JOURNAL OF BASIC AND APPLIED SCIENCES

# Bacteriological Quality Assessment of Drinking water in Amassoma Community, Bayelsa State, Nigeria.

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ARTICLE INFORMATION

*Original Article*

Received: January 13,2026
Received: May 27,2026
Accepted: June 1,2026
Published online:

**Citation:** To be added by editorial staff during production.

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***Abstract***

*The study was conducted to assess the quality of drinking water sources in the Amassoma community to determine if there are any safe options for drinking. The availability and quality of drinking water are crucial human rights concerns. The findings show that wells, rivers, and tap water are all heavily contaminated with bacteria. Total coliform concentration (TCC) ranged from 5.1 × $10^1$ CFU/mL in the River Up Water to 4.45 × $10^2$ CFU/mL in Tap 2, which is way above the WHO's safe limit of zero coliform bacteria per 100 ml of drinking water. The well water showed moderate contamination levels, with TCCs between 6.8 × $10^1$ and 9.3 × $10^1$ CFU/mL. Tap water sources, on the other hand, were significantly contaminated. Several microorganisms were identified from the collected samples, including Escherichia coli, Klebsiella pneumoniae, Proteus vulgaris, Enterobacter aerogenes, and Vibrio cholerae, the latter being responsible for cholera infections. The presence of E. coli and other coliforms indicates fecal contamination, while the detection of V. cholerae in the river raises the alarm for a potential cholera outbreak among residents. These findings are in line with previous research conducted on water source contamination in Bayelsa State and across Nigeria, which has found high levels of bacteria in water supplies. The health risks linked to these findings include the possibility of cholera, typhoid fever, and other waterborne illnesses, especially during the rainy season when flooding increases. To mitigate these issues, interventions like point-of-use water treatment methods (such as boiling, chlorination, and filtration) and improvements in sanitation infrastructure were recommended. In conclusion, the bacteriological quality of Amassoma's water sources poses a serious risk to the health of its residents.*

**Keywords: Amassoma; water; Coliform; and *Vibrio cholerae*.**

## 1. Introduction

Access to safe and clean drinking water is something that everyone should have, and it's a crucial part of public health. The World Health Organization (WHO) estimates that over two billion people around the world rely on contaminated drinking water, leading to roughly 485,000 deaths each year from diarrhea-related illnesses caused by unsafe water (WHO, 2022). This issue is especially prevalent in many developing countries like Nigeria, particularly where there's inadequate water supply infrastructure, sanitation, and hygiene education. Cholera is one of the most serious and frequent water-borne diseases found in these regions.

If there are harmful bacteria present in drinking water, it's a clear sign that it is contaminated, which can create immediate public health risks. Some of these pathogens, like fecal coliforms, *Escherichia coli*, and *Vibrio cholerae,* are used as indicators to evaluate the safety of the water. Total coliforms help indicate water quality, but fecal coliforms and *E. coli* specifically point to fecal contamination, hinting that the water could be home to harmful microorganisms (Edberg et al., 2000). Finding *Vibrio cholerae* in water samples is particularly alarming because it signals a serious public health threat; without proper water purification and sanitation practices, cholera can easily spread.

Cholera is still a problem in Nigeria today. The Nigeria Centre for Disease Control (NCDC) reported that in 2025, there were over 1,149 suspected cases of cholera, with 28 confirmed deaths in 25 states. Notably, Bayelsa had around 763 suspected cases. A lot of these outbreaks happen in communities that rely on open wells, rivers, and poorly built boreholes for their drinking water. Unfortunately, many of these water sources have poor bacteriological quality because they lack proper purification systems and waste disposal.

The study is aimed at evaluating the bacteriological quality of drinking water in Amassoma Community with the following objectives:

1. Isolate and identify the presence of *Vibrio cholerae* in water samples.
2. Determine the level of coliform contamination in drinking water samples.

**MATERIALS AND METHODS**

**Study Area**: Amassoma is one of the biggest river communities in Nigeria, situated on Wilberforce Island in the Ogboin North Local Government Area, which is part of Southern Ijaw in Bayelsa State. It's roughly 40 kilometers south of Yenagoa, the capital of Bayelsa, and is near the River Nun and Niger Delta University, as well as Bayelsa State Airport. The community has an estimated population of about 6,970, with coordinates at 4° 58' 13" N and 6° 6' 32" E (CDC, 2020).

