International Journal of Enhanced Research in Science, Technology & Engineering
ISSN: 2319-7463, Vol. 15 Issue 6, June-2026

Microbiological Evaluation of Drinking Water Samples from Different Sources

Aprajita Pandey[1], Dr. Malika Pal[2], Ms. Anjali Kumari[3]

[1]Student, Department of Microbiology, Faculty of Science, SAM Global University, Raisen, Madhya Pradesh, India
[2]Professor, Department of Microbiology, Faculty of Science, SAM Global University, Raisen, Madhya Pradesh, India
[3]Assistant Professor, Department of Microbiology, Faculty of Science, SAM Global University, Raisen, Madhya Pradesh, India

ABSTRACT

Safe drinking water is essential for maintaining public health; however, microbial contamination remains a major concern in developing countries. The present study was conducted to evaluate the microbiological quality of drinking water collected from municipal supply systems, groundwater sources, and household storage containers. A total of 100 water samples were analyzed using standard microbiological techniques including the Most Probable Number (MPN) method, selective culture media, and biochemical identification of Escherichia coli.

The results revealed that 67% of samples were contaminated, while only 33% complied with microbiological safety standards. Household-stored water exhibited the highest contamination levels, followed by groundwater and municipal water. The presence of E. coli confirmed fecal contamination and indicated potential public health risks. The findings emphasize the need for continuous monitoring, improved sanitation, and safe water storage practices.

Keywords: Drinking Water, Microbial Contamination, Coliform Bacteria, Escherichia coli, Water Quality

INTRODUCTION

Access to safe drinking water is a fundamental requirement for human health and sustainable development. Drinking water contaminated with pathogenic microorganisms remains one of the leading causes of waterborne diseases worldwide. The World Health Organization estimates that billions of people continue to consume microbiologically unsafe water, resulting in increased incidence of diarrheal diseases, typhoid fever, cholera, and other gastrointestinal infections.

Microbial contamination primarily occurs through fecal pollution arising from sewage leakage, agricultural runoff, inadequate sanitation, and poor water storage practices. Indicator organisms such as total coliforms and Escherichia coli are widely used to assess the microbiological quality of drinking water. The detection of E. coli is considered evidence of recent fecal contamination and signifies the possible presence of enteric pathogens.

In India, rapid urbanization, increasing population density, and deficiencies in water distribution infrastructure contribute significantly to microbial contamination of drinking water. Even when water receives adequate treatment, contamination may occur during distribution and household storage. Therefore, regular monitoring of drinking water quality is essential for protecting public health and preventing disease outbreaks.

The present study was undertaken to assess microbial contamination in drinking water samples obtained from municipal supply systems, groundwater sources, and household storage containers and to compare the results with WHO and BIS drinking water quality standards.

MATERIALS AND METHODS

The present investigation was designed as a cross-sectional microbiological study to evaluate the microbial quality of drinking water obtained from different sources. The study was conducted in selected urban and peri-urban regions supplied by municipal pipelines, groundwater systems, and household storage facilities. These locations were selected because they represent the major drinking water sources used by the local population.

A total of 100 water samples were collected from municipal tap water, borewell and groundwater sources, and household storage containers. Samples were collected aseptically in sterile screw-capped bottles with capacities ranging from 250 to 500 mL. Before collection, tap outlets were disinfected using alcohol swabs and allowed to run for several minutes to remove stagnant water. Groundwater samples were collected directly from borewells and hand pumps, while household-stored water was collected using sterile techniques to avoid external contamination.

Following collection, all samples were properly labeled and transported to the microbiology laboratory under refrigerated conditions at approximately 4°C. Laboratory analysis was initiated within 24 hours to preserve sample integrity.

Microbiological examination was performed using standard methods recommended by the American Public Health Association (APHA). Total coliform bacteria were estimated using the Most Probable Number (MPN) method. Serially diluted water samples were inoculated into lactose broth and MacConkey broth containing Durham tubes and incubated at 37°C for 24–48 hours. Gas production was considered indicative of coliform presence, and MPN values were determined using standard statistical tables.

Samples positive for coliform organisms were further examined for Escherichia coli using Eosin Methylene Blue (EMB) agar. Colonies producing a characteristic metallic green sheen were presumptively identified as E. coli. Confirmation was achieved through standard biochemical tests including Indole, Methyl Red, Voges-Proskauer, and Citrate utilization tests.

The total bacterial count was determined using the pour plate technique. Serial dilutions of samples were inoculated onto nutrient agar plates and incubated at 37°C for 24–48 hours. Colony-forming units (CFU/mL) were calculated to estimate bacterial load. Microbial identification was further supported by colony morphology, Gram staining, and biochemical characterization. All procedures were performed under strict aseptic conditions, and appropriate quality control measures were implemented to ensure accuracy and reliability.

RESULTS AND DISCUSSION

3.1 Distribution of Drinking Water Samples

A total of 100 drinking water samples were collected from different sources including municipal water supplies, groundwater sources, and household storage containers. The distribution of samples is presented in Table 1.

Table 1. Distribution of Drinking Water Samples

Source of Water	Number of Samples	Percentage (%)
Municipal Water	40	40
Groundwater	35	35
Household-Stored Water	25	25
Total	100	100

Municipal water constituted the largest proportion of samples (40%), followed by groundwater (35%) and household-stored water (25%).

