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Bacteriological Examination of Water

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A B S T R A C T

Water is one of the most essential elements of life on Earth. It plays a crucial role in maintaining the health of all living organisms, supporting biodiversity, and sustaining ecosystems. It is involved in various physiological, biological, and chemical processes that are fundamental to life. Without water, life as we know it would not exist. Water is not only important for drinking but also plays a central role in agriculture, industry, and sanitation. Its availability and quality directly impact food production, health, and economic development. It also serves as a medium for waste disposal and plays a role in cooling and energy generation in power plants. The bacteriological examination of water is essential for assessing its safety and suitability for human consumption. This study focuses on detecting microbial contamination in water sources using standard bacteriological techniques, such as the Most Probable Number (MPN) test, membrane filter method and multiple-tube fermentation. Key indicators, including coliform bacteria (such as *Escherichia coli*), serve as markers of faecal contamination and potential pathogenic presence and also enteric pathogens like *Salmonella*, *Vibrio* and *Klelbsiella.* The results of bacteriological analysis help in identifying pollution sources and evaluating the effectiveness of water treatment methods. Ensuring microbiological water quality is crucial for preventing waterborne diseases and safeguarding public health.

Introduction

Water is one of the most essential elements for life on Earth. It plays a crucial role in maintaining the health of all living organisms, supporting biodiversity, and sustaining ecosystems. It is involved in various physiological, biological, and chemical processes that are fundamental to life. Without

Importance of Water in Microbiology

Essential for Microbial Life – Provides hydration, facilitates nutrient transport, and enables cellular functions.

Medium for Biochemical Reactions- Acts as a solvent for enzymes and substrates in metabolic pathways.

The Microbial Habitat- supports various microbes, including bacteria, fungi, viruses and protozoa, in different aquatic ecosystems,

Role in Disease Transmission – Waterborne pathogens (e.g., *Vibrio cholerae*, *E. coli*, Giardia) cause infectious diseases

Industrial & Biotechnological Use – Used in fermentation, pharmaceuticals, and wastewater treatment.

Microbial Water Quality Indicators – Coliform bacteria and other microbes help assess water purity and contamination.

Biofilm Formation – Microbes in water form biofilms on surfaces, impacting health, industry, and the environment.
In cleaning laboratory tools, sterilizing equipment, and preparing solutions, ensuring accurate and contamination-free results.

Nature of Water

Water is a colorless, odorless, and tasteless liquid that is essential for all known forms of life. Chemically, water is made up of two hydrogen atoms (H_2) bonded to one oxygen atom (O), giving it the chemical formula H_2O. It is one of the most abundant substances on Earth, covering about 71% of the planet's surface, primarily in the form of oceans rivers, lakes, and glaciers.

Water exists in three main states

Liquid: This is the most common form of water found on Earth, including oceans, rivers, and lakes.
Solid (Ice): Water freezes at 0°C (32°F) and forms ice, which is less dense than liquid water, allowing ice to float.
Gas (Water Vapor): Water evaporates into the air as watervapor, and can also exist as steam or clouds in the atmosphere.

Microorganisms Present in Water

Water is home to a diverse range of microorganisms, including bacteria, viruses, fungi, protozoa, and algae. These microbes can be beneficial, neutral, or harmful, depending on their nature and the water environment.

Water canharbora widerange of bacteria, some of which are harmful to human health. These bacteria often enter water through contamination from+sewage, agricultural runoff, industrial waste, and other pollution sources.

Pathogenic Bacteria – Cause waterborne diseases

Example*:* *Escherichia coli* (***E. coli***), *Vibrio cholerae* (**Cholera**), *Salmonella typhi* (**Typhoid**)
Escherichia coli (E. coli)*:*. **Source:**

Water: Contaminated with human or animal feces (e.g., untreated sewage, agricultural runoff, or polluted groundwater).
Food: Raw/undercooked meats, unwashed produce, unpasteurized dairy.
Contact: Person-to-person, or with infected animals/environments.

