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№ 14389

Assessment of Bacterial Contamination and Antibiogram in Creek Town River, Cross River State

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August 10, 2024

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Date: 10th, August 2024

Abstract

This study assesses bacterial contamination and antibiotic resistance profiles in Creek Town River, Cross River State, aiming to evaluate water quality and public health risks. Water samples were collected from multiple sites along the river over a period of three months. Standard microbiological techniques were employed to isolate and identify bacterial pathogens. The assessment revealed significant levels of contamination, with bacteria such as E. coli, Salmonella, and Pseudomonas aeruginosa detected. Antibiotic susceptibility testing using the disk diffusion method showed varying resistance patterns, with many isolates exhibiting resistance to commonly used antibiotics including amoxicillin and ciprofloxacin. The findings highlight a critical need for improved waste management practices and regular monitoring to mitigate health risks associated with waterborne bacterial infections. This study provides valuable insights into the current state of water quality in Creek Town River and underscores the importance of addressing environmental pollution to safeguard public health.

I. Introduction

A. Background

Creek Town River, located in Cross River State, Nigeria, is an essential water source for local communities, supporting both domestic and agricultural activities. However, rapid urbanization and inadequate waste management systems have led to increased pollution levels, raising concerns about water quality and public health. Previous studies have documented the presence of bacterial contaminants in various water bodies in the region, but comprehensive analyses focusing specifically on Creek Town River are limited. Understanding the extent of bacterial contamination and their antibiotic resistance profiles is crucial for evaluating the safety of water and implementing effective mitigation strategies.

B. Objectives

1. To assess the levels of bacterial contamination in Creek Town River by isolating and identifying prevalent bacterial species.
2. To evaluate the antibiotic resistance profiles of these bacterial isolates using standard susceptibility testing methods.

3. To analyze the potential public health risks associated with the identified bacterial contamination and resistance patterns.
4. To provide recommendations for improving water quality and reducing the risk of waterborne diseases in the study area.

C. Significance of the Study

This study offers critical insights into the current state of water quality in Creek Town River, an important water source in Cross River State. By identifying and characterizing bacterial contaminants and their resistance to antibiotics, the research highlights potential risks to public health and the environment. The findings will inform local authorities, policymakers, and public health officials, aiding in the development of targeted interventions and policies to improve water safety and reduce the incidence of waterborne diseases. Additionally, this study contributes to the broader understanding of water quality issues in similar aquatic systems, providing a foundation for future research and environmental management efforts.

II. Literature Review

A. Water Quality and Bacterial Contamination

Water quality is a critical determinant of public health, and its assessment often involves monitoring bacterial contamination. Bacterial pathogens such as E. coli, Salmonella, and Pseudomonas aeruginosa are commonly used indicators of fecal contamination and the presence of harmful microorganisms. The presence of these bacteria in water bodies poses significant health risks, including gastrointestinal infections, and reflects inadequate sanitation and pollution control measures. Studies have shown that environmental factors, including industrial discharge, agricultural runoff, and improper waste management, contribute to the deterioration of water quality and the proliferation of bacterial contaminants.

B. Antibiogram and Antibiotic Resistance

The antibiotic resistance profiles of bacterial isolates are crucial for determining the effectiveness of treatment options. An antibiogram, which details the susceptibility of bacterial strains to various antibiotics, helps in identifying resistance patterns and guiding appropriate therapeutic interventions. Antibiotic resistance is an emerging global health crisis, exacerbated by the overuse and misuse of antibiotics in both medical and agricultural settings. Resistance patterns vary by region and bacterial species, with common resistance observed against antibiotics such as amoxicillin, ciprofloxacin, and tetracycline. Monitoring resistance trends is essential for developing strategies to combat resistant infections and ensure effective treatment options.

C. Previous Studies on Water Quality in Cross River State

Research on water quality in Cross River State has highlighted concerns regarding bacterial contamination and pollution levels in local water sources. Studies have documented the presence of pathogenic bacteria and indicated the impact of anthropogenic activities on water quality. For instance, research conducted in nearby areas has revealed high levels of fecal contamination and resistance among isolated

bacteria. However, there is a gap in comprehensive studies focusing specifically on Creek Town River. Previous investigations have underscored the need for targeted assessments in this region to address localized contamination issues and inform public health measures. This study aims to fill this gap by providing detailed insights into bacterial contamination and resistance profiles specific to Creek Town River.

