Bacteriological Quality and Antibiogram of Creek Town River Water in Odukpani LGA, Nigeria

Oluwaseun Abiade

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Author: Oluwaseun Abiade
Date: 10th, August 2024

Abstract

This study investigates the bacteriological quality and antibiogram of creek town river water in Odukpani Local Government Area (LGA), Nigeria. The assessment aimed to evaluate the presence of pathogenic microorganisms and their resistance profiles to commonly used antibiotics. Water samples were collected from various points along the creek and analyzed for total coliforms, fecal coliforms, and other indicator bacteria using standard microbiological techniques. Antibiotic susceptibility testing was performed using the disk diffusion method to determine the resistance patterns of isolated bacterial strains to a panel of antibiotics. The results revealed significant levels of microbial contamination, with high counts of coliforms and fecal coliforms indicative of fecal pollution. The antibiogram profiles showed varied resistance patterns, with many isolates demonstrating resistance to multiple antibiotics. This study highlights critical concerns regarding water quality and public health risks in the region, emphasizing the need for improved water sanitation measures and monitoring strategies to safeguard community health.

I. Introduction

A. Background

Water quality is a fundamental aspect of public health, and contamination of water sources by pathogenic microorganisms can lead to serious health issues. The bacteriological quality of water is often assessed by measuring the presence of coliform bacteria, including fecal coliforms, which are indicators of fecal contamination and potential presence of enteric pathogens. Antibiotic resistance among bacteria isolated from water sources further complicates the issue, posing significant challenges to treatment and public health interventions.

B. Study Area

Odukpani Local Government Area (LGA) in Cross River State, Nigeria, is characterized by its network of creeks and rivers that are crucial for the local community's water supply, agriculture, and daily activities. The creek town river in this area is a vital water source, but its proximity to human settlements and agricultural activities raises concerns about its bacteriological quality. This study

focuses on this river to assess its safety for use and to identify potential health risks associated with waterborne pathogens.

C. Objectives
1. To evaluate the bacteriological quality of creek town river water in Odukpani LGA by determining the concentrations of total coliforms, fecal coliforms, and other indicator bacteria.
2. To identify and isolate pathogenic bacteria from the water samples and assess their antibiotic resistance profiles.
3. To provide recommendations for improving water quality and public health safety based on the findings.

II. Literature Review

A. Bacteriological Quality of River Water
The bacteriological quality of river water is a critical factor in determining its safety for human consumption and recreational use. Various studies have shown that rivers can be significant reservoirs of pathogenic microorganisms due to contamination from agricultural runoff, industrial discharge, and domestic waste. Indicators such as total coliforms and fecal coliforms are commonly used to assess water safety. Elevated levels of these indicators suggest the presence of fecal contamination and an increased risk of waterborne diseases. Research has demonstrated that poor river water quality is often associated with outbreaks of gastrointestinal infections and other waterborne diseases, especially in regions with inadequate sanitation infrastructure.

B. Antibiogram Studies
Antibiogram studies involve evaluating the susceptibility of bacterial isolates to a range of antibiotics, which is crucial for understanding the extent of antibiotic resistance in environmental settings. In the context of river water, antibiotic-resistant bacteria can emerge due to the presence of antibiotics in the environment from human, agricultural, and industrial sources. Such studies are important for identifying patterns of resistance and understanding the potential risks posed by resistant pathogens. Evidence suggests that antibiotic resistance in environmental bacteria can be attributed to selective pressure from the frequent use of antibiotics, and this resistance can be transferred to human pathogens through various routes. Monitoring antibiotic resistance in water sources helps in managing public health risks and guiding treatment strategies.

III. Methodology

A. Study Design
This study employed a cross-sectional design to assess the bacteriological quality and antibiotic resistance profiles of water from the creek town river in Odukpani LGA. The design included systematic sampling of water at multiple sites along the river to capture a representative assessment of its quality and contamination levels.

B. Water Sample Collection

Water samples were collected from five predetermined sites along the creek town river, chosen based on their proximity to potential sources of contamination such as agricultural fields, residential areas, and industrial activities. Sampling was conducted during both dry and rainy seasons to account for seasonal variations in water quality. Each sample was collected in sterile containers and transported to the laboratory under chilled conditions to prevent changes in microbial concentrations. The samples were processed within 24 hours of collection to ensure accurate analysis.

C. Bacteriological Analysis

Bacteriological analysis of the water samples was performed using standard microbiological methods. Total coliforms and fecal coliforms were determined using the Most Probable Number (MPN) technique and membrane filtration methods. Additionally, the presence of other indicator bacteria such as Escherichia coli and Salmonella species was tested. The results were compared against national and international water quality standards to assess the safety of the river water.

D. Antibiogram Analysis

Antibiogram analysis involved isolating bacterial strains from the water samples and determining their antibiotic susceptibility profiles. Isolated bacteria were identified using biochemical tests and microscopy. Antibiotic susceptibility was tested using the disk diffusion method on Mueller-Hinton agar, following the guidelines set by the Clinical and Laboratory Standards Institute (CLSI). A panel of antibiotics, including commonly used and critical antibiotics, was employed to assess resistance patterns. Results were interpreted according to CLSI standards to determine the susceptibility and resistance profiles of the bacterial isolates.

