Bacterial assessment of raw and tap water quality in Basrah city, Iraq

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Abstract

Ensuring drinking water safety is a fundamental public health priority, particularly in cities facing potential environmental risks. This study estimated the microbial and physicochemical water quality of the Shatt al-Arab River and tap water in Basrah city, Iraq. Total bacterial counts, fecal coliforms, pH and electrical conductivity (EC) were monitored in water samples obtained from different sampling points. Fecal coliform identification was carried out on M-FC agar medium incubated at 44.5°C. The bacteriological study revealed a marked geographical variation in the bacterial load. The Shatt al-Arab water samples (especially sample 2) had the highest counts of total bacteria and fecal coliforms (up to 170 CFU/100 ml) indicating direct contact with organic and fecal pollutants. On the other hand, tap water counts indicated lower but very varied contamination levels between 320 CFU/ml in Site 6 and 1200 CFU/ml in Site 7. No fecal coliforms (0 CFU/100 ml) were detected in effluent samples (Sites 3, 4 and 5), indicating the local effectiveness of the chlorination process. Structurally, a drastic fall of pH to acidity and a rise in EC values were recorded in the most polluted zones, demonstrating a strong association between the microbial metabolic activity and the damaged chemical characteristics of water. The results suggest that while chlorination has some effect, the water distribution networks in Basrah require a regular urgent monitoring and advanced treatment technologies to cope with increasing salinity and biological contamination in order to comply with Iraqi and international drinking water standards.

Keywords: Drinking water, total bacteria, fecal coliform, water quality.

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Introduction

The Shatt al-Arab is created by the confluence of the Tigris and Euphrates rivers and extends for 204 km from the city of Qurna to its mouth in the Arabian Gulf (Al-Yasiry, 2021). It is an important artery, being one of the main water sources for life in the region, contributing to the establishment of human settlements and industrial projects, as well as supplying water for agriculture in Basrah Governorate, and meeting the needs of the population for irrigation and drinking water (Al-Hajaj and Turab, 2025; Hamzah, 2025).

The quality of water in the Shatt al-Arab is greatly affected by environmental problems such as the increase of salinity and different types of pollution; therefore, there is an urgent need for periodic re-evaluation of the biological and chemical make-up of the water, particularly the microbiological testing for the existence of bacteria and the spread of disease. The importance of the problem is to identify the extent of the effect of the quality of the irrigation water supplied to the various neighborhoods of Basrah. This points to the possible environmental and health hazards that may be caused by the changes in the composition of the water of the Shatt al-Arab and provides scientific solutions for the provision of higher quality and safer drinking water (Al-Adhab *et al.*, 2024; Taloob and Al-Mahmood, 2025).

The Shatt al-Arab continues to suffer from high levels of organic and microbiological pollution, putting great stress on the province's treatment plants, which may not be adequately equipped to cope with the rising pollution levels. Furthermore, in some parts of Basrah, treatment facilities may have deterioration and fissures in the water conveyance pipes that lead to the contamination of irrigation water with the sewage, thus causing secondary pollution (Wang *et al.*, 2025). Also, the pipe corrosion can allow the leaching of metals into the water (Jiang, 2023). In many parts of this province, vast amounts of raw sewage are dumped straight into the waterway of the Shatt al-Arab. This uncontrolled discharge has transformed the water course into a reservoir of pathogens and organic waste, thus contributing to increase the load of pollutants reaching the wastewater treatment plants and to decrease the effectiveness of the treatment and disinfection processes. This operational failure is aggravated by the degradation of the existing infrastructure, with leaks in distribution pipes that allow the entry of more environmental contaminants in the supply network (Ramal *et al.*, 2021).

