



Isolation of Bacteria from River Water and Drinking Water: A Comparative Study in Nasiriyah City

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ABSTRACT

This study aimed to isolate and identify bacteria present in river water and drinking water sources in Nasiriyah city, Dhi Qar province. A total of 100 water samples were collected from four different sources (25 samples each): the Euphrates River (representing natural river water), tap water, bottled water, and reverse osmosis (RO) water (representing different drinking water sources). Laboratory examinations were conducted using traditional bacterial culture techniques and biochemical tests. Results showed the presence of various bacterial species in all studied water sources. The Euphrates River recorded the highest bacterial contamination level with an average of 800–5,200 CFU/ml, and RO water showed the lowest contamination level with <30 CFU/ml. Several pathogenic bacterial species were isolated, including *Escherichia coli*, *Staphylococcus* spp., and *Pseudomonas aeruginosa*. Statistical analysis revealed significant differences ($p < 0.05$) between bacterial counts in different water sources. The findings indicate the importance of regular water quality monitoring and the implementation of strict water safety standards, particularly for the Euphrates River and tap water. The study recommends improving water treatment systems and developing microbiological monitoring programs for water in the region.

1. Introduction

Water quality represents one of the most critical factors affecting public health worldwide. According to World Health Organization statistics, more than 2 billion people globally lack access to safe drinking water (WHO, 2011). Increasing population growth has led to escalating water demand in major cities around the world, exacerbating challenges related to providing clean and safe drinking water (Cabral, 2010; Ahmed et al., 2020).

Climate change has contributed to reduced precipitation levels and declining river flows, while simultaneous population growth has increased demand for clean water resources (Al-Ansari et al., 2019; Li et al., 2022). Microbiologically contaminated drinking water serves as a transmission medium for numerous diseases, including diarrhea, cholera, dysentery, typhoid, and polio, and is estimated to cause approximately 505,000 diarrheal deaths annually (Bain et al., 2014; Curutiu et al., 2019;

WHO, 2015; Cabral, 2010). Pathogenic microorganisms include pathogenic bacteria, viruses, and protozoa, each capable of causing distinct types of illnesses (Landrigan et al., 2020; Bridle, 2021).

Iraq in general, and Dhi Qar province specifically, face significant challenges regarding water sources due to environmental pollution and increasing population growth. The water crisis is exacerbated by low rainfall rates and declining river levels, in addition to water resources being exposed to various pollution sources, including agricultural waste and sewage at varying concentrations.

Nasiriyah City, the center of Dhi Qar province, the Euphrates River as its main water source. demonstrated considerable variation in water quality, ranging from poor to good conditions

Sources in Nasiriyah City, Dhi Qar Province, Iraq. With decreased water discharge, a noticeable deterioration in water quality has

been observed, manifested in changes in the color, taste, and odor of tap water. A study by Abdullah et al. (2019) examining water quality parameters in the Euphrates River within southern Iraq indicated considerable variation in water quality, ranging from poor to good conditions, affecting its suitability for multiple uses, including potable water supply and agricultural applications.

As a result of these challenges, many citizens resort to alternative solutions such as bottled water or home purification systems like reverse osmosis, which is considered one of the most common and cost-effective water purification methods.

The significance of this study lies in assessing the quality of various drinking water sources available to citizens in Nasiriyah City, including bottled water and water treated by home reverse osmosis systems. Bottled drinking water is subject to strict quality and safety standards to ensure consumer safety, including regular testing to ensure that the water is free of contaminants and harmful bacteria (Gautam, 2020).

This study is essential for understanding the current status of drinking water quality and determining the extent of microbiological contamination that may pose health risks to consumers, especially with increasing reliance on alternative water sources amid deteriorating tap water quality. Despite several global studies on the microbiological quality of bottled water, such as the study by Shahryari et al. (2020), which examined 400 bottled water samples from 10 brands in Gorgan City, Iran, indicating the presence of *E. coli* and *Bacillus* spp., as well as other studies that isolated pathogenic bacteria such as *Pseudomonas aeruginosa* from bottled water (Georgieva and Dimitrova, 2016), there is a clear deficiency in studies addressing the microbiological quality of different drinking water sources. This study was conducted to evaluate the microbiological quality of different water sources in Nasiriyah City, Dhi Qar Province, Iraq. Bacterial contamination of water sources demonstrated considerable variation in

water quality, ranging from poor to good conditions.

2. Methodology

The microbiological quality of different water sources in Nasiriyah City, Dhi Qar Province, Iraq.

2.1 Sample Collection

A total of 100 water samples were collected from four sources:

- River water (Euphrates River): 25 samples collected from multiple points along the river within the city limits
- Tap water: 25 samples collected from different residential areas across the city
- Bottled water: 25 samples representing different brands available in local markets
- Reverse osmosis (RO) treated water: 25 samples from household RO systems

Sterile and sealed plastic bottles were used. All the water samples were collected in 3 plastic bottles which were washed with distilled water before sampling and transporting them to the laboratory. The samples collected from different sources were transferred to the microbiology laboratory (Department of Biology in the College of Education for Pure Science) for the necessary tests according to (Holt et al., 1994).

Bacterial total count: 0.1 ml of the water sample was grown on Nutrient agar. MacConkey agar medium was used for primary isolation. EMB agar medium was used for confirmation after performing a series of dilutions with 3 replications. The dishes were incubated at 37 °C for 24 hours or 48 hours, after which the developing colonies were counted and multiplied by the reciprocal of the dilution factor, and the average numbers were extracted. The general specifications of these bacteria were also studied and recorded.