Primarily found in the intestines of humans and animals. Its presence in water usually indicates fecal contamination.

Role in Water Contamination

Indicator Organism: *E. coli* is used as an indicator of faecal contamination in water. Its presence suggests the water may be contaminated with pathogens found in human or animal waste.

Pathogenic Strains: Certain strains, like *E. coli* O157:H7, can cause severe health problems if consumed via contaminated water.

Salmonella spp.

Source

Found in the intestinal tracts of humans and animals.
Present in faecal-contaminated water, sewage, soil, and food.
Commonly transmitted through contaminated drinking water and food (especially raw poultry, eggs, and dairy products).

Role in Water Contamination & Disease

Causes **salmonellosis**, a foodborne illness leading to diarrhea, fever, and abdominal cramps.
Some species, like *Salmonella Typhi*, cause **typhoid fever**, a severe systemic infection.

Vibrio cholerae

Source

Found in marine and freshwater environments, particularly in warm coastal waters.
Present in contaminated water, sewage, and food (especially raw or undercooked seafood).
Can survive in biofilms and estuarine environments.

Role in Water Contamination

Spreads through contaminated drinking water and food.
Faecal contamination of water supplies is the primary

mode of transmission.
Poor sanitation, floods, and natural disasters increase outbreaks.
Can survive in water sources for long periods, increasing the risk of epidemics.

Klebsiella spp.

Source

-Naturally present in soil, water, and the gastrointestinal tracts of humans and animals.
--Found in hospital environments, sewage, and contaminated water sources.
-Can survive in water distribution systems and biofilms.

Klebsiella pneumoniae: Commonly associated with polluted waters and soils.

Klebsiella oxytoca: Frequently found in various habitats, including water.

Klebsiella terrigena: Often detected in unpolluted surface waters, soils, and vegetation.

Role in Water Contamination & Disease

-Klebsiella can contaminate water through faecal matter, hospital wastewater, and sewage discharge.
Can cause infections if ingested through contaminated drinking water.

Fungi

Common fungi found in drinking water include species like Aspergillus, Penicillium, and Cladosporium. These fungi can enter water systems through contamination, biofilm formation in pipes, or improper treatment processes. Some of them, like Aspergillus, can pose health risks, especially to individuals with weakened immune systems.

Found in freshwater and marine environments; some cause infections.

Algae

Algal growth in drinking water sources can occur due to nutrient pollution, sunlight, and stagnant water. Proper filtration and water treatment methods can help control their presence**.**

Photosynthetic organisms found in water, sometimes causing algal blooms.

Example: *Chlorella* (used in biotechnology), *Microcystis* (toxic cyanobacteria)

Cyanobacteria (Blue-Green Algae): Known for producing cyanotoxins, which can pose significant health risks if ingested.

Green Algae: Usually harmless but may influence the color, taste, and smell of water.

Euglenoids: Single-celled algae that may cause discoloration in water

Sources of Contamination of Water

Microbial contamination occurs when harmful microorganisms—such as bacteria, viruses, protozoa, and fungi—enter water sources. These microbes can cause waterborne diseases, including cholera, dysentery, typhoid, and gastroenteritis.

Human and Animal Waste

Sewage and Untreated Wastewater: Contains pathogens like E. coli, Salmonella, Hepatitis A virus, and Norovirus.

Septic Tank Leaks: Faulty or overflowing septic systems can leach bacteria and viruses
into groundwater.

Agricultural runoff : Animal Manure

Used as fertilizer, it can introduce bacteria, viruses, and parasites into water bodies.

Surface Water Contamination

Stormwater Runoff: Heavy rains wash fecal matter, decaying organic material, and microbes into lakes and rivers. **Floods and Natural Disasters**: Flooding can mix sewage with drinking water supplies. **Decomposing Animal Carcasses:** Dead animals in water bodies release bacteria and viruses into the environment.
Source: Rainwater carrying contaminants from urban or

agricultural areas.

