated from all samples (100%), Klebsiella species from 75% of samples, and Pseudomonas aeruginosa from 25% of samples. Total viable bacterial counts ranged from 1.4×10^3 to 7.0×10^3 CFU/mL, exceeding WHO permissible limits for potable water.

***Conclusion*:** The presence of coliform bacteria and elevated microbial loads indicated fecal contamination of the examined wells, rendering the water unsafe for human consumption without treatment.

Keywords: Bacteriological quality, Community wells, Drinking water, Ogun State, Water contamination

1.0 INTRODUCTION

Water is one of the most important natural resources available to mankind. It is a transparent colorless liquid which falls from the sky as rain or issues from the ground as spring. The use of water to sustain living functions is cardinal for life. The many needs of water necessitate a thorough understanding of the properties that are essential for its

Corresponding author: Email:** okunyelionel@oouagoiwoye.edu.ng; **Phone: +23490 666 111 98

desired functions [1]. Water is a renewable resource that cannot be used up and the total balance of water on earth has been constant for 570 million years. A very large percentage of the large volume of available water cannot however be directly utilized; for example, water in the ocean, in glaciers, inland seas and in ice caps [2]. Safe drinking water is essential to humans and other life forms. Access to safe drinking water has improved over the last decades in almost every part of the world, but approximately one billion people still lack access to safe water and over 2.5 billion lack access to adequate sanitation. There is clear correlation between GDP per capital. However, some observers have estimated that by 2025 more than half of the world population will be facing water-based vulnerability. A recent report suggests that by 2030, in some developing countries of the world, water demand will exceed supply by 40% . All forms of life depend heavily on water. 50-90% of the weight of living organisms is water. People begin to feel thirsty after a loss of just 1% of body fluids and risks death if fluid loss nears 10%. Water usually acquires contaminants from its surroundings and those arising from humans and animals as well as other biological activities. Therefore, the earth's impurities from soil, atmosphere, and the environment are freely present in natural waters [3]. Water of good drinking quality is of basic importance to human physiology and man's continued existence depends very much on its availability. Depending on the climate, physical activity and culture, the drinking water needs of individuals vary but, for high consumers, it is estimated to be about 2 L for a 60 kg person and 1 L per day for a 10kg child. On average, a person should drink about 7 glasses of water a day. In extreme heat or physical activity, the amount should be increased [4]. Water is a critical global resource, with 1 in 4 people lacking safely managed drinking water, a figure expected to worsen due to climate change, population growth, and pollution. Macroscopic and microscopic organisms, many of which are pathogenic together with organic and inorganic materials do contaminate bodies of water with amount depending on its source [5]. Water that contains large numbers of bacteria may be perfectly safe to drink. The important consideration, from microbiological standpoint, is the kinds of microorganisms that are present. Water from streams and lakes that contain multitudes of autotrophs while pathogens may be absent. The intestinal cholera, and bacillary dysentery are of prime concern. The fact that human fecal materials is carried away by water in sewage systems that often empty into rivers and lakes present a colossal sanitary problem; thus, constant testing of municipal water supplies for the presence of fecal microorganisms is essential for the maintenance of water purity [6]. Disease-causing organisms (pathogens) transmitted via drinking water are predominantly of fecal origin (and therefore known as enteric pathogens). Since the pioneering epidemiology in the 1850's, whereby the English physician John Snow established that cholera was waterborne. Most of the pathogens that cause diarrhea and other diseases are transmitted via drinking water [7]. In Ogun state, provision of safe potable water to the public by government is rare and is restricted to urban areas. This study aimed to evaluate the bacteriological quality and physicochemical characteristics of selected community well water samples in Ogun State, Nigeria.

2.0. MATERIALS AND METHODS

2.1 Materials

2.1.1 *Biological materials*

Water samples presumably contain coliform

2.1.2. Chemicals and reagents

Water samples, Eosine Methylene Blue agar, Lactose broth, Kovacs reagent, hydrogen peroxide, crystal violet, safranin, Lugols iodine, Simon citrate salts, methyl red, absolute alcohol, oxidase reagent.

2.1.3 Equipment *and other materials*

Laboratory bench, weighing balance, colony counters, graduated flasks, beakers, cotton wool, aluminum foil, Petri-plates, inoculating loop, tripod stand, gas lighter, laminar air flow, pH meter, microscope, Duharm tube*s.*

2.2. Methods

2.2.1 Study area

Ogun State, located in Nigeria's southwestern region, is situated roughly between latitudes 6°N and 7°5'N and longitudes 3°E and 4°E. The state's administrative capital, Abeokuta. It shares borders with Lagos State to the south, Oyo and Osun to the north, Ondo to the east, and the Republic of Benin to the west.

