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Research Article

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Isolation and Identification of Faecal Coliforms in Giri Stream Water

Josiah Mohammed, Ogbu J.C*., Mabawonku J.T., and Olarinoye B.M.

Department of Microbiology, University of Abuja, Nigeria

*Corresponding Author
Ogbu J. C. Department of Microbiology, University of Abuja, Nigeria.

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Abstract

This study focused on the isolation and identification of faecal coliforms in the water of Giri Stream, situated in the Gwagwalada Area Council of the Federal Capital Territory (FCT), Abuja, Nigeria. A total of twenty (20) water samples were collected from ten designated points along the stream for analysis. The Multiple Tube Fermentation Technique was employed to assess the presence of fecal coliforms, revealing Most Probable Number (MPN) ranging from 92 to 300 MPN/100ml across the samples. All samples tested positive for lactose fermenters. Confirmatory tests indicated the presence of Escherichia coli through the formation of characteristic green metallic sheen on EMB agar. This is a key indicator of fecal pollution. The results emphasize the urgent need for regular monitoring of water quality and enhancements in sanitation practices to reduce health risks linked to contaminated water sources. Suggested actions include improving sanitation infrastructure, initiating educational campaigns to raise awareness about water quality issues, and fostering collaboration among local stakeholders to effectively tackle water quality challenges.

1. Introduction

Giri is located within the Federal Capital Territory of Abuja, Nigeria. The area is situated at an elevation of approximately 1,180 feet (360 meters) and is characterized by its hilly terrain and grass-covered landscapes [1]. The geographical setting of Giri, Abuja, significantly influences local biodiversity and plays a crucial role in water drainage and soil composition, which in turn impacts the quality of water bodies like the various streams that flow through the area. Many residential areas of Giri remain largely underdeveloped and often depend on these untreated stream waters for their daily activities, including drinking, cooking, bathing, and washing. This reliance on stream water is particularly pronounced during periods of water scarcity. However, sharing these water sources with livestock raises significant health risks due to potential contamination. Warm-blooded animal excrement is the source of faecal coliforms, a subgroup of total coliform bacteria. They are commonly used as markers of faecal contamination in aquatic environments. Escherichia coli sometimes known as E. coli. Is the most well-known and extensively researched faecal coliform. Although E. Coli is normally innocuous, the presence of pathogenic strains can result in serious sickness [2]. The detection of E. Coli in water suggests that faeces, which could contain more harmful germs, may have contaminated the area.

Assessing the danger of waterborne illness and putting in place the proper water treatment procedures depend on tracking the amount of E. coli in water bodies [3]. A variety of ailments, from minor gastrointestinal discomfort to serious, life-threatening infection can be brought on by faecal coliforms including E. coli. It is well-recognised that pathogenic strains of Escherichia coli, such as E. coli O157:H7, can cause serious foodborne illnesses that manifest as vomiting, diarrhoea, and abdominal cramps. Haemolytic uremic syndrome (HUS) is a dangerous kidney disease that may sometimes result from these infections [4]. This emphasises how important it is to monitor and manage faecal contamination in water sources to safeguard public health. The study of faecal coliforms in domestic water bodies is vital to understanding the public health risks associated with waterborne pathogens. By isolating and identifying these microorganisms, scientists can better assess the quality of water sources and implement measures to protect the health of the community. This work is set to assess the quality of stream water used in Giri for domestic purposes.

2. Materials and Methods

2.1. Study Area

Giri is a town located in the Gwagwalada Area Council of the Federal Capital Territory (FCT), Abuja, Nigeria. The town is characterized by its serene environment and ongoing residential development, making it a growing community. Geographically, Giri is accessible via the Kaduna-Lokoja road. The town experiences a tropical savanna climate with distinct wet and dry seasons, with average high temperatures around 31°C (88°F) and lows around 21°C (70°F). The wet season spans from April to October, with peak rainfall in July and August, while the dry season lasts from November to March, with January and February being the driest months. The population of Giri contributes to the approximately 150,000 residents of the Gwagwalada Area Council, reflecting its role as a developing residential area within Abuja. The samples were retrieved from different parts of flowing stream water (lat. 8°56'45.6"N and long. 7°13'26.2"E).

