BACTERIOLOGICAL ANALYSIS OF RIVER WATER IN ORIADE/OBOKUN LOCAL GOVERNMENT, OSUN-STATE, NIGERIA.

Abstract

This research investigates the bacteriological composition of the Oriade/Obokun stream water, specifically focusing on IwoyeIjesa and Ijebu Jesa. The study encompasses an analysis of water sources, usage patterns, pollution sources, and the identification of waterborne bacterial pathogens. Water samples were collected and subjected to laboratory examination for the identification of opportunistic pathogenic bacteria using a microscope.The results revealed the presence of various pathogenic bacteria, including E. coli, Salmonella, V. cholerae, Shigella spp, and Campylobacter. Notably, E. coli emerged as the predominant coliform, typically associated with fecal contamination. The detection of Vibrio cholerae signals inadequate sanitation practices, while the presence of other pathogenic bacteria raises concerns about public health implications such as gastro-intestinal infections, diarrhea, dysentery, and typhoid.The findings suggest a correlation between the identified waterborne pathogens and improper waste disposal, water source contamination through sewage and surface run-off. The study underscores the potential threat and risk of waterborne epidemics posed by bacterial contamination in the Oriade/Obokun stream water. Consequently, water supply authorities are urged to acknowledge this situation and implement measures to ensure the provision of contamination-free drinking water, thereby mitigating the risk of waterborne disease outbreaks in the IwoyeIjesa and Ijebu Jesa communities.

1.0 INTRODUCTION

Water, recognized as a universal solvent, plays a pivotal role in various physiological and ecological processes. It dissolves salts, inorganic and organic compounds, and gases that actively participate in metabolic reactions, maintain the macromolecular framework, stabilize plasma membranes, regulate thermoregulation, facilitate nutrient transport, and contribute to hemostasis and body volume/weight (Armstrong et al., 2007). As an essential component of all cells, water is a prerequisite for life on Earth, making its accessibility a key developmental issue. The demand and supply dynamics within the water use-cycle exert pressure on human needs for fresh water, leading to challenges such as population displacements, loss of wildlife, and continuous alterations in river ecology and hydrology (Botkin et al., 2005).

Water contamination, defined as the degradation of water quality from public health or ecological perspectives, arises from the presence of pollutants—biological, physical, or chemical substances—in identifiable excess that are known to be harmful to desirable living organisms. Pollutants encompass a spectrum of elements, including heavy metals, sediments, radioactive isotopes, phosphorus, nitrogen, sodium, arsenic, heat, fecal coliform bacteria, other pathogenic bacteria, viruses, and protozoan pathogens. In regions with inadequate waste management practices, direct discharge of domestic and agricultural wastes emerges as a significant source of waterborne diseases.

The pollution of municipal water by human and animal sources poses a major threat to public health, particularly in economically challenged countries. Water contaminated with excreta from either animal or anthropogenic sources serves as a vector for infectious diseases, transmitting ailments ranging from mild gastroenteritis to severe dysentery, diarrhea, cholera, typhoid, hepatitis, and giardiasis (Wanda, 2006). Consequently, the safety of drinking water is of paramount concern, and it is routinely tested for coliform bacteria—a key indicator of human or animal waste. Coliform bacteria, including Escherichia coli type 1 and Streptococcus faecalis, are naturally present in the digestive systems of humans and animals, as well as in soil and plant material (Kathleen, 2008). The absence of pathogenic microorganisms and the absence of bacteria indicative of fecal pollution are critical benchmarks for potable water quality (FEPA, 2009).

Unlike chemical composition, bacterial contamination is imperceptible by appearance, taste, or smell. Detection necessitates testing for indicator organisms, specifically Escherichia coli and total coliform bacteria (Gomes and Martinis, 2004). Water samples containing any coliform bacteria are reported as total coliform positive, prompting further analysis through fecal coliform or Escherichia coli tests, as dictated by federal regulations. The presence of these fecal bacteria in any concentration in water supplies is deemed unacceptable (Kathleen, 2008).

