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Bacteriological Analysis of Water Tanks in Girls' Hostels in Joseph Sarwuan Tarka University Makurdi, Benue State

Magen Nguveren Grace
Department Of Microbiology, Joseph Sarwuan Tarka University Makurdi

Ahemen Rejoice Seember
Department of Biochemistry, Joseph Sarwuan Tarka University, Makurdi formerly Federal University of Agriculture Makurdi Benue state Nigeria

Ihyula JP
Department of Industrial Physics. Joseph Sarwuan Tarka University, Johnpaul.ihula

Shagba, Terese Peter
Department of Biochemistry, Joseph Sarwuan Tarka University, Makurdi shagbapeter

Anifowose Samson Babatunde
Department of Industrial Physics, Joseph Sarwan Tarka University. Formerly University of Agriculture Makurdi,samsonanifowose

Awua Torkwase
Department of Fisheries, Joseph Sarwuan Tarka University formerly Federal University of Agriculture Makurdi

Abstract
This study investigated the bacteriological quality of water stored in girls' hostel tanks at Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria. Water samples were collected from three hostel tanks: Hostel Block A, Hostel Block B, and Zamf Girls Hostel using sterile containers. The samples were serially diluted and inoculated using the pour plate method into Nutrient Agar and MacConkey Agar, then incubated at 37 ºC for 24 hours to determine the total heterotrophic and coliform counts. Distinct colonies were sub-cultured on selective media such as Eosin Methylene Blue Agar, Xylose Lysine Deoxycholate (XLD) Agar, and Mannitol Salt Agar for differential identification. Bacterial isolates were characterized through Gram staining and a series of biochemical tests. Results revealed total heterotrophic bacterial counts ranging from $1.79\times10^4 \pm 0.13$ cfu/ml to $2.03\times10^4 \pm 0.13$ cfu/ml, while total coliform counts ranged from $2.53\times10^3 \pm 0.36$ cfu/ml to $3.21\times10^3 \pm 0.36$ cfu/ml, exceeding WHO and EPA permissible limits. Seven bacterial species were identified: Escherichia coli, Staphylococcus aureus, Pseudomonas aeruginosa, Klebsiella species, Bacillus species, Salmonella species, and Streptococcus species. The presence of coliforms such as Escherichia coli and Salmonella species indicates faecal contamination, while Staphylococcus aureus and Streptococcus species suggest contamination from human handling or poor hygiene. The findings suggest that the hostel water is bacteriologically unsafe for consumption. Regular cleaning, disinfection, and bacteriological monitoring of water storage tanks are therefore essential to ensure water safety and protect the health of hostel students

Keywords
Bacteriological quality, Water storage tanks, Total heterotrophic bacterial count, Total coliform count, Girls' hostels, Joseph Sarwuan Tarka University

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Introduction

Water is one of the most principal natural amenities available on earth. It covers approximately 70 % of surface of earth and remaining amount is found in environment in various forms. Out of this only 2 % of world's water is drinkable. Water is required for all living organisms and thus needed for economic development. According to a 2019 report by the World Bank, the global population's access to safely managed drinking water services has increased over time, even before the adoption of the 2030 Sustainable Development Goals (SDGs). Despite these advancements, the world continues to face serious and often overlooked crisis of poor water quality, which threatens amongst other things, the wellbeing of humans (World Bank, 2019). While global efforts have focused on improving access to safe drinking water, the quality of water continues to decline, often outpacing the growth in population and economic activities (Boretti and Rosa, 2019). Good quality water is defined by acceptable chemical, physical, biological, and radiological parameters based on international standards such as those provided by the World Health Organization. The deterioration in water quality is frequently caused by contamination at various stages of the water supply chain, particularly during distribution and storage (Wang et al., 2025). Although numerous local and international organizations are committed to enhancing water safety, water contamination, especially through human and animal faecal matter, remains a major health risk (Fleming et al., 2019; Manga et al., 2020).