**Sample Size**: Six water samples were collected from various spots in the Amassoma community; specifically, two wells, two taps, and two rivers (upstream and downstream), ensuring no duplications were made.

**ISOLATION OF VIBRIO CHOLERAE FROM WATER SAMPLES:**

Alkaline Peptone Water Preparation: Alkaline Peptone Water (APW) is an enrichment culture medium designed to create conditions that favor the growth of *Vibrio cholerae*. To prepare 1 liter of APW: 10 grams of peptone, 10 grams of sodium chloride, 1 gram of disodium phosphate, and 1,000 milliliters of distilled water were utilized. Preparation was done by dissolving 10 grams each of peptone and sodium chloride in 900 milliliters of distilled water. Afterwards, it was dissolved in the disodium phosphate and the pH was adjusted to between 8.0 and 8.5 using NaOH. Lastly, the total volume was made up to 1,000 milliliters with distilled water and the mixture was sterilized in an autoclave at 121°C for 15 minutes.

Preparation of Media for Thiosulfate Citrate Bile Salts: The Thiosulfate Citrate Bile Salts Sucrose (TCBS) agar serves as both a selective and differential medium for isolating *Vibrio cholerae*. The recipe for one liter includes: 20 grams of protease peptone, 20 grams of sodium thiosulfate, 10 grams of sodium citrate, 3 grams of bile salts, 50 grams of sucrose, 0.040 grams of bromothymol blue, 0.040 grams of thymol blue, 15 grams of agar, and 1,000 milliliters of distilled water. To make the medium, all the ingredients were dissolved in 900 milliliters of distilled water, excluding the agar. After that, the agar was added and the solution was boiled to dissolve it. The mixture was sterilized by autoclaving at 121°C for 15 minutes, then allowed to cool to about 50°C before pouring it into sterile petri dishes.

Enrichment Stage: 10ml of each water sample was inoculated into peptone water with a pH of 8.5. The cultures were incubated at 37°C for about 6 to 8 hours.

Selective Plating: A loopful of the enriched culture was streaked onto TCBS agar. This was then incubated at 37°C for 18 to 24 hours. It was observed that the *Vibrio cholerae* colonies appeared yellowish and round because of sucrose fermentation.

Biochemical Test for Identification: The suspected bacterial colonies were streaked onto nutrient agar and stained using Gram stain, along with several other biochemical tests, including Oxidase, Triple Sugar Iron, Motility, Indole, Urease, and Citrate tests. *Vibrio cholerae* was identified as Gram-negative curved rods.

Serological Confirmation: Slide agglutination test was conducted using polyclonal antisera for *V. cholerae* serogroups O1 and O139 to confirm the pathogenic strains (Kaper et al., 1995).

**DETECTION OF TOTAL COLIFORM IN WATER SAMPLES**:

To measure the most probable number (MPN) of total coliforms and *Escherichia coli* in water samples, Multiple Tube Fermentation (MTF) was used.

Presumptive Test: 10 ml, 1 ml, and 0.1 ml of the water samples was inoculated into lactose broth in sets with Durham tubes. These tubes were then incubated at 37°C for 24 to 48 hours. The presence of gas production and acidification in the tubes indicated the existence of presumptive coliforms.

Positive Confirmation Test: The suspected sample was streaked onto Eosin Methylene Blue (EMB) medium. This was incubated for 24 hours at 37°C. The appearance of colonies with a green metallic sheen confirmed the presence of *E. coli*.

Completion of the Test: The suspected colonies were then grown on nutrient agar slants for further tests like Gram staining and others (such as indole and citrate tests). Positive results were observed for *E. coli*, identifying them as Gram-negative rods, indole positive, and citrate negative.

**RESULTS AND DISCUSSION**

Table 4.1 reveals that well water from wells 1 and 2, as well as tap water 1 and 2, showed no signs of Cholera species. Instead, other types of enteric bacteria like *Escherichia coli* and *Enterobacter aerogenes* were observed instead, which suggests this water sources have been contaminated with fecal matter. On the other hand, both upstream and downstream river sources tested positive for *Vibrio cholerae*, pointing to fecal contamination and indicating the potential presence of cholera.