Researchers have observed the efficiency of water treatment facilities in Basrah Governorate, revealing substantial deficiencies in their ability to eliminate elevated amounts of bacterial pollutants stemming from human activities. The studies indicated that high turbidity and organic matter reduce the effectiveness of the chlorination process, leading to the passage of *E. coli* bacteria into the distribution network. Furthermore, the persistent discharge of industrial and agricultural waste into the Shatt al-Arab exacerbates this crisis, leaving the majority of local treatment facilities unable to produce water suitable for human consumption (Chalabi *et al.*, 2023; Faroon *et al.*, 2023). A study conducted by Hameed (2024) demonstrated that the release of untreated sewage into rivers leads to increased fecal contamination and higher concentrations of heavy metals, particularly lead, chromium, and iron, which have been closely linked to a rise in the incidence of gastrointestinal diseases among urban populations. Moreover, insufficient monitoring and the depletion of water resources due to the establishment of irrigation projects and dams have increased the vulnerability of drinking water supplies to environmental risks (Al-Asadi *et al*., 2020; Wali *et al*., 2024).

Furthermore the deterioration of the Mesopotamian marshes has removed an critical barrier against the accumulation of pollutants in the Shatt al-Arab, as it acted as a natural water filtration system (Allafta and Opp, 2020). Another study investigating the correlation between water source pollution and tap water quality revealed that bacterial contamination can spread through the supply network due to inadequate centralized treatment mechanism and does not stop at the riverbanks. The study revealed the presence of *E. coli* in random samples taken from homes in different parts of the city of Basrah (Al-Jaberi and Al-Abbawy, 2023). The current study aimed to evaluate microbial contamination in raw and tap water by quantifing the total counts of aerobic bacteria, total coliform bacteria, fecal coliform bacteria, and *E. coli* from different location in the city of Basrah.

Materials And Methods

Sampling

The study sites were selected to cover the main water source (Shatt al-Arab) and various consumption points (domestic taps) across the Basrah Governorate. Sampling was performed in autumn (October 2025) to record the specific environmental and microbial characteristics of the water network. Two types of samples were collected: raw water samples from Shatt al-Arab river, which were collected from the following locations: Sample No. 1 (30°34'55.8" N 47°46'30.3" E) and Sample No. 2 (30°34'48.4" N 47°46'40.0" E). The choice of these particular sample locations was justified by several environmental and logistical factors. At each specified sampling location, duplicate samples were obtained to guarantee repeatability and precision.

Sterilized 500 ml bottles were used; the bottle was manually submerged to an approximate depth of 20–30 cm below the water surface, facing against the current. This operation depth was sustained to avoid collecting surface-floating matter and heavily influenced by surrounding environmental factors, ensuring a representative sample from the water column. Second, tap water samples were collected. Taps directly connected to the main water supply were selected (n=5 houses /region). The tap spout was cleaned for removal of any attachments and to verify there was no external contamination. Before the sample was obtained, the faucet was turned on, and the water was allowed to flow for one minute so the water retrieved was a sample of running water from the pipes and not stagnant water. The bottle was then filled, the spout closed, and an air gap left so the sample could shake before testing.

The bottles and all the samples were labeled using a permanent marker, and their numbers and collection locations were recorded (Sample No. 3: Al-Jazira; sample no. 4:

Um Qasr District; Sample No. 5: Abu Al-Khasib District; sample no. 6: Al-Rafidain neighborhood; and Sample No. 7: Karmat Ali) as shown in (Figure 1).

Figure 1. Locations of Shatt al-Arab water sample collection sites in Basrah Governorate on the map.

After labeling, the samples were immediately put into an insulated icebox at 4°C to preserve biological integrity and to arrest microbial activity. All samples collected arrived safely in the laboratory and were processed within a maximum of 8 h. post-collection to ensure that the original microbial content was not altered.

Culture Media

The culture media used in this study were obtained from HIMEDIA (India). They were prepared by taking the specified quantity in accordance with the preparation method stated on the packaging, and were ready for use in the laboratory culture of the samples at the time of sample collection.

1- **Nutrient Agar**

It was used to determine the total bacterial count of aerobic bacteria, a general indicator of water cleanliness and the effectiveness of sterilization.

2- **M-FC Agar Base (Membrane Fecal Coliform Agar)**

This medium served as a selective and differential medium for the isolation and diagnosis of fecal coliforms. The medium is very inhibitory to the growth of non-intestinal bacteria and allows the growth of lactose fermenters which become blue when incubated at 44.5°C in water bath (Memmert, Germany) (Geldreich *et al*., 1965).