2.2 Biochemical Identification

Biochemical testing was performed to differentiate between bacterial species using the

IMViC test series (Indole, Methyl Red, Voges–Proskauer, and Citrate utilization tests) following the procedures described by MacFaddin (2000). Additional biochemical tests were also performed. Data were analyzed using SPSS version 28.0. Descriptive statistics were calculated for bacterial counts, including means, ranges, and standard deviations. Chi-square tests were used to compare contamination rates between sources. A p-value of <0.05 was considered statistically significant.

3. Results

3.1 Contamination Rates by Water Source

The results are shown in Table 1. The percentage of contamination according to the source of water was highest in river water at 100%, followed by tap water at 76%, bottled water at 20%, and RO water at 8%.

Table 1. Percentage of contamination according source of water

Source	Total count	Positive sample	%	P- value
River water	25	25	100%	p<0.001
Tap water	25	19	76%	p<0.001
Bottled water	25	5	20%	p<0.05
RO	25	2	8%	Insignificant

3.2 Total Bacterial Count

The results are shown in the table, including the mean bacterial concentration, range, and standard deviation for each water source:

Table 2. total count of bacteria

Source	main (CFU/ml)	range	Sd
River water	2,450	800-5,200	±890
Tap water	420	10-1,800	±385
Bottled water	25	0-150	±35
RO	8	0-30	±12

3.3 Isolated Bacteria

Table 3 shows the percentage distribution of bacterial species isolated from the samples:

Table 3. percentage of isolated bacteria

Bacteria	%
<i>E. coli</i>	88
<i>S. aureus</i>	32
<i>P. aeruginosa</i>	28
other	20

4. Discussion

4.1 Contamination Rates by Water Source

The reason for the presence of microbes in drinking water samples is the improper treatment of sewage before it is returned to the river, which will then be transferred to the governorate's water purification projects. The appearance of these types of bacteria, which were isolated and identified in drinking water, indicates contamination.

Detecting and monitoring **P. aeruginosa** in drinking water is critical because it poses a serious threat to public health, especially since it is widely resistant to a wide range of antimicrobials, making treatment of the infection a complex therapeutic challenge (El Din, 2019).

This provides strong evidence that this water is not safe for drinking. This may be due to the lack of attention to sterilizing drinking water in purification projects, in addition to the age of the distribution network, which constitutes another source of contamination of water intended for drinking.

4.2 Total Bacterial Count

The bacterial analysis results from Euphrates River water provide a mean bacterial concentration of 50,000 CFU/ml, as shown in Table 2, indicating a considerable microbial burden necessitating treatment. This may be due to the discharge of waste into the river. This

fecal contamination is a serious indicator of the presence of bacteria.

In tap water, the level of contamination of (76%) was shown despite it undergoing treatment processes in the water distribution network. This may be due to leakage of water into the distribution network, a low level of chlorine that does not guarantee continuous disinfection, or perhaps failure to clean the distribution tanks and pipes regularly.

Bottled water showed relatively better results (20% contamination), but it is still unacceptable according to international standards. This may be due to contamination from the source (i.e., the use of contaminated water as a raw material), contamination during manufacturing (i.e., failure to sterilize equipment and bottles, improper storage and transportation, exposure to heat and contamination), or expiration (i.e., consumption of expired water). This agrees with the study by Hamad et al. (2022), who found that bottled waters sold in shops in Al Anbar Province have bacteriological contents that are within permitted ranges for Iraqi and WHO standards.

RO system water showed the best results (only 8% contamination), confirming the effectiveness of reverse osmosis technology in removing bacteria. The limited contamination may be attributed to lack of filter maintenance, failure to change filters on schedule, post-treatment contamination, or contamination of the collection tank or pipes.

3.4 Isolated Bacteria

The high *E. coli* count (88%) indicates severe fecal contamination, as shown in Table 3. *Escherichia coli* is a commensal bacterium residing in the gastrointestinal tract of humans and animals and is subsequently released into environmental matrices through fecal material. Since fecal pollution constitutes the predominant source of waterborne pathogens, *E. coli* functions as a widely accepted indicator microorganism for evaluating contamination levels across various water systems, encompassing riverine environments, marine

coastal zones, lacustrine systems, groundwater aquifers, and surface water resources (Ishii & Sadowsky, 2008; Cabral, 2010).

The presence of this bacterium reflects poor sanitation systems and the leakage of human waste. The result for isolated *S. aureus* agrees with the findings of Ghazzawi and Shammari (2014), who diagnosed four types of bacteria, including *E. coli*, *P. aeruginosa*, *S. aureus*, and *S. saprophyticus*, in the water of Shatt Al-Arab in the south of Iraq.

4. Conclusions

Water-associated diseases constitute a primary health concern for populations in developing regions, stemming from insufficient sanitation practices, substandard water quality, and excessive accumulation of pathogen-laden wastes. Significant contamination variation: There are substantial differences in bacterial contamination levels between different water sources, with the Euphrates River showing the highest contamination and RO water the lowest. The current research identified *E. coli*, *Pseudomonas* spp., and *Staphylococcus aureus* bacteria, indicating the probable occurrence of other pathogenic organisms in the studied water samples. This study provides crucial baseline data for water quality management and public health protection in Nasiriyah City, emphasizing the urgent need for comprehensive water safety interventions.

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