Examples: Fertilizers and pesticides can lead to algal blooms, which deplete oxygen and harm aquatic life.

Contamination of Drinking Water systems

Human and Animal Waste

Source: Improperly treated sewage or fecal contamination from livestock.

Examples: Pathogens such as Escherichia coli (E. coli), Cryptosporidium, and Salmonella. These can cause gastrointestinal diseases like diarrhea or typhoid fever.

Surface Water Contamination

Source: Contaminants entering rivers, lakes, and reservoirs used for drinking water**.**

Examples: Protozoa like Giardia lamblia, bacteria like Shigella, and viruses like Hepatitis A virus.

Groundwater Pollution

Source: Leaching of contaminants from septic tanks, landfills, or agricultural activities into wells.

Examples: *Clostridium perfringens* and Vibrio cholerae, which can lead to diseases like cholera and dysentery**.**

Biofilms in Water Distribution Systems

Source: Microbial communities forming within pipes and water tanks.

Examples: Bacteria like Legionella pneumophila, which causes Legionnaires' disease, and *Pseudomonas aeruginosa*, linked to skin and respiratory infections.

Industrial Effluents

Source: Discharge of untreated or poorly treated wastewater from factories**.**

Natural Sources

Source: Soil, decaying organic material, or wild animal activity**.**

Examples: Mycobacterium avium complex (MAC) and naturally occurring Enterococcus species.

Leaking or Old Pipes: Damaged water distribution systems can allow microbial entry.

Contaminated Wells: Poorly maintained wells can harbor bacteria, especially if located near septic tanks or animal farms.

Recreational Water Sources

Public Swimming Pools and Hot Tubs: Poorly chlorinated water can harbor *E. coli, Pseudomonas, and Legionella*.
Lakes, Rivers, and Oceans: People swimming in contaminated natural water bodies can contract infections.

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Materials and Methods

Study Design

Water is one of the most essential substances on Earth. It is often called the "elixir of life" because no living organism can survive without it. About 70% of the human body is made up of water, and around 71% of the Earth's surface is covered with water.

Water plays a vital role in all life processes: It helps in digestion, circulation, excretion, and temperature regulation. Plants need water for photosynthesis, Animals and humans need clean water for drinking, cooking, and hygiene. Clean and safe water is very precious. Contaminated or polluted water can spread serious diseases like cholera, typhoid, and diarrhea, which is why water quality is so important for health.

The present study is aimed to assess the microbiological quality of water by detecting and identifying the presence of microorganisms, particularly pathogenic and indicator organisms, to determine its safety for human consumption and usage. The main objectives of this study is to check if water contains harmful microorganisms, to find out if the water is safe for drinking,to test water samples using basic microbiology methods, To detect bacteria like *E. coli* that show if water is contaminated, to compare the cleanliness of water from different sources, to understand how dirty water can cause diseases, to suggest ways to make water safer to use (Semprini and McCarty, 1991).

The project covers collection and testing of water samples from different sources including domestic, commercial, and natural water bodies (e.g., tap water, well water, river water, etc.) for microbiological analysis.

To perform standard microbiological tests such as:
Total Plate Count (TPC)
Most Probable Number (MPN) test for coliforms
Tests for specific pathogens (e.g., *E. coli*, *Salmonella*, etc.)
To identify the presence of indicator organisms like *Escherichia coli* which suggest fecal contamination.
Includes lab-based procedures such as serial dilution, culturing on selective media, and microscopic examination.
To compare microbial load in water from various sources and assess their relative safety.

To suggest appropriate water treatment methods or purification techniques based on the results. proposes possible remedial actions for improving water quality (e.g., boiling, chlorination, filtration).

Good Microbiological Practices (GMP)

Good Microbiological (GMP) involves the use of aseptic techniques and other good microbiological practices. These practices and techniques achieve two objectives.