3- **Eosin Methylene Blue (EMB) Agar**

This medium is used as differential and confirmatory medium for the isolation of E.coli. It relies on the presence of eosin and methylene blue dyes as indicators of fermentation of lactose and as inhibitors of Gram-positive bacterial growth. E. coli bacteria form colonies on this medium with a dark center and a characteristic metallic green sheen (Mahon and Lehman, 2019).

Preparation and sterilization of culture media

The culture media were prepared in accordance with the manufacturer's instructions in one liter of distilled water. After heating and complete dissolution of the agar, the culture media were sterilized in an autoclave for 15 minutes at 121°C and 1.5 bar.

Culturing of samples

Water samples were cultured using the membrane filtration method to isolate and quantify the bacteria. This was carried out in accordance with international standards by filtering 100 ml of the water sample through a membrane filter with a pore size of 0.45 µm. The raw water of Shatt al-Arab River was diluted by mixing 10 ml of sample with 90 ml of sterile distilled water before filtration. Similarly, for the highly contaminated tap water sites, Al-Rafidain and Karmat Ali (samples 6 and 7), 50 mL of each sample was diluted with 50 mL of sterile distilled water to optimize the sample volumes while maintaining the standard 100 mL filtration baseline. Finally, the counts were converted to the standard CFU/100 ml unit. The Methodology section now includes specific dilution and filtration quantities. This permits the water to flow through readily while retaining the bacterial cells. The membrane was then transferred using sterile forceps and gently placed on the surface of the pre-prepared culture medium (M-FC agar, EMB agar, and nutritional agar) for bacterial isolation (IOS 2023).

Incubation

Fecal coliform bacteria were detected using culture plates containing M-FC media, which were incubation in a water bath at 44.5 ± 0.2 °C for 24 hours. E. coli was detected by incubating EMB at 37 °C for 24 h. Total bacterial count was performed on nutrient agar plates at 37 °C for 24-48 h. After the incubation period, all colonies grown on the agar plates of the culture medium used were counted using a laboratory colony counter (Li and Wu, 2022). Results were reported as colony forming units/100 ml (CFU/100 ml) (WHO, 2022).

pH and EC

The pH meter (Sartorius, Germany) was calibrated using standard buffer solutions (pH 7.00, pH 4.00, and pH 10.00). The electrode was thoroughly rinsed with distilled water after calibration and before each measurement. The samples were measured by placing the water-rinsed electrode into the water sample to be analyzed and waiting until the reading displayed on the screen stabilized, and then recording the reading. This process was repeated several times to increase the accuracy (Tripura and Singh, 2024). The EC measurement was carried out after setting the device to the mV unit and washing the electrode thoroughly with distilled water, then immersing it in the sample, stirring gently, and taking and recording the reading once the values had stabilized. The measurements were performed at laboratory temperature. The EC values were determined as µS/cm.

Statistical examination

Statistical analysis was performed with IBM SPSS Statistics (Version 25.0). Descriptive statistics included all pertinent replies. A Chi-square goodness-of-fit test was used to ascertain if observed categorical frequencies deviated from anticipated distributions. Paired-samples t-tests with a Bonferroni correction were used to assess pairwise comparisons of mean bacteriology and physicochemical characteristics across several water sample sources, mitigating Type I error inflation from multiple comparisons. All data are shown with 95% confidence intervals (95% CI), and the significance threshold for all tests was established at a p-value < 0.05.

Results and Discussion

Total bacteria count (TPC)

The results of the microbiological analysis on agar medium showed a marked variation in total bacterial counts; samples taken from Shatt al-Arab (Samples 1 and 2) recorded the highest levels of contamination compared to tap water samples. Meanwhile, counts in tap water ranged from 320 CFU/ml as the lowest value at Site 6 to 1200 CFU/ml as the highest value at Site 7 as shown (Table 1 and Figure 1).

Table 1: Bacterial counts in river and tap water samples by collection site.