2.2.2 Sample collection

Water samples were collected in sterile 200mL glass bottles with screw cap. The bottle cap was aseptically removed and the bottles lowered into the well. The bottle was brought up to the surface and covered with a screw cap when no air bubbles were seen inside. All bottles were immediately labeled and transported in ice to the laboratory for bacteriological analysis within six hours

2.2.3 Determination of pH

ATC Pen type handheld pH meter manufactured by ROHS was used for measuring the acidity and alkalinity of the water according to the manufacturer's specification. The pH buffer powder was prepared by emptying the phosphate buffer solution in 250mL glass beaker and 250 mL of deionized water was thereafter added, the preparation were shaken until the powder has dissolve completely, the trimmer was regulated with screwdriver until the buffer solution value correspond to the measurement temperature is obtained. The electrode section of the pH meter at room temperature was inserted in solution up to the immersion level and thereafter stirred gently and wait for the reading to stabilized and recorded and kept for further analysis of the samples.

2.2.4 Total viable bacteria count

The well water samples was agitated thoroughly in an up and down movement for each sample to obtain one in one thousand dilutions of each sample. And thereafter 1mL of the (1:1000) dilution was then inoculated into 20mL of melted and cooled dehydrated nutrient agar medium prepared as indicated by the manufacturer's adopting pour plate methods. This was allowed to solidify and then incubated in an inverted position at 37^0C for 24hours. The number discrete colonies were counted and expressed as colony forming unit per ml (CFU/mL). 1mL of sterile water in 20 mL agar was used as control. The procedures were carried out in triplicates.

2.2.5 Presumptive Coliform Test

A series of 12 tubes were grouped into three containing 4 test tubes, the first four test tubes were inoculated with 10 ml double strength lactose broth each while the second and third sets on the row were inoculated with 1.0ml and 0.1ml of single strength lactose broth respectively with Duharm tubes inserted upside down in each tubes, A volume of 1ml of water sample from different locations was inoculated to each test tube and thereafter incubated at 37^0C for 24 hrs. The preparation was observed for Duharm tubes displacement, evidence of gas production and presumptive coliform presence.

2.2.6 Differential coliform test

Plates of dehydrated Eosine Methylene Blue agar prepared according to the manufacturer's specification, sterilized by autoclaving were inoculated by pour plate method from positive (gas producing) tubes, The tubes were incubated at 37^0C and examined after 48hours. The plates were observed for distinguishable nucleated colonies with dark centers. The presence of coliform-like colonies confirms the presence of a lactose fermenting Gram negative bacterium.

2.2.7 Complete confirmatory test

A loopful from both positive and negative bottles from the presumptive test was subculture on lactose broth with Duharm tubes and a slide from the nutrient agar slides, the preparation was incubated at 37℃ for 24hours. Gas production was observed for, and a slide from the nutrient agar slides were identified by carrying out Gram staining and some relevant biochemical tests.

2.2.8 Biochemical characterization

Conventional biochemical characteristics which include indole test, methyl red test, Voge Proskauer test and citrate test and others for coliform detection was carried out on the isolates

2.3. Statistical analysis

Data were analyzed using SPSS version 33. Descriptive statistics and regression analysis were performed. Statistical significance was set at $p < 0.05$.

Nigerian Journal of Pharmaceutical and Applied Science Research,
Vol.15 (2): 92-99; June 2026 ISSN: 2971-737X (Print); ISSN: 2971-7388.
Available at www.nijophasr.net https://doi.org/10.60787/nijophasr-v15-i2-642

3. RESULTS

The pH of the well water sample analyzed ranges 3.5 to 13.2 while the depth of the analyzed well was found to be between 7.2m and 11.7m. Out of the total of 12 well water sample examined, one was found to have a neutral pH, four well water samples were found to be acidic of these four samples that were found to be acidic. The remaining 8 samples were all alkaline but to varying degrees of pH indices. The intrinsic (pH) and the extrinsic factors (depth of well) of water examined are shown below.