Sample collection

General Methods for Water Sample Collection for Microbial Examination

Water sample collection is a critical step in the microbial examination of water, as the accuracy and reliability of test results heavily depend on proper sampling techniques. The following general methods are followed to ensure the sample is representative and uncontaminated:

Selection of Sampling Point

The sampling location should be chosen based on the purpose of the examination (e.g., source water, treated water, distribution system).
Avoid collecting samples near inflow or outflow pipes, dead zones, or stagnant areas.

Use of Sterile Containers

Collect samples in **sterile, leak-proof, wide-mouthed bottles**, usually made of glass or high-grade plastic.
The bottles should have a **tight-fitting cap** and a capacity of around **250–1000 mL**.
Containers are often pre-sterilized and may contain **sodium thiosulfate** (0.1 mL of 10% solution per 120 mL bottle) to neutralize residual chlorine if sampling chlorinated water.

Sampling Procedure

Do not rinse the bottle before collecting the sample, as it may remove the neutralizing agent or introduce contamination.
Remove the cap carefully without touching the inner side or the mouth of the bottle.
Immerse the bottle about **20–30 cm below the surface** (or as specified), with the mouth facing slightly upward, and fill it to about **3/4th full** to allow air space for mixing before analysis.
Replace the cap immediately and tighten securely.

Results and Discussion

The microbial examination of water is a critical process to ensure its safety for consumption and other uses. This involves testing for the presence of microorganisms, particularly those that indicate fecal contamination, such as coliform bacteria. These tests help identify potential pathogens that could cause diseases like typhoid, cholera, or hepatitis. Common methods include the presumptive, confirmed, and completed tests, which detect coliforms like *E. coli, Salmonella* and other microbes.

Different water samples from different areas and the results are enclosed below

MPN method

Medium used: MacConkey broth

The analysis of 15 water samples from various sources, including tap water, river water, tank water, ground water, and commercial drinking water, revealed significant variability in their biochemical characteristics. Contaminated Water Sources (Samples 1–3, 5, 7–8, 10–12): A substantial number of samples tested positive for both Indole and Methyl Red, while testing negative for VP and Citrate. This pattern is highly suggestive of contamination with *Escherichia coli*, a common indicator of fecal contamination. For example, samples from Palakalaru water (Sample 1), Gujjanagundla Park tap water (Sample 3), and Amaravathi River water (Sample 8) all displayed this IMViC pattern (+ + - -). The presence of *E. coli* in these samples indicates potential contamination from sewage or animal waste, which poses serious health risks, including gastrointestinal infections and waterborne diseases such as cholera and dysentery.

Such findings are particularly concerning for municipal sources (Sample 2) and public-use water sources (Samples 7 and 8), which ideally should be free of pathogenic bacteria. Their positive results call for immediate public health attention and remediation, including disinfection protocols and improved sanitation measures. Relatively Safe or Treated Water(Samples 4, 6, 9, 13–15): In contrast, several samples (Samples 4, 6, 9, 13, 14, and 15) tested negative across all four tests. This suggests that they are free from coliform contamination, or at least from *E. coli*-like bacteria. These samples likely come from treated sources or cleaner groundwater.

For instance, Ozonized water (Sample 14) and Smart Water (Sample 15) are commercial products and are expected to undergo purification processes. The absence of microbial indicators in these samples confirms the effectiveness of water treatment.

Sample 4 (Karthikeya Hostel Water), despite being from a residential hostel, also showed negative results, indicating safe water practices or filtration systems in place. Groundwater samples such as from Perecherla (Sample 9) and Repalla (Sample 6) also fared well in the tests, reflecting the natural filtration effect of soil layers or minimal human activity in the vicinity.