Water pollution manifests in two primary forms: point source pollution, resulting from the direct release of harmful substances into bodies of water, and non-point source pollution, arising from the indirect introduction of pollutants from the environment into water bodies/sources (Kerker, 2003). In Nigeria, water pollution is pervasive, affecting both rural and urban areas. An estimated 1.5 million people lack access to safe drinking water, with sources of contamination including raw sewage, garbage, and oil spills (Ladeji, 2002). The World Health Organization (WHO, 2005) reports that over 80% of diseases in developing countries stem from contaminated water, inadequate sanitation, and poor hygiene practices. Addressing these challenges is essential for ensuring the well-being of communities and fostering sustainable development.

2.STUDY LOCATION

Oriade and Obokun are two local government areas situated in Osun State, Nigeria, with rich historical backgrounds that span centuries and reflect the diverse cultural tapestry of the region. This historical overview aims to provide a concise narrative of the significant milestones and cultural evolution of Oriade and Obokun.

The history of Oriade Local Government is deeply rooted in the traditions of the Yoruba people, one of the major ethnic groups in Nigeria. The town of Ipetu-Ijesa, a prominent settlement within Oriade, has played a pivotal role in the region's cultural and economic development. Historically, the Yoruba people established powerful kingdoms, and the impact of these kingdoms is evident in Oriade's historical narrative. The town is known for its adherence to Yoruba traditions and customs, contributing to the preservation of the cultural heritage of the people.

Similarly, Obokun Local Government has a storied past closely intertwined with the Yoruba civilization. The town of Ibokun, a key community within Obokun, has been a center of cultural activities and historical significance. The Yoruba people, known for their vibrant art, rich mythology, and advanced political structures, have left an indelible mark on the history of Obokun. The town has witnessed the rise and fall of kingdoms and has been a hub for trade and commerce, reflecting the economic dynamism of the region.

Both Oriade and Obokun have been influenced by the presence of powerful Yoruba kingdoms, such as the Oyo Empire, which played a crucial role in shaping the political landscape of the area. The Oyo Empire, with its complex system of governance and military prowess, significantly impacted the social and political organization of Oriade and Obokun.

The advent of colonialism in Nigeria marked a transformative period in the history of Oriade and Obokun. The British colonial administration, seeking economic opportunities and strategic control, left an imprint on the socio-political structure of the region. The effects of colonial rule, including changes in land tenure systems and administrative structures, have had lasting consequences on the development of Oriade and Obokun.

Post-independence, Oriade and Obokun have continued to evolve as integral parts of Osun State. The local governments have embraced modernity while preserving their cultural heritage. Urbanization, improved infrastructure, and educational developments have shaped the contemporary landscape of Oriade and Obokun.

Culturally, the people of Oriade and Obokun celebrate various festivals and ceremonies that highlight their traditions, music, dance, and art. These cultural practices serve as a testament to the resilience of the Yoruba heritage in the face of changing times.

2.1 Materials

The materials, equipment, and reagents employed in this study encompassed Nutrient Agar, Eosin Methylene Blue (EMB) Agar, Petri dishes, conical flasks, beakers, test tubes, inoculating loops, sterile swab sticks, cotton wool, spirit lamps, distilled water, hand gloves, nose masks, sterile plastic containers, aluminum foil, masking tape, sterile EDTA bottles, needles and syringes, measuring cylinders, micro pipettes, autoclave, incubator, microscope, microscope slides, weighing balance, immersion oil, ethanol, hydrogen peroxide, Gram's staining reagents, detergent, and disinfectant, among others.

2.2 Sterilization of Materials

To ensure the sterility of all materials, thorough procedures were followed before and after each use. Glassware was meticulously washed with detergent, rinsed, and drained before being wrapped in aluminum foil and sterilized in an oven (hot air) at 70°C for 1 hour. The working bench and surrounding area were disinfected using cotton wool soaked in 70% alcohol. The inoculating loop was flame-sterilized to red hot and allowed to cool before use. Culture media and distilled water were sterilized in an autoclave at 121°C for 15 minutes. Microbial analyses were conducted near a Bunsen flame.