2.2. Collection of Water Samples

A total of twenty(20) water samples were collected aseptically from ten selected points in the flow of the river. The collected water samples were labelled serially and then immediately transported to the microbiology lab at the University of Abuja.

2.3. Equipment and Materials Used

The materials used for the collection of samples include sterile hand gloves and sterile test tubes.

Other materials include pipettes, inoculating wire loop, test tubes, aluminium foil, cotton wool, petri dishes, conical flasks, measuring cylinder, glass rod, and beakers

Equipment used in the laboratory include autoclave, incubator, refrigerator, weighing balance, and hot air oven.

2.4. Media Preparation and Sterilisation

Media used: Lactose Broth, EMB Agar.

- **Lactose Broth:**
  This is the base media that supports the growth of a wide range of bacteria.
- **EMB Agar:**
  This is used for the isolation and differentiation of gram-negative bacteria

2.5. Identification of Coliforms using Multiple Tube Fermentation Technique

2.5.1. Presumptive Test give numbering to all subheadings

Each water sample was mixed thoroughly to ensure even distribution of bacteria. For each water sample, the following inoculations were prepared: 3 DSLB (Double Strength Lactose Broth) tubes were inoculated with 10 mL of the water sample, 3 SSLB (Single Strength Lactose Broth) tubes were inoculated with 1 mL of the water sample, and 3 SSLB tubes were inoculated with 0.1 mL of the water sample. All tubes were labelled appropriately with the sample identity and volume used. All tubes were placed in an incubator at 35°C for 48 hours, which is the optimal temperature for coliform growth. The tubes were then checked for colour change and evidence of gas production. The number of positive results from each set was recorded and compared with the standard chart to determine the presumptive coliform count per 100 ml water sample.

➢ **Confirmatory Test**

Positive lactose broth tubes that showed gas production during the presumptive test were selected as those tubes indicated potential coliform presence Then a sterile inoculating loop was used to streak broth from each positive tube onto respective EMB agar plates. Proper streaking technique was applied to isolate colonies .The inoculated EMB plates were then inverted and incubated at 35°C for 24 hours. After incubation, the plates were examined for signs of colony morphology.

➢ **Completed Test**

A Gram stain was made from the inoculated EMB agar plate and then a Methyl Red test was performed to check for acid production from glucose fermentation, confirming the presence of *E. coli* among the coliforms.

3. Results

➢ **Presumptive Test Results**

Th table below presents the results of the presumptive test(using lactose fermentation) for fecal coliforms across twenty (20) water samples. The multiple tube fermentation method was used to determine the presence of lactose fermenting bacteria as indicative of coliforms. All 20 water samples indicated the presence of lactose fermenters. the microbial load (lactose fermenters) ranged from 92 to 300 cells/ml.

Sample	Positive Tubes (10ml)	Positive Tubes (1ml)	Positive Tubes (0.1ml)	MPN Value (MPN/ml)
1	5	5	3	210
2	4	3	2	92
3	5	5	4	240
4	4	4	3	170
5	5	4	2	110
6	4	3	3	120
7	5	5	5	300
8	4	4	2	130

9	5	4	4	200
10	5	5	3	210
11	4	3	3	120
12	5	4	2	110
13	4	3	3	120
14	5	5	4	240
15	4	4	3	170
16	5	5	3	210
17	4	3	2	92
18	5	5	4	240
19	4	4	3	170
20	5	4	4	200

Table 1: Presumptive Test Results

- **Confirmatory Test Results**

Th table below presents the colony morphology results from twenty (20) water samples tested for fecal coliforms. The bacterial cultures made from positive presumptive tubes all grew having colonies with green metallic sheen on EMB agar, a characteristic of *Escherichia coli*.