Table.1 Diseases Caused by Waterborne Bacteria

Name of the bacteria	Causing disease	Symptoms
Ecoli	Gastroenteritis	• Watery diarrhea (can be mild to severe). • Abdominal cramps and bloating. • Nausea and vomiting. • Fever (mild or moderate). • Dehydration (in severe cases).
Klebsiella	Urinary Tract Infections (UTIs)	• Frequent, painful urination • Blood in urine (hematuria) • Foul-smelling urine • Fever and lower back pain (if kidneys are infected)
	Bloodstream Infections (Bacteremia/Septicemia)	• High fever, chills • Low blood pressure (septic shock)
	Wound and Soft Tissue Infections	• Redness, swelling, and pus formation • Delayed wound healing
	Liver Abscess	• Fever and chills • Severe upper right abdominal pain • Nausea and vomiting
Salmonella	Salmonellosis	• Diarrhea (may be watery or bloody). • Abdominal cramps and pain.

Sample.1 Palakaluru tap water

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	1	1	1	1	1
5ml broth + 1ml sample	0	1	0	1	1
5ml broth + 0.1ml sample	0	0	1	1	1

Combination of positive tubes – 5-3-3
MPN index is 140 per 100ml
Gas formation, Organism growth and Colour change was observed

Sample.2 Municipal water Guntur

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	1	0	0	0	1
5ml broth + 1ml sample	0	1	0	1	0
5ml broth + 0.1ml sample	0	0	0	0	0

Combination of positive tubes- 2-2-1
MPN index is 9 per 100 ml
Gas formation, Organism growth and Colour change is observed

Sample.3 Gujjanagundla water

sample	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	0	0	1	1	1
5ml broth + 1ml sample	0	1	1	0	0
5ml broth + 0.1ml sample	0	0	1	0	0

Combination of positive tubes-3-2-1
MPN index is 17 per 100ml
Gas formation, Organism growth and Colour change is observed

Sample.4 Karthikey ladies hostel

sample	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	0	0	0	0	1
5ml broth + 1ml sample	0	0	0	0	0
5ml broth + 0.1ml sample	0	0	0	0	0

Combination of positive tubes-1-0-0
MPN index id 2 per 100ml
Gas formation, Organism growth and Colour change is observed

Sample.5 Kumbh Mela water

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	1	1	1	1	1
5ml broth + 1ml sample	1	1	1	1	1
5ml broth + 0.1ml sample	1	1	1	1	0

Combination of positive tubes- 5-5-4; MPN index is 1600per 100ml
Gas formation, Organism growth and Colour change is observed

Sample.6 Repalle municipal water

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	0	0	0	1	1
5ml broth + 1ml sample	0	0	0	0	1
5ml broth + 0.1ml sample	1	0	0	0	0

Combination of positive tubes- 2-1-1
MPN index is 9 per 100ml
Gas formation, Organism growth and Colour change is observed

Sample.7 SVN Colony Water, Guntur

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	0	0	0	1	1
5ml broth + 1ml sample	0	0	0	0	1
5ml broth + 0.1ml sample	1	0	0	0	0

Combination of positive tubes 2-1-1; MPN index is 9 per 100ml
Gas formation, Organism growth and Colour change is observed

Sample.8 Amaravathi water

Smaple	T1	T2	T3	T4	T5
10 ml broth + 10 ml sample	1	1	1	1	1
5ml broth + 1ml sample	0	1	1	1	1
5ml broth + 0.1ml sample	1	1	1	1	0

Combination of positive tubes 5-4-4; MPN index is 350per 100ml;
Gas formation, Organism growth and Colour change is observed

Sample.9 Peracherla ,ground water

sample	T1	T2	T3
10ml broth + 10 sample	1`	1	1
5ml broth + 1ml sample	1	1	0
5ml broth + 0.1ml sample	0	0	1

Combination of positive tubes – 3-2-1; MPN index is17 per 10ml

Sample.10 Narasaraopet, LT Nagar Ground Water

sample	T1	T2	T3
10ml broth + 10 sample	1`	1	1
5ml broth + 1ml sample	1	1	0
5ml broth + 0.1ml sample	0	0	1