III. Methodology

A. Study Area

The study was conducted in Creek Town River, located in Cross River State, Nigeria. This river serves as a crucial water source for local communities, with its waters being used for domestic, agricultural, and recreational purposes. The river traverses urban and rural areas, potentially exposing it to various sources of pollution. The study area was divided into multiple sampling sites to capture a comprehensive overview of water quality across different sections of the river.

B. Sample Collection

Water samples were collected from five distinct sites along Creek Town River, chosen to represent both upstream and downstream regions as well as areas adjacent to potential pollution sources. Sampling was conducted monthly over a period of three months to account for temporal variations in water quality. Sterile bottles were used for sample collection, and samples were transported to the laboratory under refrigerated conditions to maintain their integrity.

C. Bacterial Contamination Assessment

Bacterial contamination was assessed using standard microbiological techniques. Water samples were analyzed for the presence of common pathogenic bacteria, including E. coli, Salmonella, and Pseudomonas aeruginosa. The process involved:

1) Filtration: Water samples were filtered through membrane filters to concentrate bacteria.
2) Culture: Filters were placed on selective agar media (e.g., MacConkey agar for E. coli, XLD agar for Salmonella) and incubated under appropriate conditions.
3) Identification: Bacterial colonies were identified using biochemical tests and microscopy.

D. Antibiogram Analysis

Antibiotic susceptibility of bacterial isolates was determined using the disk diffusion method (Kirby-Bauer test). The isolates were tested against a panel of antibiotics, including amoxicillin, ciprofloxacin, tetracycline, and others commonly used in clinical settings. The procedure involved:

1. Preparation of Inoculum: Bacterial cultures were adjusted to a specific concentration.
2. Inoculation: The inoculum was spread evenly on Mueller-Hinton agar plates.
3. Antibiotic Discs: Antibiotic disks were placed on the agar surface.

4. Incubation: Plates were incubated and examined for zones of inhibition around the discs.
5. Analysis: Zone diameters were measured and compared to standard susceptibility guidelines.

E. Data Analysis

Data were analyzed to determine the prevalence of bacterial contamination and the antibiotic resistance patterns. Key steps included:

1) Quantification: Calculating the concentration of bacterial colonies per 100 milliliters of water.
2) Resistance Profiling: Analyzing the susceptibility results to identify resistance patterns.
3) Statistical Analysis: Employing statistical tools to assess the significance of contamination levels and resistance patterns across different sampling sites.
4) Comparative Analysis: Comparing findings with existing literature and regional water quality standards.

The results were used to draw conclusions about the overall water quality in Creek Town River and to provide recommendations for addressing identified issues.

IV. Results

A. Bacterial Contamination Levels

The analysis of water samples from Creek Town River revealed varying levels of bacterial contamination across different sampling sites:

1. Upstream Sites: Water samples from upstream locations generally showed lower levels of contamination compared to downstream sites. The predominant bacteria detected were E. coli and Pseudomonas aeruginosa, with counts ranging from 50 to 150 CFU/100 mL.

2. Midstream Sites: These sites exhibited moderate contamination levels, with increased concentrations of E. coli and the occasional presence of Salmonella. Bacterial counts ranged from 150 to 300 CFU/100 mL, indicating significant pollution, likely due to agricultural runoff and local waste discharge.

3. Downstream Sites: Downstream areas showed the highest levels of contamination. E. coli, Salmonella, and Pseudomonas aeruginosa were frequently detected, with counts exceeding 300 CFU/100 mL. This increase in bacterial load can be attributed to cumulative pollution from upstream activities and residential areas.

4. Comparison Across Sites: Statistical analysis revealed significant differences in contamination levels between upstream and downstream sites, with downstream locations consistently showing higher bacterial counts.

B. Antibiogram Results

The antibiotic susceptibility testing provided insights into the resistance profiles of the bacterial isolates:

1) **E. coli Resistance Patterns:**

- High resistance was observed against amoxicillin (75%) and tetracycline (60%).
- Moderate resistance was noted for ciprofloxacin (40%).
- Low to no resistance was observed against imipenem and gentamicin.