One critical but often neglected area of contamination is water storage, a vital component of many domestic and institutional water supply systems. Domestic water storage, especially in unpiped systems, presents numerous challenges that compromise water quality (Nnaji et al., 2019). Water storage tanks do harbour several pathogens that cause different diseases and illnesses. Waterborne illnesses caused by bacteria found in contaminated water storage tanks increases the risk of spreading waterborne diseases, and may lead to many infectious outbreaks (Khan and AlMadani, 2016).

In Nigeria, several studies have confirmed the presence of coliform bacteria, in water sources across tertiary institutions (Ekiamene et al., 2024; Ogba, 2021), Escherichia coli, Klebsiella species, Staphylococcus aureus, Pseudomonas aeruginosa, and other pathogenic microorganisms in water sources within tertiary institutions (Ogba, 2021; Ekiamene et al., 2024) highlighting a persistent risk associated with poorly maintained water storage systems. Traditional methods like chlorination have been employed to manage microbial contamination, but research has shown that coliform-free water does not necessarily mean the water is free from other human pathogens (Jodi and Almajir, 2022).

1.2.Statement of the Problem

Water tanks, especially those in the hostels are used to store water which are used by the students for domestic and personal hygiene purposes. However, when improperly maintained by the university management, these tanks may become breeding grounds for pathogenic microorganisms. The absence of regular water testing after each supply, coupled with possible lapses in sanitation practices, creates conditions favourable for microbial contamination. Female students are particularly vulnerable due to increased susceptibility to infections such as urinary tract infections and gastrointestinal illnesses. The accumulation of microbial contaminants, especially bacteria, in stored water used for drinking, bathing, and other domestic activities raises the risk of disease outbreaks within such environments.

1.3.Aim and Objectives of the Study

1.3.1.Aim of the study

The aim of this study was to carry out the bacteriological analysis of water tanks in girls' hostels in Joseph Sarwuan Tarka University Makurdi, Benue State.

1.3.2.Objectives of the study

i.To isolate and identify bacteria contaminating the water tanks

ii.To determine the bacteriological loads present in water samples collected from selected hostel tanks. water tanks.

iii.To determine the prevalence of bacteria from the isolates.

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1.4.Justification of the Study

The justification for this study lies in the need to protect the health and wellbeing of students, particularly female students occupying the university hostels. Water is essential for hygiene and disease prevention, yet the quality of water in storage tanks is often assumed rather than verified. Given the vulnerability of female students to infections, assessing the bacteriological quality of their water source is crucial. This study will generate valuable data on the presence of harmful bacteria in hostel water tanks and identify potential sources of contamination. The findings will support university management and health officials in implementing effective water hygiene measures and raise awareness among hostel residents about water safety. Ultimately, this study is both timely and necessary for guiding preventive actions, safeguarding student health, and ensuring that stored water in the university meets acceptable bacteriological standards. It may also serve as a baseline for future research on water quality in similar settings.

Literature Review

Several studies across Nigerian universities have highlighted concerns regarding the bacteriological quality of water in student hostels, indicating the potential health risks associated with contaminated water sources.

Ekiamene et al. (2024) carried out a study in Rivers State University, Port Harcourt. In their study, they assessed the bacteriological quality of borehole water supplies in the university's hostels. The study identified six bacterial species: Bacillus species, Staphylococcus species, Pseudomonas species, Klebsiella species, Salmonella species, and Escherichia coli. Notably, all isolates were biofilm producers, with varying percentages, and a significant portion exhibited haemolytic activity. They concluded that the presence of these bacteria prompts the need for regular monitoring and treatment of water sources to ensure safety among students.

In Achievers University, Owo, Ondo State, Akinkugbe and Adedeji (2023), conducted a bacteriological analysis of water tanks in the university's halls of residence. Their findings revealed the presence of various bacteria, including Escherichia coli, Salmonella species, Shigella species, Proteus species, Pseudomonas species, Staphylococcus species, Streptococcus species, and Bacillus species. The study concluded that the water from these tanks was unsuitable for direct human consumption without prior treatment, posing serious health risks to consumers.

