RESEARCH PAPER

Study on Diversity of Microbial Flora of Water in rural areas of Beswan, Aligarh

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ABSTRACT

Water is necessary for everyone. Access to high-quality drinking water is essential for human survival (WHO 2025). The World Health Organization discovered that 36 percent of urban Indians and 65 percent of rural Indians did not have access to reliable sources of safe drinking water. Microorganisms presence in water can provide substantial issues, which can cause numerous diseases transmitted through contaminated water (WHO 2017, 2024). The primary goal of this study is to isolate and identify the microorganisms present in various water sources and from water distribution networks in rural areas of Beswan, Aligarh and to assess the microbiological quality of drinking water and risks related to microbial contamination. The presence of microbes in drinking water constitutes a serious public health risk particularly in rural areas where water sources are vulnerable to pollution. A study was conducted to isolate, identify and characterize the bacterial species isolated from water using standard microbiological techniques. The key parameters were examined. The data revealed significant geographical variability in microbial loads. The presence of harmful bacteria such as *E. coli* and *P. aeruginosa*, *Salmonella* indicates serious lapses in the water supply systems in different rural areas of Beswan, Aligarh region. Poorly maintained infrastructure of water supply, water storage tanks, improper maintenance of water pipelines have been found associated with higher microbial contamination rates. The present study focuses on the diversity of microbial flora present in the water their identification and biochemical characterization. This study clearly highlights the microbial diversity in different water samples of rural areas of Beswan Aligarh and emphasizes the importance of routine surveillance to maintain safety and risks of water borne diseases.

Keywords: Microbial contamination, Water quality, Water treatment, Public health risk.

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INTRODUCTION

Safe drinking water is a basic requirement and fundamental human right, so human health must be protected by preventing microbial contamination of water intended for consumption. (WHO 2024, Abu et al.2018, Volker et al.,2010, Cabral 2010). In rural areas, people often use untreated surface water from various sources such as rivers, dams, wells, ponds, hand pumps, and municipal supplies for drinking and household tasks. These unprotected water sources are susceptible to contamination by microbes via rainfall run-off, agricultural pollutants, effluents, and animal feces, making the water unsuitable and unsafe for human consumption (WHO 2024, Abu et al.2018, Pruss et al., 2019). Faecal coliforms and *Pseudomonas* serve as key indicators of water contamination, and their presence suggests a potential health risk, particularly for those who are immunocompromised (Defat et al., 2021, WHO 2014, 2017, Bain et al., 2014 To address the necessity for clean water and mitigate health issues, the government has begun providing mobile water supplies in rural and urban regions. Although groundwater is typically seen as a fresh and safe source, escalating contamination due to quick population expansion and increased industrial activity poses a significant threat (WHO 2025, Abou et al., 2018, Defat et al., 2021). Microorganisms present in

water can lead to a variety of waterborne diseases and outbreaks (WHO 2017, 2023, 2025, Payal et al 2018).The existence of every form of life is dependent upon water which is essential for existence of life. Approximately sixty percent of a person's body weight is made up of water. Water is required for development, repair, maintenance and physiological activities. The World Health Organization discovered that thirty six percent of urban Indians and sixty five percent of rural Indians do not have access to reliable sources of drinking water (WHO 2024). Infectious pathogens have the potential to induce illnesses associated to water toxicity in both humans and animals, could be considered as a natural source of microbial(Gupta,A.D. and Rajporohit, D.,2011). Many organisms found their home in the human waste that is responsible for contaminating water sources.(Pavlov et al., 2004, Sharma et al., 2005, Cabral 2010, Madigan et al., 2018, WHO 2025. It is clearly mentioned in the literature that certain bacteria are prevalent in fresh waters and are capable of producing toxins as well as transmitting diseases in the human beings and animals (Bengani, R. 2025). The most significant danger is posed by a disease that is passed through the use of dirty water. In light of the fact that the percentage of the organisms found in water samples is often low. With regard to the drinking water quality, India is ranked 120th out of 122 countries. It is possible that the contaminants to be of a chemical, microbiological or physical substances. Human activities in the surrounding areas also contributes to the worsening of the pollution (Rakesh pant et al., 2023, Aadil H.et al. 2020, Rashid R et al. 2025)The availability of high quality drinking water is essential to human beings for the continuation of their life. Anand, C., P. Akolkar and R. Chakrabarti (2006) ascertained the importance of water supply to people living in both urban and rural regions should be suitable for consumption in order to prevent potential health hazards. As a consequence in the vast majority of possible water sources ought to be treated before being consumed (Prest, E.I., Hammes, F., van L.M and V, J.S. 2016, Kaufman 2004, The contamination of groundwater is directly responsible for number of cases of water borne diseases. It is necessary to keep a close check on the groundwater as well as the levels of contamination (WHO 2008, *Völker et al.,* 2010). Remarkable differences have been found between fatty acid profiles of *C. tora* collected from different locations in India (Shukla,S. et al.,2018). Water is obtained from a variety of sources, the most common of which are municipal water supplies, surface water sources, canals and ponds, groundwater sources, hand pumps, tube wells and dug wells. The main objective of this study is to isolate, identify and characterize the microbial organisms present in the drinking water of rural areas of Beswan, Aligarh.