Sample Number	Presence of *E.Coli*
1	+
2	+
3	+
4	+
5	+
6	+
7	+
8	+
9	+
10	+
11	+
12	+
13	+
14	+
15	+
16	+
17	+
18	+
19	+
20	+

Table 2: Confirmatory Test Results

- **Completed Test Results**

The table below summarizes the results of the completed test for the 20 water samples. Isolates from the confirmed step were all Gram negative and methyl red positive, confirming their identity as *E. coli*. This consistent positivity indicates the presence of Gram-negative bacteria, further supporting the identification of faecal coliforms in the samples.

Sample Number	Gram reaction	Methyl red test	Identified Organism
1	G-	+	*Escherichia coli*

2	G-	+	*Escherichia coli*
3	G-	+	*Escherichia coli*
4	G-	+	*Escherichia coli*
5	G-	+	*Escherichia coli*
6	G-	+	*Escherichia coli*
7	G-	+	*Escherichia coli*
8	G-	+	*Escherichia coli*
9	G-	+	*Escherichia coli*
10	G-	+	*Escherichia coli*
11	G-	+	*Escherichia coli*
12	G-	+	*Escherichia coli*
13	G-	+	*Escherichia coli*
14	G-	+	*Escherichia coli*
15	G-	+	*Escherichia coli*
16	G-	+	*Escherichia coli*
17	G-	+	*Escherichia coli*
18	G-	+	*Escherichia coli*
19	G-	+	*Escherichia coli*
20	G-	+	*Escherichia coli*

Table 3: Results for Completed Tests

4. Discussion, Conclusion and Recommendation

4.1. Discussion

The results from the faecal coliform testing provide significant insights into the microbial quality of the water samples analyzed. The presumptive test for fecal coliforms yielded varying Maximum Probable Number (MPN) values across samples, with Sample 7 showing the highest concentration at 300 MPN/ml, indicating a substantial presence of fecal contamination. In comparison, a recent study by reported average MPN values for fecal coliforms in bore water samples at 44 MPN/100 ml, which is significantly lower than the average results for the Giri streamwater(208 MPN/100mL) [5]. The World Health Organization (WHO) recommends that drinking water should have no detectable fecal coliforms, making these findings well above the acceptable limits for domestic water.

The confirmatory tests reinforced these findings, as gas production in lactose broth and the identification of Gram-negative, non-spore-forming rods confirmed the presence of coliforms. The potential presence of *E. coli* is a primary concern due to its association with fecal contamination and health risks, as noted by, who identified *E. coli* as a significant contaminant in various water sources [6]. The completed tests further validated the presence of fecal coliforms, underscoring the potential for pathogenic organisms in the water supply, particularly in samples with higher MPN values. Overall, these results illustrate a concerning level of pollution in the water samples tested, particularly regarding fecal coliforms, which pose direct health risks to human populations relying on this water source for drinking or recreational purposes.

5. Conclusion

In conclusion, the comprehensive analysis of the water samples has revealed significant concerns regarding fecal contamination, as evidenced by the presence of fecal coliforms, which indicates potential health risks associated with the water supply. These findings underscore the necessity for ongoing monitoring and assessment of water quality to safeguard public health. The data collected not only highlights the current state of pollution but also serves as a critical foundation for future investigations aimed at identifying sources of contamination and implementing effective management strategies. Addressing these issues is essential to ensure safe and clean water for communities that depend on these sources.

Recommendations:

Improved Sanitation Practices: Sanitation infrastructure in surrounding areas should be enhanced to reduce fecal contamination, including proper waste disposal systems.

Public Awareness Campaigns: Educational campaigns should be launched to inform the community about the importance of maintaining water quality and the risks associated with pollution, with local involvement in conservation efforts encouraged.

Engagement of Stakeholders: Local stakeholders, including government agencies, environmental organizations, and community members, should be involved in collaborative efforts to address water quality issues and implement effective management strategies.

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