2.3 Sample Collection

Water samples from the Oriade Local Government Area, specifically Iwoye and Iloko divisions in Osun State, Nigeria, were collected from labeled sites A and B (upstream and downstream). Collected in sterile plastic containers, these samples were promptly transported to the laboratory and analyzed within three hours of collection.

2.4 Preparation of Culture Media

Culture media, including Nutrient Agar and Eosin Methylene Blue (EMB) Agar, were prepared following the manufacturer's instructions. For Nutrient Agar, 14 grams were dissolved in 500ml of distilled water, heated, and swirled for a homogeneous mixture. The resulting solution was sterilized in an autoclave at 121°C for 15 minutes. Similarly, Eosin Methylene Blue (EMB) Agar was prepared by dissolving 17.9 grams in 500ml of distilled water, heating, swirling, and sterilizing under the same conditions.

2.5 Sample Inoculation

A serial dilution followed by the Pour-plate technique was employed for total viable count and presumptive coliform testing. Using sterile pipettes, 1 ml of each diluent was transferred to labeled petri dishes, mixed with sterile Nutrient Agar, allowed to set, and then incubated at 37°C for 24 hours. The resulting colonies were subcultured onto freshly prepared Eosin Methylene Blue Agar for further biochemical and morphological characterization.

2.6 Cultural Characterization

Morphological and cultural characteristics such as shapes, elevation, and edges were considered for the identification of isolates.

2.7 Catalase Test

The presence of catalase enzyme was detected by smearing a small portion of the culture on a clean, grease-free glass slide, adding one to two drops of 3% hydrogen peroxide, and observing for the release of free oxygen gas.

2.8 Gram's Staining

Gram's staining was conducted to differentiate bacterial types. Smears were made on glass slides, air-dried, heat-fixed, stained with crystal violet, rinsed, flooded with Lugol's iodine, decolorized with alcohol, stained with safranin, and then air-dried. Microscopic examination under oil immersion revealed Gram-positive (purple) and Gram-negative (red to pink) organisms.

2.9 Coagulase Test

A smear of the developed colony was made on a clean, grease-free glass slide, and blood serum was added, checked for agglutination, and interpreted for coagulase activity.

3.0 RESULT AND DISCUSSION

3.1 RESULTS

Table 1: Morphological and Cultural Characteristics of Bacteria Isolated from Water Samples

Samples	Isolated Microorganisms	Gram's Reaction	Shapes	Motility	Edge	Elevation
1	Escherichia coli	-ve	Rod	Motile	Rough	Undulate
2	Vibrio cholerae	+ve	Spiral	Non	Rough	Undulate
3	Bacillus spp.	+ve	Rod	Non	Rough	Undulate
4	Serratia spp.	-ve	Rod	Non	Smooth	Flat
5	Streptococcus spp.	+ve	Cocci	Non	Rough	Undulate
6	Streptobacillus spp.	+ve	Rod	Non	Rough	Undulate

Key: (1) Iwoye downstream A, (2) Iloko downstream B, (3) Iwoye up stream A, (4) Iloko upstream stream B, (5) Okeeruru up stream, (6) Okeeruru downstream.

Table 2: Biochemical Reactions

Samples	Isolated Microorganisms	Catalase Test	Coagulase Test
1	Escherichia coli	+ve	+ve
2	Vibrio cholerae	+ve	+ve
3	Bacillus spp.	+ve	-ve
4	Serratia spp.	+ve	-ve

Samples	Isolated Microorganisms	Catalase Test	Coagulase Test
5	Streptococcus spp.	+ve	-ve
6	Streptobacillus spp.	+ve	-ve

Key: (1) Iwoye downstream A, (2) Iloko downstream B, (3) Iwoye up stream A, (4) Iloko upstream stream B, (5) Okeeruru up stream, (6) Okeeruru downstream.