Table 1: Intrinsic and extrinsic factors examined (pH/Depth of well

Location	Intrinsic and extrinsic factors examined (pH/Depth of well							
	A		B		C		D	
Ikenne	4.5	11.7m	12.2	10.8m	13.2	9.9m	11.2	9m
Lemme	12.2	9m	4	9m	11.0	7.2m	13.1	8.1m
Idi aba	3.5	15m	5	12m	7	10.2m	9	8.6m

pH 13.2 (reviewer demanded for explanation resolved)

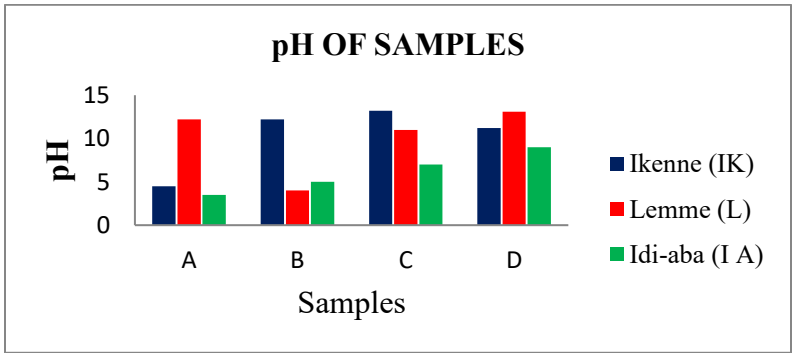

Figure 1: Intrinsic parameters (pH) of the Examined Well Water

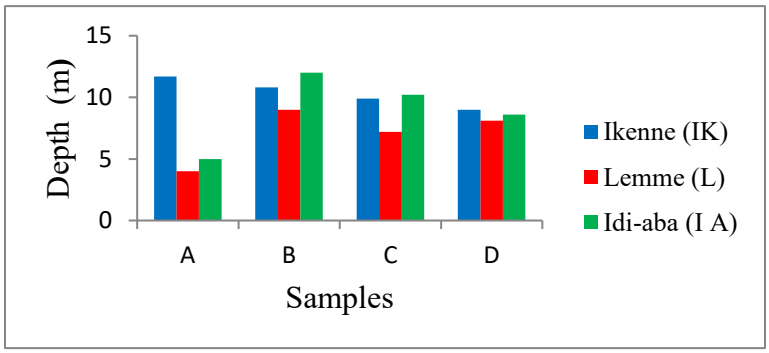

Figure 2: Extrinsic parameters (Depth) of the examined Well water

Table 2: Statistical Influence of intrinsic and Extrinsic factors examined on the level of Bacterial Contamination of well.

Intrinsic/Extrinsic Factor examined	**Coefficient (B)**	**S.E.**	**T value**	**P value**
Constant (a)	313.46	787.2	0.98	0.35
pH(x1)	290	301.8	1.03	0.04
Depth of Well (x2)	186	300.6	1.91	0.09

Model, $y = a+B_1x_1+B_2x_2$, where y = Total viable bacterial counts (cfu/ml);

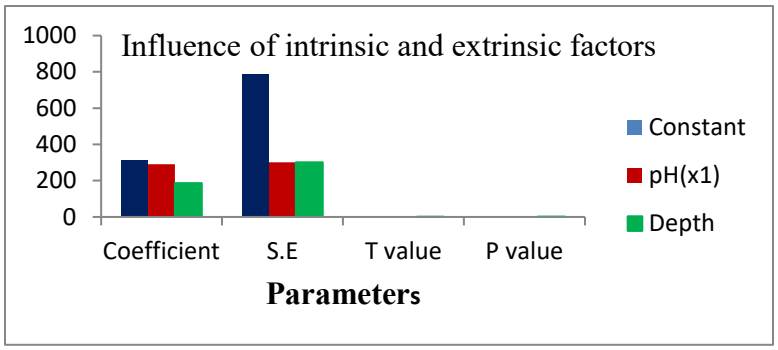

Figure 3: Influence of intrinsic and extrinsic factors

Table 3: Statistical analysis of Total viable bacteria counts

Locations						
	A	B	C	D	F value	P value
Ikenne	6.3	4.9	2.8	3.0	3.13	<0.05
Lemme	2.5	7.0	3.3	2.0	18.10	<0.05
Idi aba	5.0	1.4	6.5	5.5	1.83	>0.05
F value	2.16	5.16	9.3	3.3		
P value	<0.05	<0.05	<0.05	<0.05		

The total viable count that ranged from 1.4×10^3 to 7.0×10^3 CFU/mL as reflected in Idi-aba and Lemme exceeded WHO guideline for safe drinking water.