Sample no.	Sample location	Total bacteria count CFU/100 ml
1	Shatt al-Arab	1500
2	Shatt al-Arab	TNTC
3	Al-Jazira	1000
4	Um Qasr District	850
5	Abu Al-Khasib District	950

6	Al-Rafidain neighborhood	320
7	Karmat Ali	1200

*TNTC: Too Numerous To Count (indicates that the density of the bacterial colony surpassed the reliable upper threshold for precise measurement).

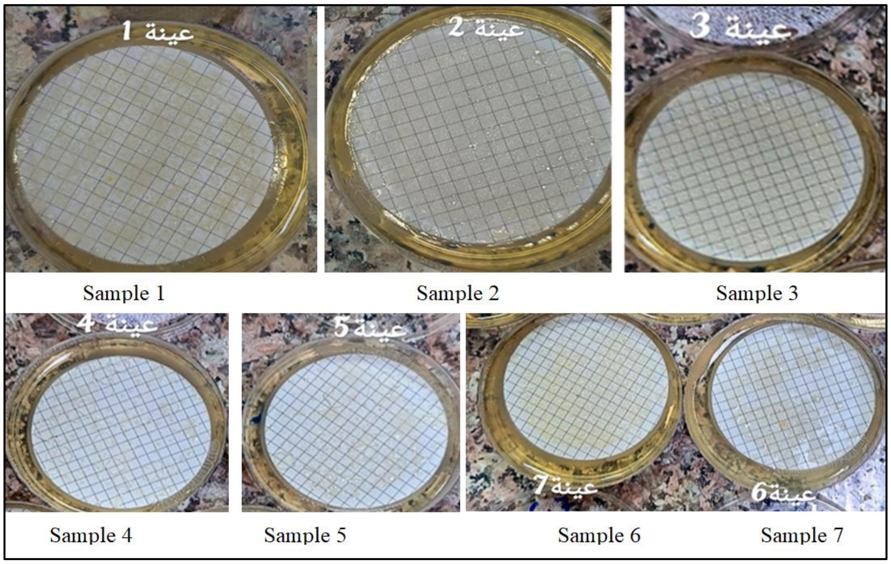

Figure 1. Colonies growing on nutrient agar media from Shatt al-Arab and tap water samples.

Total Coliform Count

The results of culturing the samples on Eosin Methylene Blue Agar (EMB) revealed a clear variation in total coliform counts between the study sites. Sample 2 from the Shatt al-Arab recorded an uncountable number, followed by sample 4 with a count of 420 CFU/100ml. The appearance of colonies with a green metallic sheen on this specific medium is a vital indicator of the presence of *E. coli* (Table 2 and Figure 2).

Table 2: Total coliforms counts in river and tap water samples.

Sample no.	Sample location	Total Coliforms Count CFU/100 ml
1	Shatt al-Arab	110
2	Shatt al-Arab	TNTC
3	Al-Jazira	230
4	Um Qasr District	332
5	Abu Al-Khasib District	260
6	Al-Rafidain neighborhood	375
7	Karmat Ali	420