Combination of positive tubes – 3-2-1; MPN index is17 per 100ml

Sample.11 Kesanapalli, Ground water

sample	T1	T2	T3
10ml broth + 10 sample	1	1	1
5ml broth + 1ml sample	1	1	0
5ml broth + 0.1ml sample	0	1	1

Combination of positive tubes – 3-2-0
MPN index is 14 per 100ml

Sample.12 Pochampally, well water

sample	T1	T2	T3
10ml broth + 10 sample	1	1	1
5ml broth + 1ml sample	1	1	0
5ml broth + 0.1ml sample	0	0	1

Combination of positive tubes – 3-2-1; MPN index is17 per 100ml

Sample.13 Vignan degree & PG college

sample	T1	T2	T3
10ml broth + 10 sample	0	0	0
5ml broth + 1ml sample	0	0	0
5ml broth + 0.1ml sample	0	0	0

Combination of positive tubes-0-0-0; MPN index id 0 per 100ml
No gas production, no organism and no colour change in broth

Sample.14 Ozonized Water

sample	T1	T2	T3
10ml broth + 10 sample	0	0	0
5ml broth + 1ml sample	0	0	0
5ml broth + 0.1ml sample	0	0	0

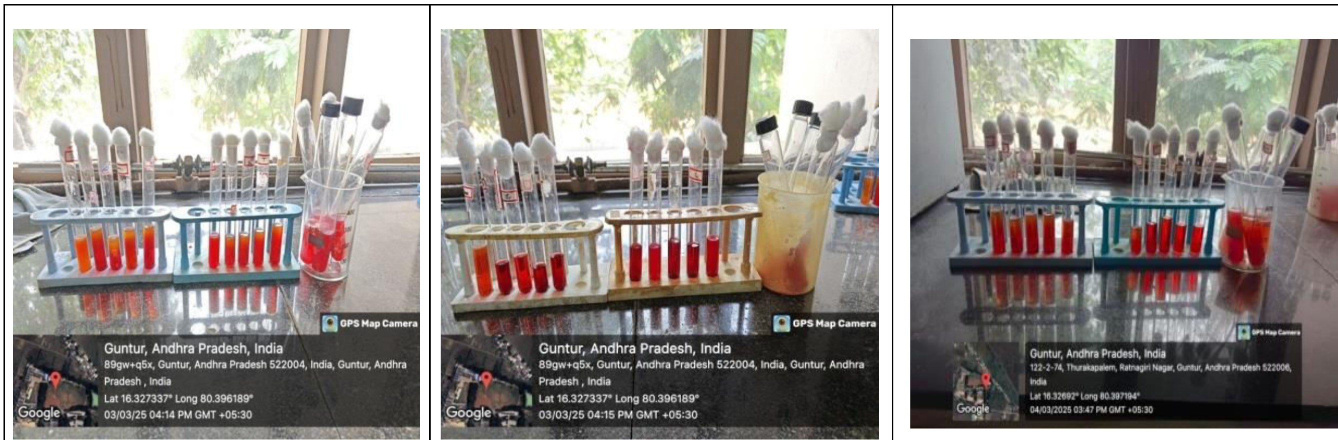
Combination of positive tubes-0-0-0; MPN index id 0 per 100ml; No gas production, no organism and no colour change in broth

Sample.15 Smartwater

sample	T1	T2	T3
10ml broth + 10 sample	0	0	0
5ml broth + 1ml sample	0	0	0
5ml broth + 0.1ml sample	0	0	0

Combination of positive tubes-0-0-0; MPN index id 0 per 100ml; No gas production, no organism and no colour change in broth