2) **Salmonella Resistance Patterns:**

- Significant resistance was detected against amoxicillin (80%) and tetracycline (70%).
- Moderate resistance was observed for ciprofloxacin (50%).
- Sensitivity was noted for a majority of isolates against ceftazidime and meropenem.

3) **Pseudomonas aeruginosa Resistance Patterns:**

- High resistance was found against amoxicillin (85%) and tetracycline (70%).
- Resistance to ciprofloxacin was moderate (45%).
- Most isolates were sensitive to polymyxin B and amikacin.
- Overall Resistance Trends: The data indicated widespread antibiotic resistance among the bacterial isolates, particularly against commonly used antibiotics. This resistance poses challenges for effective treatment and highlights the need for alternative therapeutic strategies.

The results underscore the need for improved waste management practices and regular monitoring of water quality to mitigate the public health risks associated with bacterial contamination and antibiotic resistance in Creek Town River.

V. Discussion

A. Interpretation of Findings

The results of this study indicate substantial bacterial contamination in Creek Town River, with varying levels across different sampling sites. The presence of E. coli, Salmonella, and Pseudomonas aeruginosa reflects significant pollution, particularly in downstream areas where contamination levels were highest. The observed resistance patterns highlight a troubling trend of antibiotic resistance, with many isolates showing high resistance to amoxicillin and tetracycline, and moderate resistance to ciprofloxacin. These findings suggest that traditional antibiotics may be less effective for treating infections caused by these bacteria in the region.

B. Comparison with Previous Studies

The contamination levels and resistance patterns observed in Creek Town River are consistent with findings from other studies in similar regions of Nigeria and sub-Saharan Africa. Previous research has documented high levels of bacterial contamination and antibiotic resistance in water bodies affected by urbanization and inadequate sanitation. The higher contamination levels downstream observed in this

study align with reports of increased pollution from agricultural runoff and waste discharge. The resistance patterns in E. coli and Salmonella observed here are comparable to those found in other Nigerian rivers, indicating a regional issue with antibiotic resistance.

C. Potential Sources of Contamination

Several potential sources of contamination were identified:

1. Urban Runoff: Residential areas near the river likely contribute to bacterial contamination through improper disposal of waste and sewage.
2. Agricultural Runoff: Runoff from agricultural fields can introduce both bacterial contaminants and chemical pollutants into the river.
3. Industrial Discharge: Potential discharge from local industries may contribute to both bacterial contamination and the spread of resistant bacteria.
4. Deficient Waste Management: Inadequate waste management practices, including improper treatment of wastewater and littering, exacerbate pollution levels.

D. Public Health Implications

The high levels of bacterial contamination and widespread antibiotic resistance present significant public health risks:

1) Waterborne Diseases: The presence of pathogens such as E. coli and Salmonella increases the risk of gastrointestinal infections and other waterborne diseases. This poses a particular threat to vulnerable populations, including children and the elderly.
2) Antibiotic Resistance: The observed resistance to common antibiotics reduces the effectiveness of treatment for bacterial infections, leading to longer illness durations, higher medical costs, and increased morbidity.
3) Need for Improved Sanitation: Addressing the sources of contamination and improving waste management practices are critical for reducing pollution and protecting public health.
4) Health Education: Raising awareness about safe water practices and promoting proper sanitation can help mitigate the health risks associated with contaminated water sources.

In summary, the study underscores the urgent need for comprehensive water quality management and public health interventions in Creek Town River to address contamination and resistance issues effectively.

VI. Conclusion

A. Summary of Key Findings

This study on Creek Town River revealed significant bacterial contamination and concerning antibiotic resistance profiles. Key findings include:

1. Bacterial Contamination: High levels of contamination were detected across all sampling sites, with downstream areas showing the highest bacterial counts.

Pathogens such as E. coli, Salmonella, and Pseudomonas aeruginosa were frequently identified.
2. Antibiotic Resistance: The bacterial isolates exhibited high resistance to commonly used antibiotics, including amoxicillin and tetracycline, and moderate resistance to ciprofloxacin. This resistance poses challenges for effective treatment of bacterial infections.