**Table 1: *Vibrio cholerae* and other Bacteria Isolates from various water samples**

| Water Sources | Micro-organisms |
|---|---|
| Well Water 1 and 2 | *Escherichia coli*, *Klebsiella pneumoniae* |
| Well Water 1 and 2 | *Escherichia coli*, *Proteus vulgaris*, *Vibrio cholerae* |
| Tap 1 and 2 Water | *Enterobacter aerogenes* |

The data in Table 2 showed that the total viable count for well water at dilution factors of $10^{-6}$ and $10^{-7}$ ranged from about 45 to 68 ($\times 10^1$). For the river samples, both upstream and downstream counts went from 10.9 to 76 ($\times 10^1$), while tap waters 1 and 2 had counts between 267 and 185 (CFU/ML). When we looked at total coliform counts, well water samples 1 and 2 ranged from 68 to 93 ($\times 10^1$); upstream and downstream counts were between 51 and 87 ($\times 10^1$), and for tap waters 1 and 2, the total coliform counts ranged from 84 to 445 (cfu/ml). Overall, these results suggest that the drinking water sources in the Amassoma community are contaminated with fecal coliforms, making them unsafe for consumption.

**Table 2: Determination of Coliform levels in Drinking Water Samples**

| Water Source | Dilution Factor | Total Viable Count (CFU/plate) | Total Coliform Count (CFU/mL) |
|---|---|---|---|
| Well 1 Water | $10^{-6}$ | $4.5 \times 10^1$ | $6.8 \times 10^1$ |
| Well 2 Water | $10^{-7}$ | $6.8 \times 10^1$ | $9.3 \times 10^1$ |
| River Upstream | $10^{-6}$ | $1.09 \times 10^1$ | $5.1 \times 10^1$ |
| River Upstream | $10^{-7}$ | $7.6 \times 10^1$ | $8.7 \times 10^1$ |
| Tap 1 Water | $10^{-6}$ | $2.67 \times 10^2$ | $8.4 \times 10^1$ |
| Tap 2 water | $10^{-7}$ | $1.85 \times 10^2$ | $4.45 \times 10^2$ |

**DISCUSSION**

In Wells 1 and 2, the total coliform counts were measured at $6.8 \times 10^1$ CFU/mL and $9.3 \times 10^1$ CFU/mL, respectively. This total includes bacteria like *E. coli* and *K. pneumoniae*, with *E. coli* being a key marker for fecal contamination, a situation that can be common in rural areas where wells are not covered. As Edberg et al. (2000) noted, fecal matter from latrine sites can end up in surface water and contaminate wells. Similarly, the presence of *K. pneumoniae* also suggests fecal contamination. This finding aligns with the results from Eze et al. (2020) in Nigeria.

Bacteriological tests from River Up and River Down showed total coliform counts of $5.1 \times 10^1$ CFU/mL and $8.7 \times 10^1$ CFU/mL, respectively. Besides *E. coli,* P. vulgaris and *V. cholerae* were observed in the river water. The presence of *V. cholerae* is quite concerning because these bacteria can thrive in rivers by attaching to plankton and sediment. Meanwhile, *Proteus vulgaris* indicates that the water sources are likely contaminated by feces, stemming from both human and animal waste. This mirrors findings from research in southern Nigeria, where locals rely on these rivers for washing and fishing (Oloruntoba et al., 2014).

For the tap water samples, tap 1 showed a total coliform count of $8.4 \times 10^1$ CFU/mL while tap 2 had a higher count of $4.45 \times 10^2$ CFU/mL Tap water was less expected to be contaminated since it comes from treated sources. However, issues like leaking pipes, irregular water supply, and poor sanitary conditions, especially the presence of *Enterobacter aerogenes*, could lead to contamination. The significantly higher contamination level in tap water 2 really highlights potential risks.

A major finding from this research was identifying the *V. cholerae* species in the Amassoma river water. This bacterium causes cholera, a disease that leads to severe diarrhea and dehydration, which can be fatal. Nigeria has ongoing challenges with cholera, with frequent outbreaks occurring in Bayelsa State and other parts of the Niger Delta (WHO, 2019). Water sources in Nigeria have been found to harbor toxigenic *V. cholerae* O1 strains that carry virulence factors like ctxA and tcpA, contributing to epidemic outbreaks of this disease (Marin et al., 2023). It's important to recognize that the low infectious doses of *V. cholerae* put people at greater risk, especially those who do not produce enough stomach acid and are malnourished (Nelson et al., 2009). Drinking untreated water from rivers can leave the local population open to various infections. The World Health Organization states that there should be no *E. coli* in 100 ml of drinking water, which is a standard used when testing water in Nigeria (WHO, 2022). Unfortunately, the contamination levels in Amassoma far exceed those standards, creating a serious risk for individuals due to the absence of water treatment. In 2024, tests revealed thermotolerant coliforms and *E. coli* in water from hand-dug wells and surface sources in Sagbama Town, surpassing WHO/NSDWQ standards. This situation is largely due to inadequate sanitation and waste management practices in Amassoma (Enetimi et al. 2020).