Ogba et al. (2021) in their study analysed 30 water samples from storage tanks within the university community in University of Calabar, Cross River State. The results revealed the presence of Escherichia coli in all samples, indicating faecal contamination. Other bacteria identified included Klebsiella pneumoniae, Staphylococcus aureus, Pseudomonas aeruginosa, Streptococcus species, Enterobacter aerogenes, Proteus species, Lactobacillus species, and Listeria species. The study concluded that the presence of faecal coliform in all water samples rendered the water unsuitable for human consumption without adequate treatment.

In Covenant University, Ota, Ogun State, Ogunde et al. (2017) evaluated the physicochemical and bacteriological quality of water supplied to student hostels. While most physicochemical parameters were within acceptable limits, the bacteriological analysis revealed the presence of Escherichia coli in all samples, with counts ranging from 2 to 28 cfu/100ml. The study highlighted the potential health risks associated with the consumption of such contaminated water and recommended urgent treatment measures.

In Michael Okpara University of Agriculture, Umudike, Abia State (2022), in an investigation into the bacteriological quality of water in hostel tanks by students revealed total viable counts ranging from 0.84×10^5 to 1.44×10^5 cfu/ml and total coliform counts between 0.72×10^5 and 1.31×10^5 cfu/ml. The predominant bacteria identified were Escherichia coli, Pseudomonas aeruginosa, Streptococcus species, and Staphylococcus aureus. The study concluded that the water was unfit for human consumption due to significant bacterial contamination.

Gap the study aims to address

The justification for this study lies in the need to protect the health and wellbeing of students, particularly female students occupying the university hostels. Water is essential for hygiene and disease prevention, yet the quality of water in storage tanks is often assumed rather than verified.

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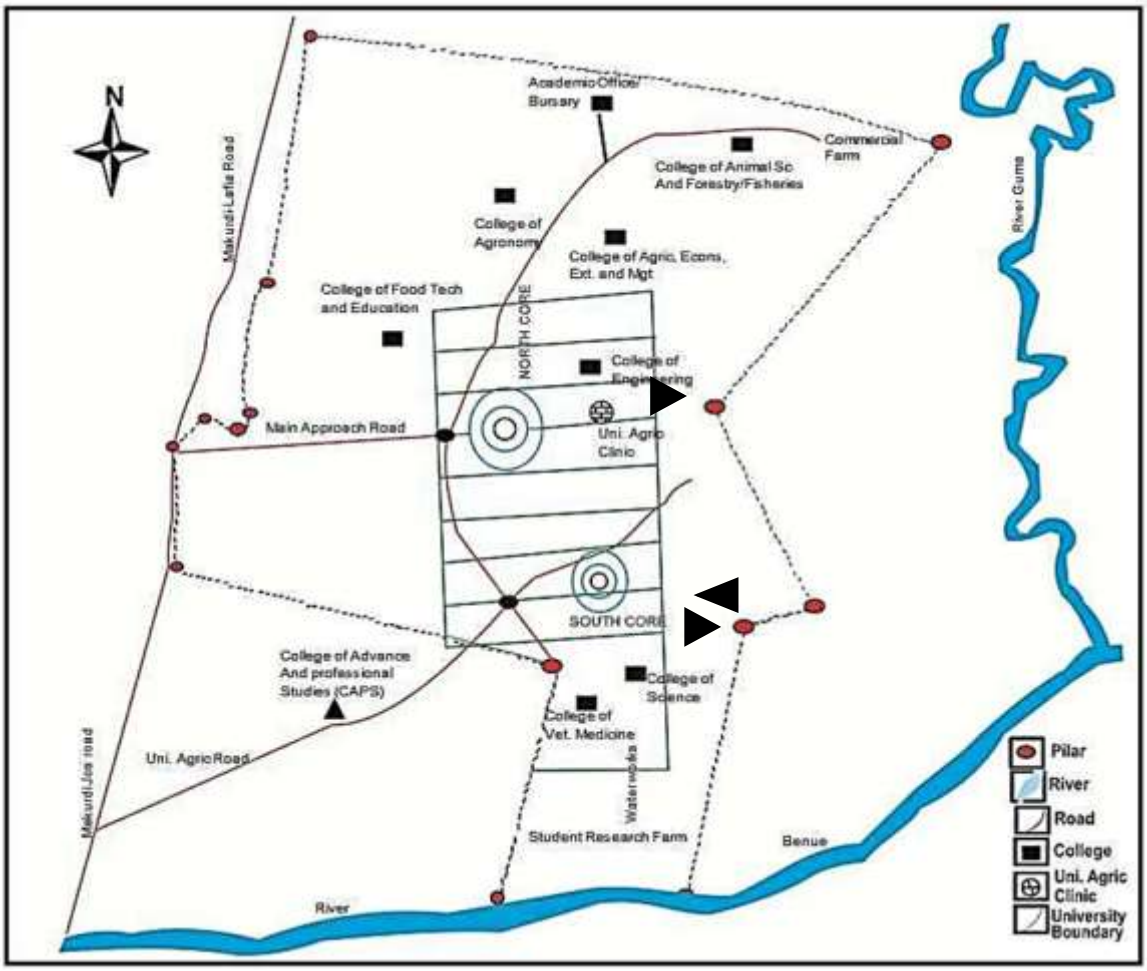
Given the vulnerability of female students to infections, assessing the bacteriological quality of their water source is crucial. This study will generate valuable data on the presence of harmful bacteria in hostel water tanks and identify potential sources of contamination. The findings will support university management and health officials in implementing effective water hygiene measures and raise awareness among hostel residents about water safety. Ultimately, this study is both timely and necessary for guiding preventive actions, safeguarding student health, and ensuring that stored water in the university meets acceptable bacteriological standards. It may also serve as a baseline for future research on water quality in similar settings.