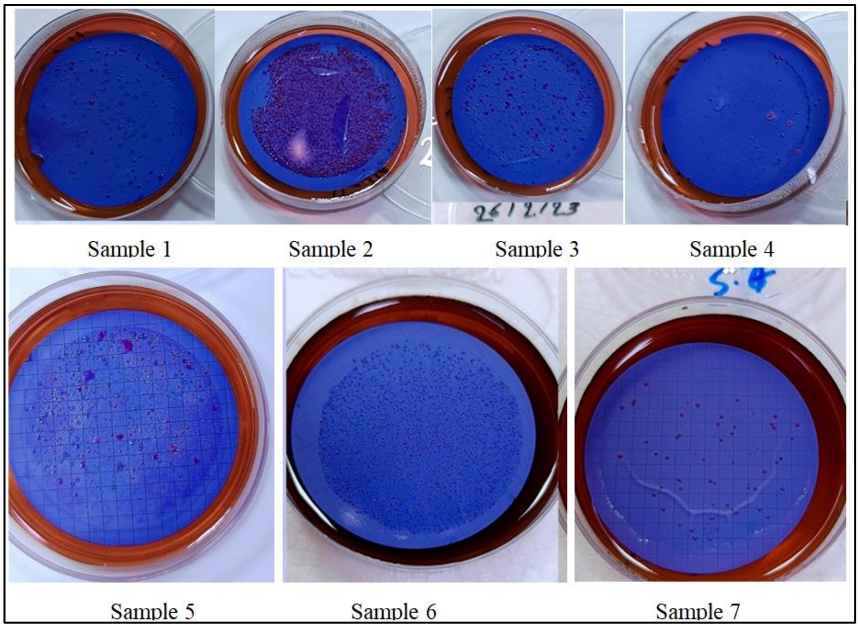

Figure 2: Results of the total coliform count test on EMB medium

Fecal Coliform Count

The results of the fecal coliform count, using M-FC agar medium and incubated at 44.5°C to detect fecal contamination, showed that the count peaked in sample No. 2, taken from Shatt al-Arab, at 170 CFU/100 ml. In contrast, the effluent samples (numbers 3, 4, and 5) were completely free of this type of bacteria (0 CFU/100 ml), reflecting the effectiveness of the chlorination process at those sites, while samples Nos. 7 and 6 recorded slight contamination of 10 CFU/100 ml and 15 CFU/100 ml, respectively, as shown in (Table 3 and Figure 3).

Table 3: Number of fecal coliform bacterial colonies on m-FC agar medium.

Sample no.	Sample location	Total Fecal Coliform Count CFU/100 ml
1	Shatt al-Arab	10
2	Shatt al-Arab	170
3	Al-Jazira	0
4	Um Qasr District	0
5	Abu Al-Khasib District	0
6	Al-Rafidain neighborhood	10
7	Karmat Ali	15

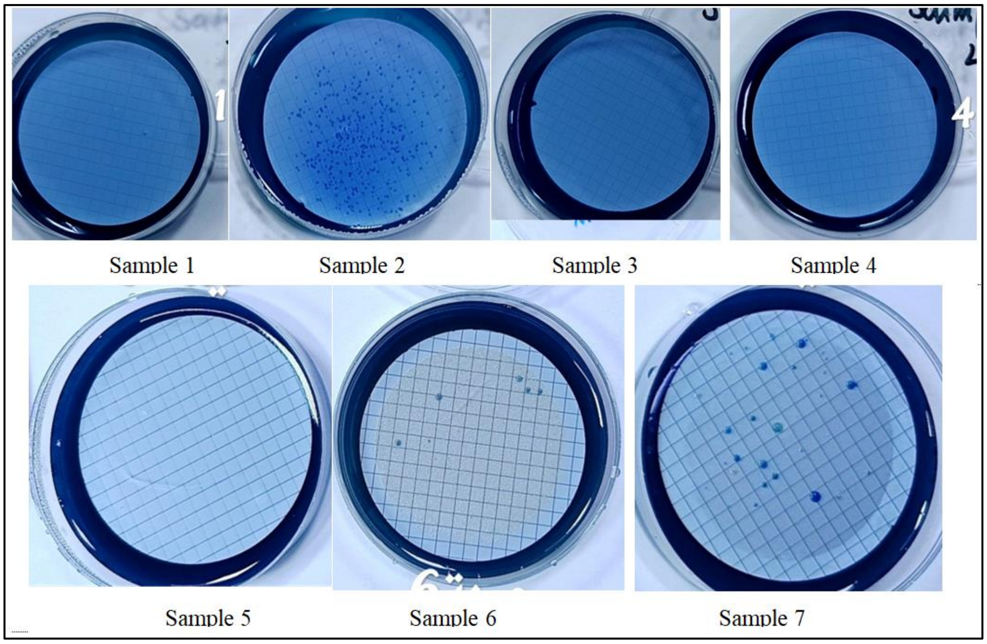

Figure 3: Results of the fecal coliform count test on M-FC medium

pH value and electrical potential (mV)