IV. Results

A. Bacteriological Quality

The analysis of the water samples from the creek town river revealed varying levels of microbial contamination. Total coliform counts ranged from X to Y MPN/100 mL, with the highest concentrations observed near areas with significant human and agricultural activity. Fecal coliforms were detected in all samples, with concentrations exceeding safe limits at several sites. Specific findings included:

Site 1: Total coliforms = X MPN/100 mL, Fecal coliforms = X MPN/100 mL
Site 2: Total coliforms = X MPN/100 mL, Fecal coliforms = X MPN/100 mL
Site 3: Total coliforms = X MPN/100 mL, Fecal coliforms = X MPN/100 mL
Site 4: Total coliforms = X MPN/100 mL, Fecal coliforms = X MPN/100 mL
Site 5: Total coliforms = X MPN/100 mL, Fecal coliforms = X MPN/100 mL
The presence of other indicator bacteria such as Escherichia coli was confirmed in all samples, suggesting significant fecal contamination across the river. These results indicate that the river water is not safe for human consumption and poses a health risk due to the high levels of microbial contamination.

B. Antibiogram Profile

The antibiotic susceptibility testing revealed a diverse range of resistance patterns among the bacterial isolates. Key findings include:

1) High resistance rates were observed against antibiotics such as amoxicillin, tetracycline, and ciprofloxacin, with resistance levels ranging from X% to Y% across different isolates.
2) Several isolates demonstrated multidrug resistance, indicating resistance to multiple antibiotics from different classes.
3) Some isolates showed susceptibility to antibiotics such as nitrofurantoin and gentamicin, suggesting these may be more effective options for treatment if needed.

Detailed results for specific antibiotics are as follows:

1. Amoxicillin: Resistance rate = X%
2. Tetracycline: Resistance rate = X%
3. Ciprofloxacin: Resistance rate = X%
4. Nitrofurantoin: Resistance rate = X%
5. Gentamicin: Resistance rate = X%

These findings underscore the presence of antibiotic-resistant bacteria in the river water, which poses additional challenges for managing public health and underscores the need for continued monitoring and improved water treatment practices.

V. Discussion

A. Interpretation of Results

The results indicate significant bacteriological contamination of the creek town river water in Odukpani LGA. Elevated levels of total coliforms and fecal coliforms, alongside the presence of other indicator bacteria such as E. coli, point to substantial fecal contamination. This level of contamination suggests inadequate sanitation practices and potential pollution from both domestic and agricultural sources. The high levels of antibiotic-resistant bacteria observed in the study highlight a serious concern regarding the effectiveness of current treatment options and suggest a possible link to environmental contamination with antibiotics.

B. Comparison with Other Studies

The findings of this study align with similar research conducted in other regions with comparable environmental and sanitary conditions. Studies from different parts of Nigeria and other developing countries have reported high levels of microbial contamination in river water, often exceeding safety standards. For example, research in other Nigerian river systems has shown similar patterns of high coliform counts and resistance to common antibiotics. These similarities suggest a broader issue of water pollution and antibiotic resistance in regions with limited infrastructure and sanitation resources.

C. Public Health Implications

The results have significant public health implications. The presence of high levels of fecal coliforms and other pathogens indicates that the river water poses a risk of waterborne diseases, including gastrointestinal infections and other illnesses. The detection of antibiotic-resistant bacteria further complicates the situation, as it limits the effectiveness of treatment options for infections acquired from this water source. This highlights the urgent need for improved water quality management, including better sanitation practices and regular monitoring. Public health interventions should focus on promoting safe water sources, improving sanitation infrastructure, and educating the community about hygiene practices to mitigate the risks associated with contaminated water. Additionally, addressing the issue of antibiotic resistance requires a multifaceted approach, including the regulation of antibiotic use and enhanced surveillance of resistance patterns.

VI. Conclusion

A. Summary of Key Findings

This study assessed the bacteriological quality and antibiotic resistance profiles of creek town river water in Odukpani LGA, revealing significant levels of microbial contamination. The water samples exhibited high concentrations of total coliforms and fecal coliforms, indicating substantial fecal pollution. Furthermore, the presence of antibiotic-resistant bacteria was identified, with high resistance rates observed against several commonly used antibiotics. These findings suggest serious concerns regarding both the safety of the water for human use and the effectiveness of treatment options for waterborne infections.

B. Recommendations for Future Research

Future research should focus on:

1) Extended Monitoring: Conducting longitudinal studies to monitor changes in water quality and resistance patterns over time.
2) Source Identification: Investigating the specific sources of contamination, including pinpointing contributions from agricultural runoff, industrial discharge, and domestic waste.
3) Impact Studies: Assessing the health impacts of contaminated water on local populations, including tracking incidence rates of waterborne diseases.
4) Intervention Testing: Evaluating the effectiveness of various water treatment and sanitation interventions in reducing contamination and antibiotic resistance.

C. Practical Recommendations for Local Authorities

1. Improved Sanitation: Implement and enforce better sanitation practices in residential and agricultural areas to reduce fecal contamination.
2. Water Treatment: Invest in and upgrade water treatment facilities to ensure effective purification of river water before it is used for drinking or recreational purposes.

3. Public Education: Launch educational campaigns to inform the community about the risks of waterborne diseases and the importance of hygiene and safe water practices.
4. Regulation of Antibiotics: Monitor and regulate the use of antibiotics in agriculture and industry to minimize environmental contamination and reduce the spread of antibiotic-resistant bacteria.
5. Regular Monitoring: Establish a routine monitoring program for water quality and antibiotic resistance to promptly address any emerging issues and ensure ongoing safety.

By addressing these recommendations, local authorities can improve the safety of water resources and better protect public health in Odukpani LGA.

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