These findings echo earlier research conducted in other communities, showing that the proximity of latrines, use of shallow wells, and poor storage facilities contribute to ongoing contamination issues. The detection of *V. cholerae* in water samples from the Amassoma River adds to the severity of the situation, especially considering the cholera outbreak currently affecting Nigeria. According to the Nigeria Centre for Disease Control and Prevention, Bayelsa State reported 50% of cholera cases as of June 2, 2024, including the Southern Ijaw LGA where Amassoma is located (NCDC, 2024). Cholera is more likely to spread in areas lacking proper water, sanitation, and hygiene (WASH) infrastructure, with recent reports highlighting cases in 2024 mainly from the southern regions like Bayelsa and other urban areas (Eneh et al. 2024). Marin et al. (2023) also pointed out that environmental surveillance in Nigeria from 2008 to 2015 showed a high prevalence of toxigenic *V. cholerae* isolates. Clearly, Amassoma is one of many areas facing contaminated water issues in cholera-prone regions.

Ultimately, the presence of enteric bacteria alongside *V. cholerae* suggests serious health risks for Amassoma's population. These risks include bacterial diseases like *E. coli* causing diarrhea, *K. pneumoniae* linked to urinary tract infections, and *Enterobacter* leading to septicemia. With *V. cholerae present,* the potential for an epidemic is concerning.

Contamination might not just be happening at the source but could also occur through the water distribution system or how it is stored at home. Overall, the situation in Amassoma aligns with current observations in Bayelsa/Niger Delta and reflects the national cholera risk factors noted in 2024. Immediate actions are essential to ensure safe water practices in the interim; like boiling water, using narrow-mouth covered containers, and keeping water sources away from latrines and flood zones. Medium-term strategies should include sanitary surveys, well-head protection, community chlorination, and microbial testing to meet WHO/NSDWQ guidelines for zero tolerance of *E. coli* (WHO, 2022).

## CONCLUSION AND RECOMMENDATION

### Conclusion

The findings from the research showed that the drinking water quality in the Amassoma community is not up to par and poses health risks across all the sources examined. Each type of drinking water was tested; like well water, tap water, and river water, showed harmful levels of faecal indicator bacteria. This clearly highlights the urgent need for safe water access. There is a pressing demand for effective water treatment solutions, ongoing monitoring, and improvements in sanitation practices.

Recommendations

In light of these findings, here are some important steps that need to be taken:

Point-of-Use Water Disinfection: We should encourage practices like boiling, chlorination, and filtering water at the point of use. Chlorination, in particular, has proven to effectively kill off *V. cholerae*.

Sanitation Upgrades: It's crucial to work on reducing open defecation and improving sewage management to prevent contamination of both surface and underground water sources.

Environmental Surveillance: Regular monitoring for coliforms and harmful organisms, like *V. cholerae*, needs to be established to catch any outbreaks early on.

Municipal Water Supply System Overhaul: Given the contamination in tap water, there is urgent need to fix pipeline leaks and enhance municipal water processing systems.

Public Awareness Campaigns: Launching educational programs on proper water management can help reduce secondary contamination at home.

**Patents:** *The research has not resulted in any patent application*

**Supplementary Materials**: *Supplementary materials are available from the corresponding author upon request.*

**Author Contributions**: *Abstract, E.R.T, A.E, and O.B.O.N; Introduction, E.R.T, A.E; Analysis, E.R.T, A.E, and O.B.O.N; Investigation, E.R.T, A.E and O.B.O.N; Result Interpretation, E.R.T, A.E and O.B.O.N; Funding, A.E and O.B.O.N.*

**Funding:** This research received no external funding.

**Data Availability Statement**: The data presented in this study are available on request from the corresponding author.

**Acknowledgement:** *We wish to sincerely appreciate our colleague Mrs. Alice Manda, the Laboratory Technologist who greatly supported during the analysis.*

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

**Nomenclature**: *Not applicable*

**Appendix**: *Not applicable*

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