The current study offers novel, original information regarding the diversity of microbial flora found in drinking water in the rural areas of Beswan, Aligarh, aiming to propose effective water treatment and management strategies for improving water quality.

MATERIALS AND METHODS

Regions selected for study

The different places of rural areas of Beswan Aligarh were selected for the analysis of microbial flora based on the availability of water.

Collection of Sample

A sophisticated technique was used for sample collection, preservation and transportation to maintain the viability and stability of the microorganisms present in the collected water samples. A total of 5o samples of treated, untreated and raw water samples were collected from eight different rural areas of Beswan Aligarh. About 250 ml of water samples were collected aseptically in three different sterilized glass bottles. The samples were correctly labeled and transported on ice to the laboratory for analysis. Standard parameters were used to determine the physicochemical properties and water quality index of the collected water samples, with the latter being a crucial tool for assessing water suitability for drinking.

Isolation, purification and characterization of microorganisms from water

To isolate faecal coliforms, total coliforms, *Pseudomonas*, and heterotrophic bacteria from water samples, standard microbiological techniques and procedures were employed. Three 100 ml volumes from each sample were filtered through 0.45 µm pore-sized cellulose nitrate membranes using a water pump. The membranes were then aseptically transferred to plates containing appropriate selective media,

ensuring no air bubbles were trapped beneath them. Following the manufacturers' specifications, all culture media were prepared; each sample was analyzed in triplicate. Heterotrophic bacteria were isolated by spreading 1 ml of the treated water sample onto nutrient agar plates. Water samples collected from essential municipal pumping stations and dugwells underwent serial dilution. A 1 ml aliquot of the 5-fold serial dilution was spread onto nutrient agar plates, which were then incubated at 37°C. Following incubation, the resulting bacterial colonies were enumerated, characterized, and the data recorded. The final results quantified the concentration of faecal coliforms, total coliforms, and *Pseudomonas* per 100 ml of water, and heterotrophic bacteria per 1 ml of water. Bacterial colonies were initially isolated and purified through repeated subculturing using the streaking plate method. Subsequent Gram staining of young cultures confirmed all isolates were gram-negative bacilli. The confirmed gram-negative isolates then underwent a series of primary and secondary biochemical tests for identification, specifically including the Gram Staining, Methyl red test, Citrate utilization test, Oxidase test, Urease test, Indole test and Catalase test.

RESULTS

The results of this study clearly reported the presence of bacterial flora from different sources of rural areas of Beswan Aligarh. Different bacterial species were obtained from water Heterotrophic bacteria, Faecal Coli forms ,Coliforms, Pseudomonas aeruginosa, Campylobector , Salmonella Choleraesuis, Proteus vulgaris, Serratio odorifera, Pseudomonas luteola and Enterio bactor asburiae from various water samples of rural areas of Beswan Aligarh.