Materials and Methods

Study Area

This study was carried out at Joseph Sarwuan Tarka University, Makurdi the Capital of Benue state in Nigeria. The school is located in the Northern part of Makurdi Local Government Area of Benue State. It has a land mass of 8,048 hectares. The school is divided into three major cores: South Core, North Core and Middle Core. The University shares common boundaries with river Benue and Makurdi town in the South, in the West with Federal Housing Estate, in the East with Todugh village, in the North with Agan village and the North East with Guma Local Government Area. The University has a population of over thirteen thousand people including students and staff in different colleges (Manyi *et al*., 2017).

This study covered the three halls of girls hostels in JOSTUM, Benue State. These halls are being supplied with borehole water stored in overhead tanks. The water from the tanks is used for various domestic purposes which include: drinking, bathing, washing etc. (Figure 1).



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Keys: ▼ = Hostel Block A
◀ = Hostel Block B
▶ = Zamf Girls Hostel Block

Figure 1: Map of Joseph Sarwuan Tarka University Showing Study Areas (Source: Benue State Ministry for Lands and Survey, 2017).

Sample Collection

Methods described by Akinkugbe and Adedeji (2023) were adopted. Water samples for analysis were collected from the three girls' hostels (Hostel Block A, Hostel Block B, and Zamf Girls Hostel Block) respectively using sterile containers. Special care was taken while collecting samples to obtain fair samples. Samples from the tanks were taken after allowing the tap to run for about one minute after cleaning the tap mouth with cotton wool soaked with alcohol. The samples were analyzed mainly for microbial colony count. All samples were transported to the Microbiology Laboratory in Joseph Sarwuan Tarka University for processing.

Sterilization and Disinfection of Materials

All glasswares were washed with detergent and air-dried. The glasswares were packed with aluminum foil into canisters and placed into a hot air oven for sterilization at 160 ºC for 1 hour. The wares were brought out of the oven and allowed to cool after sterility had been achieved. They were kept for storage when needed. Work surfaces were cleaned and sterilized by swabbing with 95 % ethanol before and after any work. An aseptic working environment was achieved with the use of a spirit lamp. Inoculating loops were sterilized by flaming over a spirit lamp until red hot and then allowed to cool before use.