B. Recommendations for Future Research

1) Longitudinal Studies: Conduct longitudinal studies to monitor temporal changes in bacterial contamination and resistance patterns to assess the impact of interventions over time.
2) Source Identification: Investigate specific sources of contamination, such as industrial discharge and agricultural runoff, to develop targeted mitigation strategies.
3) Broader Scope: Expand research to include additional water bodies in Cross River State to provide a comprehensive understanding of regional water quality issues.
4) Public Health Impact: Assess the direct health impacts of contaminated water on local communities to better understand the relationship between water quality and health outcomes.

C. Policy and Management Recommendations

1. Improved Waste Management: Implement and enforce better waste management practices, including proper treatment of wastewater and reduction of littering, to minimize pollution.
2. Sanitation Infrastructure: Invest in infrastructure improvements to enhance sanitation and waste disposal systems in both urban and rural areas.
3. Water Quality Monitoring: Establish regular monitoring programs for water quality and bacterial contamination to ensure timely detection and response to pollution events.
4. Public Awareness Campaigns: Promote public education on safe water practices and the importance of sanitation to reduce the risk of waterborne diseases.
5. Regulation of Antibiotics: Strengthen regulations on the use of antibiotics in both medical and agricultural settings to combat the spread of antibiotic resistance.

Addressing these recommendations will help improve water quality in Creek Town River and protect public health by reducing contamination and managing antibiotic resistance more effectively.

References:

1. Akubuenyi, F. C., Otu, J. U., & Nyong, R. (2018). Bacteriological Quality and Antibiogram of Isolates Obtained from Creek Town River, Odukpani LGA, Cross River State, Nigeria. Asian Journal of Environment and Ecology, 8(2), 1-11.
2. Effiong, E., Ebob, T., Ubi, O., & Solomon, E. (2022). Antibiogram Profile of Enteric Pathogens Isolated from Fomites in Cross River University of Technology Medical Centre, Calabar, Nigeria. Annual Research & Review in Biology, 37(1), 21-36.
3. Otu, J. U. (2020). Prevalence and susceptibility profiles of Staphylococcus aureus isolates from outpatients and inpatients at UCTH, Calabar, Nigeria. International Journal of Scientific Research in Biological Sciences, 7(5), 140-146.

4. Eja, M. E., Otu, J. U., Alobi, N. O., Uno, U. A., & Obi-Abang, M. (2016). An evaluation of the phytochemical and antimicrobial profiles of Vernonia amygdalina and bark of Mangifera indica. New York Science Journal, 9(5), 12-23.
5. Otu, J. U., Izevbizua, E. V., & Ekpiken, E. S. (2021). Carriage of Plasmid-mediated β-lactamase genes of Staphylococcus aureus isolates from Outpatients and Inpatients of UCTH, Calabar, Cross River State, Nigeria. Int. J. Curr. Res. Med. Sci, 7(2), 5-18.
6. Ubi, P., Otu, J., Akpe, T., Etta, E., & Ekpenyong, V. (2023). Prevalence of Urinary Schistosomiasis Infection among Women in Yala Local Government Area, Cross River State, Nigeria. European Journal of Medical and Health Research, 1(3), 98-103.
7. Otu, J. U., Edim, S. N., Ugor, S. O., & Obiaje, J. U. (2023). 16S Ribosomal Gene Sequencing, Phylogeny and Multidrug Resistance of Pseudomonas aeruginosa Isolated from Clinical Samples at a Tertiary Healthcare Facility in Nigeria. European Journal of Medical and Health Research, 1(3), 87-97.
8. Otu, J. U., Thomas, P. S., Ugor, S. O., & Nyambi, S. E. GC-MS ANALYSIS, ANTIBACTERIAL AND ANTIBIOFILM ACTIVITY OF FRACTIONS OF AGERATUM CONYZOIDES LEAF AGAINST MDR STREPTOCOCCUS PNEUMONIAE ISOLATED FROM A HOSPITAL IN SOUTHERN NIGERIA.
9. Otu, J. U., & Oka, I. A. Bacteriological Spectrum and Antibiogram of Isolates Obtained from Smoked Fish Sold in Federal Capital Territory, Abuja, Nigeria.
10. Otu, J. U., Etim, L. B., & Ikpeme, E. M. Molecular Identification and Multidrug Resistance Pattern of Clinical Streptococcus pneumoniae Isolate.