Figure.1 SAMPLE-1, 2 & 3



Sample.16

Sample	Peptone Water	Eosin Methylene Blue (*E.Coli*)	Endo Agar Medium (*Klebsiella*)	Standed Plate Count CFU/100ml
Sample -1	+ve Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	700
Sample -2	+ve Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	600
Sample -3	+ve (Gas production)	No Green Metallic sheen was observed	Nopinkcolour colonies was observed No pink colour colonies are observed	60
Sample – 4	-ve No gas production)	No green Metallic sheen was observed	No pink colour colonies are observed	5
Sample -5	+ve (Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	700
Sample – 6	+ve (Gas production)	No green Metallic sheen was observed	No pink colour colonies are observed	70
Sample -7	+ve (Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	490
Sample -8	+ve (Gas production)	Green Metallic sheen was	pink colour colonies are observed	900
Sample -9	+ve (Gas production)	No green Metallic sheen was observed	No pink colour colonies are observed	800
Sample -10	+ve (Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	700
Sample -11	+ve (Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	800
Sample -12	+ve (Gas production)	Green Metallic sheen was observed	pink colour colonies are observed	300
Sample -13	-ve (No Gas production)	No Green Metallic sheen was observed	No pink colour colonies are observed	15
Sample -14	-ve (No Gas production)	No Green Metallic sheen was observed	No pink colour colonies are observed	1
Sample -15	-ve (No Gas production)	No Green Metallic sheen was observed	No pink colour colonies are observed	2

Sample.17

Sample	Indole Test	Methyl Red test	Voges-Proskauer test	Citrate Utilization Test
Sample -1	+ve	+ve	-ve	- ve
Sample -2	+ve	+ve	-ve	-ve
Sample -3	-ve	-ve	-ve	-ve
Sample – 4	-ve	-ve	-ve	-ve
Sample -5	+ve	-ve	-ve	-ve
Sample – 6	-ve	-ve	-ve	-ve
Sample -7	+ve	+ve	-ve	-ve
Sample -8	+ve	+ve	-ve	-ve
Sample -9	-ve	-ve	-ve	-ve
Sample-10	+ve	+ve	-ve	-ve
Sample -11	+ve	+ve	-ve	-ve
Sample -12	+ve	+ve	-ve	-ve
Sample -13	-ve	-ve	-ve	-ve
Sample -14	-ve	-ve	-ve	-ve
Sample -15	-ve	-ve	-ve	-ve

Figure.2 Sample – 4 Karthikey ladies hostel

Sample.18 Results for Biochemical tests

Sample	Indole Test	Methyl Red test	Voges-Proskauer test	Citrate Utilization Test
Sample -1	+ve	+ve	-ve	- ve
Sample -2	+ve	+ve	-ve	-ve
Sample -3	+ve	+ve	-ve	-ve
Sample – 4	-ve	-ve	-ve	-ve
Sample -5	+ve	-ve	-ve	-ve
Sample – 6 (Repalla Ground water)	-ve	-ve	-ve	-ve
Sample -7 (SVN Colony Tank Water)	+ve	+ve	-ve	-ve
Sample -8 (Amaravathi River Water)	+ve	+ve	-ve	-ve
Sample -9 (Perecherla Ground Water)	-ve	-ve	-ve	-ve
Sample-10(Narsaraopet LT Nagar groundwater)	+ve	+ve	-ve	-ve
Sample -11 (Kesanupalli Ground Water)	+ve	+ve	-ve	-ve
Sample -12 (Pochampalli Well water)	+ve	+ve	-ve	-ve
Sample -13 (VDC)	-ve	-ve	-ve	-ve
Sample -14 (Oonized water)	-ve	-ve	-ve	-ve
Sample -15 (Smart Water)	-ve	-ve	-ve	-ve

Sample.19 Here are the Indian standards for drinking water quality parameters based on the Bureau of Indian Standards (BIS) specifications: Bureau of Indian Standards (BIS) specification IS 10500:2012.