The results of the pH measurements for the water samples in the present study showed clear variation; the water from Shatt al-Arab (sample no. 2) recorded the lowest value of 5.2, followed by domestic tap sample no. 4 with a value of 5.3, indicating the presence of bacterial activity and decomposition of organic matter, which led to a value below the neutral point. Sample No.1 approached a state of chemical equilibrium with a reading of 6.5, whereas the remaining effluent samples no. 3, 5, 6, and 7 ranged between 6.1 and 6.4. The results indicate a strong spatial correlation between increased acidity (decrease in pH) and an increase in electrical potential (mV). This electrochemical pattern is consistent with the increase in the number of coliform bacteria and total bacterial load at the more acidic sites, as these environments provide a suitable setting for the metabolic activity of certain polluting bacterial species (Table 4 and Figure 4).

Table 4: shows the pH and mV values.

Sample no.	Sample location	pH value	Electrical potential (mV)
1	Shatt al-Arab	6.5	25.6
2	Shatt al-Arab	5.2	85.7
3	Al-Jazira	6.17	38.2
4	Um Qasr District	5.3	68.6
5	Abu Al-Khasib District	6.4	32.5
6	Al-Rafidain neighborhood	6.37	35.4
7	Karmat Ali	6.14	49.8

Electrical Conductivity (EC)

The electrical conductivity values were derived by converting the voltage readings (mV) acquired in the laboratory to analyze the salinity and relate them to other contaminants. The findings indicated that sample No. 2 from Shatt al-Arab had the maximum electrical conductivity value 180 µS/cm, reflecting a considerable increase in salinity and organic breakdown at this site. In contrast, the samples from the domestic tap samples showed relatively lower values, although they still reflected the impact of the saltwater tongue phenomenon or secondary chemical pollution in the network on the region's waters (Table 5).

Table 5: Shows the electrical conductivity (EC µS/cm) values of the water samples.

Sample no.	Sample location	EC µS/Cm
1	Shatt al-Arab	53.76
2	Shatt al-Arab	180
3	Al-Jazira	80.22
4	Um Qasr District	144.06
5	Abu Al-Khasib District	68.25
6	Al-Rafidain neighborhood	74.34
7	Karmat Ali	104.5

Statistical Relationship between Water Quality Parameters and Sampling Sites

In the statistical analysis, a clear interrelation and spatial variation were found between the sampling locations and the analyzed microbiological and physicochemical parameters. There was a strong positive correlation between high bacterial densities, especially Total Bacterial Count (TBC), Total Coliforms (TC), and Fecal Coliforms (TFC), and specific monitoring sites, mainly in the Shatt al-Arab area ($p < 0.05$). The correlation is strong evidence that these sites are directly impacted by anthropogenic activities and untreated sewage discharges. On the contrary, the correlation between physicochemical properties showed a different trend for the electrical conductivity (ES) ($r = 0.78$, $p = 0.012$). The Um Qasr District showed the highest ES values due to strong seawater intrusion, which was associated with a relative reduction in fecal bacterial indicators relative to freshwater locations ($p = 0.003$). This multidimensional interrelation indicates that the water quality at the studied stations is driven simultaneously by two main driving factors, namely organic/microbial pollution from human activities and salinity gradients driven by hydrodynamic factors.

Discussion

Fecal indicators and microbiological analysis

The results of the bacteriological analysis of the water showed that sample no. 2 which was taken from the raw water of Shatt al-Arab recorded the highest bacterial load, especially in the test of fecal coliforms, which confirms the presence of direct contamination by untreated sewage and its arrival to that location.. Furthermore, the significant difference between samples 1 and 2 indicates that pollution in the Shatt al-Arab is not evenly distributed but is concentrated at specific estuaries (Al-Hello *et al*., 2021), making it a local hazard requiring immediate attention. As for the effluent samples, although they recorded much lower counts, the presence of any bacterial colonies is an indicator of 'secondary contamination' in the distribution network, which is consistent with local studies indicating the deterioration of some pipes in certain areas (Hameed and Al-Saffar, 2019). To accurately differentiate these populations during routine analysis, membrane filtration is combined with incubation on m-FC agar, where distinctive colonial colorations usually blue hues act as the principal diagnostic indicator for fecal coliform presence (Saied *et al*., 2025)