Discussion

The substantial presence of various microorganisms in the water samples underscores the urgent need for proper water treatment before human consumption. The point prevalence of enteropathogens, including Escherichia coli and Serratia spp., is subject to variations based on sampling time and site, providing rough estimates of their prevalence in surface water and contributing qualitative data for risk assessment (Kukkula et al., 2009).

The notably high presence of Escherichia coli in the water samples corroborates the findings of previous studies by Niemi et al. (2007) and Leclerc et al. (2001). The occurrence of enteropathogens in surface water is directly linked to potential contamination sources, with environmental conditions influencing the survival of these microbes in water. The abundance of Escherichia coli serves as a clear indicator of fecal contamination, implicating inadequate sanitation and unhygienic practices as major contributors to microbial contamination in the water (Sahota, 2005). The presence of other pathogenic organisms such as Vibrio cholerae, Streptococcus spp., and Streptobacillus spp. raises significant health concerns due to their greater health risks.

Moreover, the alignment of this research with the findings of Howard et al. (2003), Oyedeji et al. (2009), Adekunle et al. (2004), Onifade et al. (2008), and Dada (2009) emphasizes the persistent challenge of waterborne diseases, especially in developing nations. The prevalence of diseases like diarrhea, typhoid fever, cholera, and bacillary dysentery among the population is closely linked to the consumption of unsafe water and unhygienic drinking water production practices

(Mead et al., 2009). The most perilous form of water pollution occurs when fecal contaminants, including E. coli, Vibrio cholerae, and Salmonella typhi, enter water bodies or the water supply, posing a grave threat to public health.

In conclusion, addressing waterborne diseases requires comprehensive efforts to improve water treatment infrastructure, promote proper sanitation practices, and enhance public awareness. Strategies aimed at mitigating fecal contamination and ensuring the safety of water sources are paramount to safeguarding the health of communities reliant on these water bodies. This research contributes vital insights into the microbial composition of water samples, offering a foundation for future initiatives in water quality management and disease prevention.

4.0 Conclusion

In conclusion, the key to preventing bacterial contamination of drinking water lies in the proper location and construction of wells, coupled with effective control of human activities to prevent sewage from entering water bodies. The evident link between waterborne diseases and improper disposal of refuse, water contamination by sewage, and surface runoffs underscores the need for comprehensive programs to educate the general populace. These programs should emphasize the proper disposal of refuse, sewage treatment, and the necessity of water purification to ensure its fitness for drinking. The implicated organisms carry public health significance, contributing to various forms of infections.

In areas lacking tap water, particularly in rural dwellings, researchers and government agencies should organize educative programs to enlighten villagers on the proper use of surface water, promoting safe practices and minimizing health risks associated with waterborne pathogens.

Recommendations

Considering the quality of drinking water in the study area, the following recommendations are proposed:

1. Boiling of Drinking Water:As a preventive measure, it is recommended to boil drinking water before consumption to eliminate potential bacterial contaminants.

2. Government Intervention: The reported cases of waterborne bacterial pathogens in drinking water are alarming. Government agencies should prioritize and fulfill their responsibility of providing safe drinking water to the community.

3. Chlorine Disinfection:Regular chlorine disinfection treatment of drinking water should be ensured to maintain its safety and prevent the proliferation of harmful bacteria.

4. Quality Check:The quality of drinking water should be regularly monitored and assessed in accordance with the drinking water guidelines established by the World Health Organization (WHO).

5. Source Protection:Measures should be implemented to protect the sources of drinking water from unnecessary human and animal access, minimizing the risk of contamination.

6. Maintaining Reservoir Hygiene: General cleanliness and hygiene of water main storage reservoirs should be maintained to prevent the growth and spread of waterborne pathogens.

7. Sewage Treatment: Proper treatment and disinfection of sewage water should be carried out before disposal to prevent contamination of water sources and safeguard public health.

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