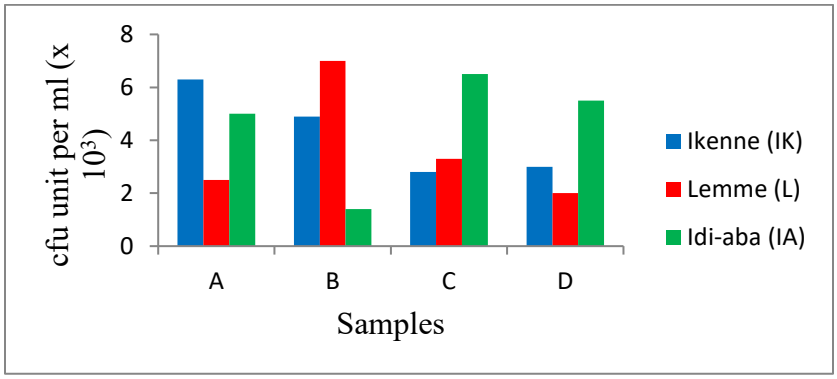

Figure 4: Total viable bacteria count

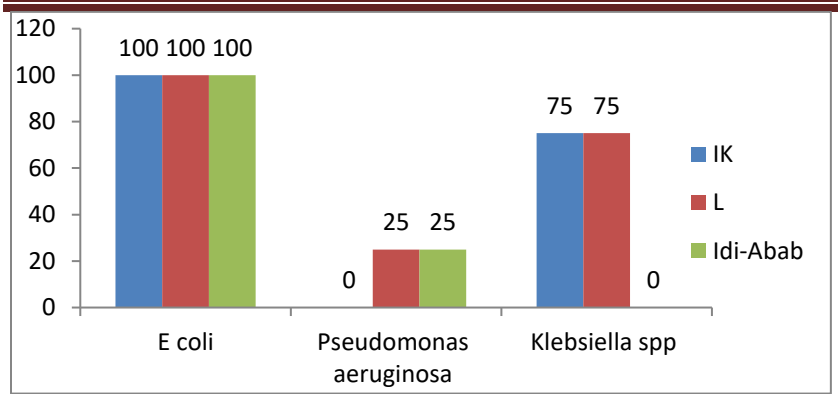

Figure 5: Distribution of Bacterial Isolates in the Examined Water Samples.

4.0 DISCUSSION

Transmission of diseases through consumption of faecally contaminated waters particularly in developing and under-developing countries has long been identified and documented. In Ogun state, provision of safe portable water to the public by government is rare and is restricted to urban areas mainly inhabited by the socioeconomic class of population. The low socio-economic class which forms the majority of the population cannot afford the exorbitant cost of digging boreholes. Sequel to the indispensability of water to human existence, most households are left with no other alternative than to dig wells as source of drinking water and for other uses [8]. This research examined well water for bacterial pathogens from three different locations. The pH of the well water sample analyzed ranges 3.5 to 13.2 which disagrees with the acceptable standard pH range of 6.5 to 8.5 as stated in EPA (2011). The pH of 13.2 obtained seems questionable, this may be attributed to gradual leaching of inner well casing or contamination from surrounding environment. The acidic and alkaline values dictate the types of microbes that survive and metabolic activities of these microbes released into water could be detrimental to human health. Of the total of 12 well water samples examined, one was found to have a neutral pH, four were found to be acidic while remaining 8 samples were all alkaline but to varying degrees of pH indices. The pH values outside the recommended range can indirectly affect human health also by acting as secondary contaminants in water. The fact that most of the well water samples were found to be alkaline might have also contributed to the widespread occurrence of the organisms in the sample because alkaline pH represent a good condition for many bacterial growth, which corroborates the study of Horikoshi et.al.,(2025) on alkaphiles; some applications of their products for biotechnology [9]. The depth of a well is a critical factor in its vulnerability to contamination, with shallower wells generally at higher risk of bacterial and agricultural pollution while deeper wells often face challenges with natural mineral of chemical contaminants. The depth of the analyzed well was found to be between 7.2m and 11.7m, the result of the p-value analysis showed that the depth of the wells examined does not significantly influence the number of organisms, which contradict standard specification of EPP well solutions-an international deeper well drillers on the connection between well depth and water quality. Generally, well less than 50-100 feet deep are more susceptible to surface contaminants, whereas well deeper than 100-150 feet often tap into protected confined aquifers. Other factors such as environmental conditions or kinds of fetchers used would have led to contamination of the wells irrespective of the depth [10]. The total viable count of water samples is an important bacteriological determinant of quality water. The total viable counts of the well water samples examined ranged from 7 and 1.4 from Lemme and Idi-Aba as shown in Table 3 the level of significance of the water samples studied. The was expressed in [10^3] exceeded 100 – 500 CFU/mL for potable water standardized by WHO guideline for drinking water quality. The quantity of the bacteria present could be attributed to the quality of water while the source of contamination could be attributed to poor hygiene and activities around the environment which agrees with the study of Martin and Stephen (2016) Health concerns of heterotrophic plate count (HPC) bacteria in dental equipment water lines [11], and hence sequel to the outcome of this results of total viable counts from this study, the water is unsafe for human consumption. Traditional indicators of fecal contaminants (coliform, *Escherichia coli*) do not always correlate with the presence of other waterborne pathogens, meaning water can test safe but still hazardous and also, failure to detect injured bacteria that unable to form colonies on selective media can results in underestimation of contamination. Government should prioritize its policy on provision of safe portable water to the public and also, public health education should be intensified in improving and protecting the quality of drinking water sources.