Preparation of Media

All media to be used in this study were prepared according to manufacturers' instructions.

Nutrient Agar: The medium was prepared by dissolving 28 g in 1000 ml of distilled water. The mixture was sterilized by autoclaving at 121 ºC for 15 minutes. It was properly mixed before dispensing aseptically into sterile Petri dishes when cooled (Cheesebrough, 2010).

MacConkey Agar: This medium was prepared by measuring 52 g in 1000 ml of distilled water and autoclaved at 121 ºC for 15 minutes. The sterilized medium was poured into sterile Petri dishes and allowed to gel. The medium was used for isolation of pure cultures (Cheesebrough, 2010).

Xylose Lysine Deoxycholate (XLD) Agar: This medium was prepared by dissolving 28.34 g in 500 ml of distilled water and properly mixed. The mixture was heated with occasional swirling until it boiled and then dispensed aseptically into sterile Petri dishes when cooled. The medium was used to isolate pure cultures of *Salmonella* and *Shigella* species (Cheesebrough, 2010).

Eosin Methylene Blue (EMB) Agar: This selective medium was prepared by dissolving 36 g in 1000 ml of distilled water. The mixture was sterilized by autoclaving at 121 ºC for 15 minutes. The sterilized medium was poured into sterile Petri dishes and allowed to gel, and was subsequently used for sub-culturing and identification of *Escherichia coli* (Cheesebrough, 2010).

Mannitol Salt Agar: The medium was prepared by dissolving 11.1 g in every 100 ml distilled water (55.5 g in 500 ml distilled water). The mixture was sterilized by autoclaving at 121 ºC for 15 minutes. It was properly mixed and then dispensed aseptically onto sterile Petri dishes (Cheesebrough, 2010).

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Bacteriological Analysis

Serial dilution

Ten-fold serial dilution was carried out using sterile distilled water as the diluent. Ten test tubes containing 9 ml of sterile distilled water were used for each sample. They were labelled and arranged appropriately in a test tube rack. Swab samples were serially diluted in the test tubes containing 9 ml of distilled water using a sterile syringe; each transfer was followed by gentle agitation to mix the contents uniformly. The procedure was repeated for all diluents in the same manner (Cheesebrough, 2010).

Isolation procedure

Each of the samples was isolated by inoculating 0.1 ml of the serially diluted samples into already prepared Nutrient Agar and MacConkey Agar using the pour plate method. The samples were taken from the test tubes aseptically using a sterile pipette. The plates were allowed to gel properly and incubated at 37 ºC for 24 hours.

Plate count/ enumeration of bacterial isolates

To determine the plate count, Heterotrophic Plate Count (HPC)/total count was carried out to estimate the total number of bacteria in each sample that developed into colonies on Nutrient Agar and MacConkey Agar using a colony counter. The colony-forming units per ml (CFU/ml) were calculated according to APHA (2017). Plates having between 30–300 colonies were counted, while those that were too numerous to count (TNC) were discarded.

Identification of bacterial isolates

The identification of bacteria was carried out based on the classification scheme given in Bergey's Manual of Determinative Bacteriology (Whitman, 2015). The discrete colonies of bacterial isolates were identified based on colony morphology, Gram staining, and biochemical tests according to methods described by Cheesebrough (2010).

Gram staining procedure

Smears of various cultures were made on clean glass slides. The smears were stained with crystal violet solution for 60 seconds and then washed with tap water and drained off. The slides were flooded with iodine solution for 60 seconds and washed again with tap water. The glass slides were tilted, and alcohol (70 %) was added rapidly, then washed with tap water. The slides were flooded with safranin (counterstain) for 60 seconds. All slides were examined under oil immersion objective lens (Cheesebrough, 2010).