3.2 Overall Microbial Contamination Status

Microbiological examination revealed widespread contamination among the analyzed drinking water samples. The contamination status is shown in Table 2.

Table 2. Overall Microbial Contamination Status

Status	Number of Samples	Percentage (%)
Contaminated	67	67
Non-Contaminated	33	33
Total	100	100

Among the 100 analyzed samples, 67% were microbiologically contaminated, whereas only 33% complied with acceptable microbiological standards. The high prevalence of contamination indicates a substantial public health concern and emphasizes the need for continuous monitoring of drinking water quality.

3.3 Source-wise Coliform Contamination

The occurrence of coliform bacteria varied considerably among different water sources. Household-stored water exhibited the highest contamination levels, while municipal water showed comparatively lower contamination.

Table 3. Source-wise Coliform Contamination

Water Source	Coliform Positive (%)
Municipal Water	30
Groundwater	68
Household-Stored Water	80

The results indicate progressive deterioration of water quality from municipal supply systems to household storage conditions.

3.4 Detection of Escherichia coli

Escherichia coli was detected in all categories of drinking water sources, confirming the occurrence of fecal contamination.

Table 4. Detection of Escherichia coli in Drinking Water Samples

Water Source	E. coli Positive (%)
Municipal Water	15
Groundwater	55
Household-Stored Water	60

Household-stored water demonstrated the highest E. coli positivity (60%), followed by groundwater (55%). Municipal water exhibited the lowest prevalence (15%). The presence of E. coli indicates possible contamination by human or animal waste and suggests increased risk of waterborne diseases.

3.5 MPN-Based Risk Classification

The microbiological quality of drinking water samples was further assessed using MPN analysis. The classification of samples according to contamination level is presented in Table 5.

Table 5. MPN-Based Microbial Risk Classification

Category	Percentage (%)
Safe	28
Moderate Contamination	34
High Contamination	38

Only 28% of samples were categorized as microbiologically safe. Moderate contamination was observed in 34% of samples, while 38% showed high contamination levels. Thus, more than two-thirds of the analyzed samples exceeded acceptable microbiological limits.

3.6 Comparative Risk Assessment

Comparison of contamination patterns revealed a clear risk gradient among water sources. Municipal water represented the lowest risk category, whereas groundwater and household-stored water exhibited considerably higher contamination levels. Household-stored water was identified as the most contaminated source with 80% coliform positivity and 60% E. coli positivity.

The findings suggest that water quality deteriorates during storage and handling. Possible contributing factors include inadequate sanitation, sewage infiltration into groundwater sources, use of uncovered storage containers, repeated hand contact, and poor hygiene practices. Similar findings have been reported in previous studies investigating drinking water quality in developing regions.

The present study demonstrates that microbial contamination remains a significant challenge to drinking water safety and highlights the importance of regular surveillance, effective water treatment, proper storage practices, and public awareness programs to minimize waterborne disease transmission.

CONCLUSION

The present study demonstrated that microbial contamination of drinking water remains a significant public health concern. Analysis of 100 drinking water samples revealed that 67% were microbiologically contaminated, indicating widespread deviation from WHO and BIS standards for potable water.

Groundwater and household-stored water exhibited considerably higher contamination levels than municipal water. The detection of coliform bacteria and Escherichia coli confirmed the presence of fecal contamination and suggested an increased risk of waterborne diseases among consumers. Household-stored water was identified as the most contaminated source, highlighting the importance of proper storage and handling practices.

The study emphasizes the need for improved water treatment systems, routine microbiological surveillance, maintenance of distribution infrastructure, and public awareness programs regarding safe water storage. Effective implementation of these measures is essential for reducing microbial contamination and safeguarding community health.

REFERENCES

1. American Public Health Association. (2017). Standard methods for the examination of water and wastewater (23rd ed.). APHA.
2. Bartram, J., & Ballance, R. (Eds.). (1996). Water quality monitoring: A practical guide. E & FN Spon.
3. Bivins, A., Lowry, S., Murphy, H. M., Borchardt, M. A., Coyte, R., Labhasetwar, P., & Brown, J. (2020). Waterborne pathogen monitoring in Jaipur, India reveals microbial risks in groundwater. npj Clean Water, 3(35).
4. Bureau of Indian Standards. (2012). Drinking water specification IS 10500:2012. BIS, New Delhi.
5. Centers for Disease Control and Prevention. (2021). Drinking water advisory and waterborne diseases.
6. Chauhan, J. S., Badwal, T., & Badola, N. (2020). Assessment of potability of spring water in Uttarakhand, India. Applied Water Science, 10, 73.
7. Flemming, H. C., & Wuertz, S. (2019). Bacteria and biofilm persistence in water systems. Nature Reviews Microbiology, 17, 247–260.
8. Gupta, A., & Singh, N. (2022). Post-treatment contamination in household drinking water. Journal of Water and Health, 20(2), 199–207.
9. UNICEF India. (2021). Household water safety and sanitation report. UNICEF.
10. World Health Organization. (2022). Guidelines for drinking-water quality (4th ed.). WHO.