Parameter	Acceptable Limit	Permissible
SPC Count	Should be minimal, ideally <500 CFU/Ml	Not specified higher limits
E. coli	0 per 100 mL (absence required)	Not permissible in any quantity
Fungi	should not present	Notpermissible
	should not present	Notpermissible

Figure.3


When it comes to your sleep, trust the
Guntur, Andhra Pradesh, India
7cxp+5q4, Kanna Vari Thota, Guntur, Andhra Pradesh 522004, India
Lat 16.297851° Long 80.437117°
28/03/25 04:23 PM GMT +05:30
GPS Map Camera
Guntur, Andhra Pradesh, India
89gw+q5x, Guntur, Andhra Pradesh 522004, India, Guntur, Andhra Pradesh , India
Lat 16.327337° Long 80.396189°
01/03/25 03:41 PM GMT +05:30
Guntur, Andhra Pradesh, India
7cxp+5q4, Kanna Vari Thota, Guntur, Andhra Pradesh 522004, India
Lat 16.297875° Long 80.4371°
27/03/25 02:10 PM GMT +05:30
Guntur, Andhra Pradesh, India
7cxp+5q4, Kanna Vari Thota, Guntur, Andhra Pradesh 522004, India
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7cxp+5q4, Kanna Vari Thota, Guntur, Andhra Pradesh 522004, India
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Guntur, Andhra Pradesh, India
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Figure.4

For instance, Ozonized water (Sample 14) and Smart Water (Sample 15) are commercial products and are expected to undergo purification processes. The absence of microbial indicators in these samples confirms the effectiveness of water treatment.

Sample 4 (Karthikeya Hostel Water), despite being from a residential hostel, also showed negative results, indicating safe water practices or filtration systems in place. Groundwater samples such as from Perecherla (Sample 9) and Repalla (Sample 6) also fared well in the tests, reflecting the natural filtration effect of soil layers or minimal human activity in the vicinity.

Sample 5 (Kumbh Mela Water) showed a positive Indole test but negative Methyl Red, VP, and Citrate results. This partially matches the *E. coli* pattern, suggesting the presence of indole-producing bacteria, though not necessarily *E. coli*. This raises concern, as such gatherings often attract large crowds and can lead to environmental contamination, particularly if proper sanitation is not maintained.

Interestingly, none of the samples tested positive for the Voges-Proskauer test, which would typically suggest the presence of non-pathogenic coliforms like *Enterobacter*. This uniform negativity reinforces the likelihood that the positive cases are indeed due to *E. coli* or similar acid-producing enteric bacteria.

Narasaraopet LT Nagar ground water (Ref. No: 2347) is bacteriologically unsatisfactory for drinking purposes as evidenced by the presence of MPN count of coliform Bacteria.

Kesanapally ground water (**Ref. No:** 2348) is bacteriologically unsatisfactory for drinking purposes as evidenced by the presence of MPN count of coliform Bacteria.

Pochampally well water (**Ref. No**: 2349) is bacteriologically unsatisfactory for drinking purposes as evidenced by the presence of MPN count of coliform Bacteria.

Water plays an important role in human life, wit out water there is no life. So everyone should aware of water contamination, water borne diseases and treatment of water.
The water samples which are tested indicates the presence of fecal indicators in more than half of the samples tested indicates that a significant portion of water sources in the region may be unsafe for direct consumption.
Waterborne pathogens can cause severe illness, especially in vulnerable populations such as children, the elderly, and immunocompromised individuals.

This study underscores the importance of routine water quality monitoring, especially in communal and public-use areas. The results also suggest the need for:

Improved wastewater management and sanitation infrastructure,
Public awareness on boiling or treating water before consumption,
Chlorination of water and filtration of water
Regular maintenance of water storage tanks and supply lines.

Author Contributions

R. Sujatha Lakshmi: Investigation, formal analysis, writing—original draft. B. Srilakshmi: Validation, methodology, writing—reviewing. G. Vijay Sundar:—Formal analysis, writing—review and editing. G. Bhargavi: Investigation, writing—reviewing. M. Nagalakshmi: Resources, investigation writing—reviewing.

Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethical Approval Not applicable.

Consent to Participate Not applicable.

Consent to Publish Not applicable.

Conflict of Interest The authors declare no competing interests.

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