Biochemical characterization of test organisms

Indole test

Kovac's reagent was used. Organisms were grown in peptone broth and incubated at 35–37 ºC for 24 hours. Afterward, 0.5 ml of Kovac's reagent was added to the overnight peptone water culture and shaken. The observation of a red ring above the peptone water indicated a positive indole test (Cheesebrough, 2010).

Catalase test

This test will be carried out on Gram-positive cocci to test their ability to produce the enzyme catalase. Few colonies will be collected and added to a clean glass slide using a wire loop, 1-2 drops of hydrogen peroxide solution (H_2O_2) will be added to it. The production of bubbles shows positive result for catalase test (Cheesebrough, 2010).

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Citrate test
This test was carried out on Gram-positive cocci to determine their ability to produce the enzyme catalase. Few colonies were collected and added to a clean glass slide using a wire loop, and 1–2 drops of hydrogen peroxide solution (H_2O_2) were added. The production of bubbles showed a positive result for the catalase test (Cheesebrough, 2010).

Motility test
This test was used to determine whether an organism was motile or non-motile. Motile organisms contain flagella. Sulphide Indole Motility medium was used to prepare a semi-solid medium in a test tube. A straight wire or needle was used to make a single stab down the centre of the tube to about half the depth of the medium. It was incubated at 37 ºC and examined at intervals after 6 hours and above. Motile bacteria typically diffused, indicating hazy growth spreading throughout the medium (positive result), while negative results showed growth confined to the stab (Cheesebrough, 2010).

Coagulase test
This test differentiated *Staphylococcus aureus* from other *Staphylococci*. The isolates were collected and emulsified on clean grease-free slides. A drop of human plasma was introduced using a sterile pipette. The slide was gently stirred. A positive result showed clumping or agglutination within 10–20 seconds (Cheesebrough, 2010).

Citrate utilization test
Simon's citrate slants were streaked with the isolated colonies and incubated at 37 ºC for 48 hours. A positive reaction indicated a colour change from green to blue, while a negative result was depicted by the unchanged green colour. The citrate test screened bacterial isolates for the ability to utilize citrate as their carbon and energy source (Cheesebrough, 2010).

Oxidase test
A strip of filter paper was soaked with a freshly made 1 % aqueous tetramethyl-p-phenylenediamine dihydrochloride and rubbed with an amount of culture on a platinum loop. The appearance of an intense blue-purple colour within 5–10 minutes indicated a positive result (Cheesebrough, 2010).

Statistical Analysis
All experiments were carried out in duplicates. The data generated will be analysed using descriptive statistics. Bacteria occurrence will be presented as percentages. Additionally, the mean microbial load obtained from various hostels will be examined and subjected to One-way Analysis of Variance (ANOVA) in Statistical Package for Social Sciences (SPSS) version 23.0.

Results and Discussion
Table 1 shows the total bacterial counts of water samples collected from the girls' hostel water tanks in Joseph Sarwuan Tarka University, Makurdi. The total heterotrophic bacterial counts obtained ranged from 1.79×10^4 to 2.03×10^4 cfu/ml, while the total coliform counts ranged from 2.53×10^3 to 3.21×10^3 cfu/ml. The highest total heterotrophic bacterial count was recorded in Hostel Block B (2.03×10^4 cfu/ml), followed by Hostel Block A (1.86×10^4 cfu/ml), while the lowest was recorded in Zamf Girls Hostel Block (1.79×10^4 cfu/ml). Similarly, the total coliform count was highest in Hostel Block B (3.21×10^3 cfu/ml) and lowest in Zamf Girls Hostel Block (2.53×10^3 cfu/ml). The mean total heterotrophic bacterial count and coliform count across all samples were $1.89 \pm 0.13 \times 10^4$ cfu/ml and $2.83 \pm 0.36 \times 10^3$ cfu/ml respectively. When compared with the World Health Organization (WHO) and Environmental Protection Agency (EPA) standards of $\leq 1.0 \times 10^2$ cfu/ml for heterotrophic bacteria and 0 cfu/100 ml for coliform bacteria, it is evident that all the values obtained from the hostel water samples exceeded the permissible limits.