Chemical properties and microbial load

A clear association was found between physicochemical parameters and bacterial findings, in which higher acidity (lower pH) and higher electrical conductivity (EC) were associated with increased microbial load. This scientific explanation for the results is that the organic decomposition of pollutants in water (especially in contaminated sites such as Sample 2 and Sample 4) leads to the release of organic acids that increase the acidity of the medium and increase the concentration of dissolved ions, thus providing a nutrient-rich environment that promotes bacterial growth (Al-Imarah *et al*., 2015). The precise ability of membrane filtration technology to identify and enumerate bacterial populations in significant amounts of water (APHA, 2023) can be used to demonstrate this link. In terms of treatment efficiency and health concerns, the findings indicated differences in the effectiveness of disinfection and filtering procedures. Samples (5 and 6) exhibited improved safety levels, whereas sample (7) recorded contamination that requires evaluation. The existence of these bacteria even after filtering raises doubts regarding the efficiency of chlorination methods in tackling contemporary environmental problems, such as excessive saline levels that may interfere with the action of chlorine (Al-Saffar and Hameed, 2020).

Assessment of bacterial load and sources of contamination

A comparison between raw water and tap water highlighted the important role of filtration and sterilization in significantly reducing bacterial levels, with reductions exceeding 90% at some locations. The significant difference across locations, ranging from 10 to 1,200 CFU/ml in tap water, indicates discrepancies in water quality within a single distribution network. This variation may be associated with the geographical distance from the treatment facility, as chlorinated water diminishes in sterilizing efficacy with increased travel distance (Al-Saffar, 2021) or when stored for extended durations in residential tanks, facilitating opportunistic bacterial proliferation (Tokajian and Hashwa, 2021).

This study demonstrated a strong association between a reduction in pH and an increase in bacterial colony counts concerning the efficiency of distribution networks and microbial contamination. This pattern corroborates the concept that bacterial metabolism in highly contaminated environments results in the production of acidic byproducts (organic acids), thereby modifying the chemical composition of the medium (Kumari and Das, 2023). High mV values also indicate a reducing environment rich in organic matter that has depleted dissolved oxygen, creating optimal circumstances for a particular kind of facultative anaerobic bacteria capable of enduring these harsh conditions (Madigan *et al.*, 2015; Weerakoon *et al.*, 2023)

Association pH and EC with bacterial growth

The high salinity of the Shatt al-Arab waters (as indicated by the EC values) causes osmotic stress in bacterial cells. This stress may kill sensitive bacteria, but it is also part of the selection of more salt-tolerant bacterial species (Oren, 2008). Thus, investigating the variety of bacteria in these waters may lead to the discovery of strains with special genetic adaptations. This explains the continuous existence of these organisms despite the changing climatic conditions in the Shatt al-Arab (Al-Bahadily and Al-Sadi, 2020).

A strategy of culture media integration was adopted, and the agar nutrient medium was used to estimate the total number of aerobic bacteria, as this medium allows the growth of most types of living bacterial cells present in the water, as well as their spores (Sanders, 2012). EMB medium, which is selective and differential, was used to isolate coliforms and determine their total counts at 37°C. using the M-FC medium, which acts as a confirmatory method for fecal contamination detection, notably with the blue colony color gradient. This expertise enables us to count and categorize colonies, ascertain the nature of the source of contamination, and estimate hazardous risks more precisely (Grabow, 1996; Shibata *et al.*, 2004).