S.No	Sample	Place	Identification of Isolates
1.	Treated water	Municipal water supply Beswan, Aligarh	Pseudomonas aeroginosa
2.	Treated water	Killa Beswan , Aligarh	Pseudomonas luteola
3.	Treated water	Naglawas , Aligarh	Serratia odorifera
4.	Treated water	Mirzapur, Aligarh	Heterophilic bacteria
5.	Treated water	Jehraulli, Aligarh	Serratia odorifera

Table 1: Identification of Isolates from treated water

S.No	Sample	Place	Identification of Isolates
1.	Untreated water	Municipal water supply Beswan, Aligarh	E.Coli
2.	Untreated water	Sathni, Aligarh	Pseudomonas aeroginosa
3.	Untreated water	Dwapur , Aligarh	Salmonella Choleraesuis
4.	Untreated water	Garihya, Aligarh	Campylo bactor
5.	Untreated water	Naglaponda , Aligarh	Proteous vulgaris
6.	Raw water	Mirzapur , Aligarh	Enterio bactor asburiae
7.	Raw water	Mahasua ,Aligarh	Coli forms
8.	Raw water	Rapur , Aligarh	Proteous vulgaris

Table 2: Showing identification of Isolates from untreated and raw water

Table.3. Biochemical Characterization of bacterial isolates

Samples	**Gram Staining**	**Catalase**	**Indole**	**Citrate**	**Oxidase**	**Urease**	**Methyl Red**	**Organisms**

Treated water	-ve	+ve	-ve	+ve	+ve	-ve	-ve	Pseudomonas aeroginosa
Treated water	-ve	+ve	-ve	+ve	+ve	-ve	-ve	Pseudomonas luteola
Treated water	-ve	+ve	-ve	+ve	-ve	+ve	-ve	Serratia odorifera
Treated water	+ve	-ve	+ve	+ve	-ve	+ve	+ve	Heterophilic bacteria
Treated water	-ve	+ve	-ve	+ve	-ve	+ve	-ve	Serratia odorifera
Untreated water	-ve	+ve	+ve	-ve	-ve	-ve	+ve	E.Coli
Untreated water	-ve	+ve	-ve	+ve	+ve	-ve	-ve	Pseudomonas aeroginosa
Untreated water	-ve	+ve	-ve	-ve	-ve	-ve	+ve	Salmonella Choleraesuis
Untreated water	-ve	+ve	+ve	-ve	+ve	-ve	+ve	Campylo bactor
Untreated water	-ve rods	+ve	-ve	+ve	-ve	+ve	+ve	Proteous vulgaris
Raw water	+ve rods	-ve	+ve	+ve	-ve	+ve	+ve	Enterio bactor asburiae
Raw water	-ve	+ve	+ve	-ve	-ve	-ve	+ve	Coli forms
Raw water	-ve rods	+ve	-ve	+ve	-ve	+ve	+ve	Proteous vulgaris

DISCUSSION

Isolation and characterization of bacterial strains from surface and drinking water was carried out from water samples. Various water samples collected from rural areas of Beswan, Aligarh revealed the presence of several types of bacteria, including total Coliforms, Faecal coliforms, *E. coli*, Heterotrophic bacteria, *Pseudomonas aeruginosa*, *Campylobacter*, *Salmonella* and *Proteus vulgaris*. These findings serve as a clear indication of water contamination in these areas. These organisms can carry potential pathogens, which pose severe health risks, particularly to consumers with compromised immune systems. The treatment process itself, as well as the difference between raw water and treated drinking water, may explain the reduction in the total number of bacteria.However, the presence of bacteria in the water post-treatment may still harbor potential pathogens, and the associated health risks must be considered during the water distribution process. It is very important while treating the water for human use. Serious attention to be followed while purifying the drinking water for human use and the purification facility should also be perfect in all manners while treating the drinking water for the community. The study findings indicate a greater quantity and variety of isolates sourced from water. The presence of these bacteria at the rural location is potentially linked to contamination originating from human activities, animals and wild birds.

CONCLUSION

The evaluation of the drinking water's bacteriological quality confirmed the presence of various bacterial species. Twelve different bacterial species including opportunistic pathogens were obtained from water samples of rural areas of Beswan Aligarh. These bacterial strains were characterized morphologically, microscopically and biochemically. The bacterial species obtained were Heterotrophic bacteria ,Faecal Coli forms, *Pseudomonas aeruginosa, Campylobector, Salmonella and Proteus vulgaris*. The presence of bacteria can result in undesirable water properties that negatively impact human health. Consequently, it is crucial to monitor water quality and enforce stringent control measures for effective drinking water treatment. These actions not only enhance the overall quality of drinking water production but

also aid in the prevention of community outbreaks of waterborne diseases. This study offers new insights into the bacterial flora present in the water.

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