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able 2 presents the cultural characteristics of bacterial isolates identified from the girls' hostel water samples. The colonies showed distinct appearances on nutrient and selective media that aided identification. Metallic green sheen on Eosin Methylene Blue agar indicated *Escherichia coli*, while golden yellow colonies on Mannitol Salt Agar with yellow zones confirmed *Staphylococcus aureus*. Greenish colonies on nutrient agar were identified as *Pseudomonas aeruginosa*, and mucoid pink colonies on MacConkey agar as *Klebsiella* species. Large irregular colonies on nutrient agar represented *Bacillus* species, red colonies with black centres on Xylose Lysine Deoxycholate Agar (XLD) indicated *Salmonella* species, and small haemolytic colonies on blood agar were identified as *Streptococcus* species.

Table 1: Total Bacterial Count (cfu/ml) of Water Samples Collected from Girls' Hostel Water Tanks

Sampling Site	TotalHeterotrophic Bacterial Count (cfu/ml)	Total Coliform Count (cfu/ml)
Hostel Block A	1.86×10^4	2.74×10^3
Hostel Block B	2.03×10^4	3.21×10^3
Zamf Girls Hostel Block	1.79×10^4	2.53×10^3
Mean ± SD	$1.89 \pm 0.13 \times 10^4$	$2.83 \pm 0.36 \times 10^3$
WHO/EPA Standard (2017/2018)	$\leq 1.0 \times 10^2$ cfu/ml	0 cfu/100 ml

Table 2: Cultural Characteristics of Bacterial Isolates Identified in the Study from Girls' Hostel Water Samples

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	Cultural Appearance on Nutrient Agar	Appearance on Selective/Differential Media	Probable Isolates
	Circular, smooth, moist colonies	Metallic green sheen on Eosine Methylene Blue agar	*Escherichia coli*
	Golden yellow colonies	Growth on Mannitol Salt Agar with yellow zone	*Staphylococcus aureus*
	Irregular, greenish colonies	Greenish pigment on Nutrient Agar	*Pseudomonas aeruginosa*
	Mucoid, raised colonies	Pink colonies on MacConkey agar	*Klebsiella* species
	Large, flat, irregular colonies	Rough edges on Nutrient Agar	*Bacillus* species
	Circular, smooth colonies	Red colonies with black centres on XLD agar	*Salmonella* species
	Small, circular colonies	Tiny colonies with haemolysis on Blood Agar	*Streptococcus* species

Table 3 displays the Gram staining and biochemical characteristics of the bacterial isolates from the hostel water samples. *Escherichia coli* was Gram-negative, indole-positive, catalase-positive, and motile. *Staphylococcus aureus* appeared as Gram-positive cocci in clusters, catalase- and coagulase-positive. *Pseudomonas aeruginosa* was Gram-negative, oxidase- and citrate-positive, and motile, indicating its environmental origin. *Klebsiella* species were Gram-negative, non-motile, catalase- and citrate-positive. *Bacillus* species were Gram-positive rods, motile, catalase- and citrate-positive. *Salmonella* species were Gram-negative, motile, and oxidase-positive, while *Streptococcus* species were Gram-positive cocci, non-motile, and catalase-negative.

Table 4 shows the percentage prevalence of bacterial isolates recovered from water samples collected from the girls' hostel water tanks. Seven bacterial genera were identified, with varying levels of occurrence across the three sampling sites. *Staphylococcus aureus* had the highest overall prevalence (23.7 %), followed by *Bacillus* species (21.1 %), *Escherichia coli* (15.8 %), and *Klebsiella* species (13.2 %). *Pseudomonas aeruginosa* and *Salmonella* species both had a prevalence of 7.9 %, while *Streptococcus* species recorded the lowest occurrence at 5.3 %. The highest frequency of bacterial isolation was recorded in Hostel Block B (36.8 %), followed by Zamf Girls Hostel Block (31.6 %) and Hostel Block A (26.3 %).