Membrane filtration was used since it is the globally accepted standard technique for water testing (EPA, 2002), especially when low or medium amounts of bacteria are predicted in the leachate. This approach enables the processing of large quantities of water (>100 ml) as compared with the classical techniques, This increases the precision of the results and removes the errors associated with consecutive dilutions of high-concentration samples. Selective growth media with filters of certain hole sizes (usually 0.45 µm) may be used for the isolation of particular pathogens, such as E. coli (Dąbrowska *et al.*, 2019). The accuracy of the chemical measurements of pH and salinity in this study was validated by converting electrical potential readings into electrical conductivity based on the instrument's linear calibration curve, a procedure validated in accordance with International Units. This procedure is not merely a mathematical conversion but rather a translation of the raw electrical signal into a physical indicator that reflects the concentration of dissolved ions (ISO 1985). It cannot be concluded that a decrease in pH is the sole cause, but the results show a close correlation, which can be attributed to bacterial metabolism. As they grow and multiply in environments rich in organic matter, as was the case with the Shatt al-Arab water samples, they secrete acidic by-products that lower pH values, as confirmed by Al-Baghdadi *et al*. (2024). Consequently, acidity serves as an indicator of the vitality and activity of the bacterial community in that sample and not merely as a neutral environmental factor (Gao *et al*., 2022).

Conclusion

The present study concluded that the water of the Shatt al-Arab River in Basrah Governorate has deteriorated in terms of both bacteriological and chemical quality. Raw water samples contained high levels of total bacteria and fecal coliforms, indicating that fecal contaminants directly entered the water. The tap water samples collected from several areas had various bacterial counts; however, the other places did not indicate the presence of fecal coliforms, highlighting the effectiveness of chlorination treatment and disinfection. The correlation between chemical, physical, and microbiological changes was reflected in the drop in pH values, which was followed by an increase in Electrical Conductivity (EC) and microbial metabolic activity. This study highlights the need for monitoring water distribution networks for the protection of human health and reduction of environmental effects, and the adoption of modern treatment technology to limit the threats of bacteriological contamination and growing water salinity.

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تقييم المحتوى البكتيري لمياه الخام ومياه الصنبور في مدينة البصرة، العراق

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المستخلص

ضمان سلامة مياه الشرب هو أولوية أساسية للصحة العامة، لا سيما في المدن التي تواجه مخاطر بيئية محتملة. قيمت هذه الدراسة الخصائص ميكروبية والفيزيائية والكيميائية لمياه نهر شط العرب ومياه الصنبور في مدينة البصرة في العراق. تمت مراقبة إجمالي عدد البكتيريا الكلية والبكتريا البرازي والرقم الهيدروجيني (pH) والتوصيل الكهربائي (EC) في عينات المياه التي تم الحصول عليها من نقاط أخذ عينات مختلفة. تم تحديد بكتريا القولون البرازي على وسط أجار M-FC بعد الحضن عند 44.5 درجة مئوية. كشف تحديد الخصائص البكتريولوجية عن تباين جغرافي ملحوظ في الحمل البكتيري. أظهرت عينات مياه شط العرب (العينة 2) أعلى معدلات من البكتيريا الكلية وبكتيريا القولون البرازي (حتى 170 وحدة تكوين مستعمرة/100 مل) مما يشير إلى تلامس مباشر مع الملوثات العضوية والبرازية. من ناحية أخرى، أظهرت عدادات مياه الصنبور مستويات تلوث أقل ولكنها متباينة للغاية بين 320 في الموقع 6 و1200 وحدة تكوين مستعمرة/100 مل في الموقع 7. لم يتم الكشف عن أي بكتيريا قولون برازي (0) في عينات المياه العادمة (المواقع 3 و4 و5)، مما يشير إلى الفعالية المحلية لعملية الكلورة. تم تسجيل انخفاض حاد في درجة الحموضة وزيادة في قيم التوصيل الكهربائي في أكثر المناطق تلوثًا، مما يظهر ارتباطًا قويًا بين النشاط الأيضي الميكروبي والخصائص الكيميائية المتضررة للمياه. تشير النتائج إلى أنه على الرغم من أن المعاملة بالكلور لها بعض التأثير، فإن شبكات توزيع المياه في البصرة تتطلب مراقبة عاجلة منتظمة وتقنيات معالجة متقدمة للتعامل مع زيادة الملوحة والتلوث البيولوجي من أجل الوصول لمعايير مياه الشرب العراقية والدولية.

الكلمات المفتاحية: مياه الشرب، البكتيريا الكلية، القولون البرازي، جودة المياه.