5. CONCLUSION

The study revealed significant bacteriological contamination of community well water samples in selected areas of Ogun State. The presence of *Escherichia coli*, *Klebsiella* species, and *Pseudomonas aeruginosa* above WHO permissible limits indicates poor microbiological quality and possible fecal contamination. Regular monitoring, improved sanitation practices, and provision of safe potable water are strongly recommended.

DECLARATIONS

Acknowledgements

The authors acknowledge the contributions of the laboratory technologists in the Department of Pharmaceutical Microbiology and Biotechnology, University of Ibadan, Nigeria"

Funding: This research was funded by the authors.

Conflict of Interest: The authors declare no conflict of interest.

Authors Contributions

OLO: Conceptualization, design, data analysis, manuscript drafting
Others: Laboratory analysis, data collection, manuscript review
.

Ethical Approval:

Ethical approval was not required for this study because no human or animal subjects were involved.

6. REFERENCES

[1] NAFDAC, "Consumer Safety Bulletin," National Agency for Food and Drug Administration and Control, Abuja, 2013, p. 7. https://www.scirp.org/reference

[2] Udoma E. Mendie The Theory and Practice of Clean Water Production for Domestic and Industrial Use 2012; pp 3-7 Lacto-Medals Publishers ISBN 978-978-929-454-1

[3] Gerba, C.P., Rose, J.B., International guidelines for water recycling: microbiological considerations. Water Sci. Tech. Water. Supply 2003; 3 (4), 311–316.

[4] Oloyede, SO, Oluwafemi Idowu, Olabisi, Overvaluations of Water Quality with World Health Organization and Nigeria Industrial Standards Using Geographic Information System WSN 2015; 24: 18-42

[5] National Academies of Sciences, Engineering, and Medicine. Indicators for Waterborne Pathogens. Washington, DC: The National Academies Press.2004; pp17 https://doi.org/10.17226/11010

[6] Harold J. Benson Microbiological applications Laboratory manual in general microbiology 8th edition. ISBN 0-07-231888-0 international edition www.mhhe.com. IWA Publishing, London (Chapter 13), 2003; pp. 289–315

[7] Ashbolt, N.J. Methods to identify and enumerate frank and opportunistic bacterial pathogens in water and biofilms. In: Bartram, J., Cotruvo, J., Exner, M., Fricker, C., Glasmacher, A. (Eds.), Heterotrophic Plate Counts and Drinking-water Safety. The Significance of HPCs for Water Quality and Human Health, IWA Publishing, London.2003; (Chapter 9), pp. 146–176. Ashbolt,

[8] Water quality surveys : a guide for the collection and interpretation of water quality data
By IHD-WHO Working Group on Quality of Water Internet Archive (2020);PP71 -91 ISBN 9789231014734 urn:oclc:record:812129673

[9] Horikoshi K. Alkaliphiles: some applications of their products for biotechnology. Microbiol Mol Biol Rev. 1999;63(4):735-750.

[10] EppWell Solutions. The connection between well depth and water quality [Internet]. 2025 [cited 2026 May 10]. Available from: https://eppwellsolutions.com

[11] Martin JA, Stephen Edberg Health concerns of heterotrophic plate count (HPC) bacteria in dental equipment water lines American Journal of Dentistry 2016; 29(3):137-138