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Table 3: Gram Staining and Biochemical Characteristics of Bacterial Isolates from Girls' Hostel Water Samples

	Gram Reaction	Cell Shape / Arrangement	IND	CAT	COA	CIT	OXD	MOT	Probable Organism
	Gram-negative	Rods, single	+	+	-	-	-	+	*Escherichia coli*
	Gram-positive	Cocci in clusters	-	+	+	-	-	-	*Staphylococcus aureus*
	Gram-negative	Rods, single	-	+	-	+	+	+	*Pseudomonas aeruginosa*
	Gram-negative	Rods, single	-	+	-	+	-	-	*Klebsiella species*
	Gram-positive	Rod, chains	-	+	-	+	+	+	*Bacillus species*
	Gram-negative	Rod, single	-	+	-	+	+	+	*Salmonella species*
	Gram-positive	Cocci, chains	-	-	-	-	-	-	*Streptococcus species*

Keys; + =Positive, - = Negative, IND = Indole, CAT = Catalase, COA = Coagulase, CIT= Citrate, Oxidase; MOT= Motility.

Table 4: Percentage Prevalence of Bacterial Isolates from Water Samples Collected from Girls' Hostel Water Tanks

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Bacterial Isolates	Hostel Block A	Hostel Block B	Zamf Girls Hostel Block	Total (Frequency and %)
Escherichia coli	2 (5.3 %)	3 (7.9 %)	1 (2.6 %)	**6 (15.8 %)**
Staphylococcus aureus	3 (7.9 %)	3 (7.9 %)	3 (7.9 %)	**9 (23.7 %)**
Pseudomonas aeruginosa	0 (0.0 %)	2 (5.3 %)	1 (2.6 %)	**3 (7.9 %)**
Klebsiella species	1 (2.6 %)	2 (5.3 %)	2 (5.3 %)	**5 (13.2 %)**
Bacillus species	3 (7.9 %)	3 (7.9 %)	2 (5.3 %)	**8 (21.1 %)**
Salmonella species	1 (2.6 %)	0 (0.0 %)	2 (5.3 %)	**3 (7.9 %)**
Streptococcus species	0 (0.0 %)	1 (2.6 %)	1 (2.6 %)	**2 (5.3 %)**
Total	**10 (26.3 %)**	**14 (36.8 %)**	**12 (31.6 %)**	**38 (100 %)**

Conclusion and Future Scope

This study revealed that water stored in the girls' hostel tanks at Joseph Sarwuan Tarka University, Makurdi, was bacteriologically contaminated and exceeded the WHO and EPA permissible limits for potable water. The total heterotrophic bacterial and coliform counts were above acceptable standards, indicating that the water was microbiologically unsafe for consumption. Seven bacterial species were isolated, namely Staphylococcus aureus, Bacillus species, Escherichia coli, Klebsiella species, Pseudomonas aeruginosa, Salmonella species, and Streptococcus species. The presence of Escherichia coli and Salmonella species indicated faecal contamination, while Staphylococcus aureus and Streptococcus species suggested contamination from human handling and poor hygiene. The findings further indicated that poor tank hygiene, environmental exposure, and possible contamination from the source water contributed to the microbial contamination. The study concluded that regular cleaning, disinfection, and bacteriological monitoring of water storage tanks are essential to ensure safe water supply and prevent waterborne infections among students.

Future research directions: Future studies should investigate the physicochemical quality of hostel water alongside bacteriological assessment to provide a more comprehensive evaluation of water safety. Molecular techniques should be employed to confirm bacterial identification and determine antimicrobial resistance patterns of the isolates. Further research should also evaluate the effectiveness of different water treatment and tank disinfection methods in reducing microbial contamination and assess seasonal variations in water quality to guide long-term water management strategies in university hostels.

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