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Assessment of Water Bacterial Contamination and Physical Quality of General Estuary River in Iraq.

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Abstract

Background: Water quality is an important indicator of environmental and public health. Bacterial contamination and changes in physical properties of river water can negatively affect water's suitability for domestic and agricultural uses. **Aim**. To assess bacterial contamination and physical quality of the General Estuary River in **Iraq** during the period 2023–2024. **Methods**. Water samples were collected from three locations representing different cities along the General Estuary River during 2023–2024. Three 100 mL water samples were collected biweekly from each location. The samples were transported in a cool box to the laboratory for bacteriological and physical analyses. Total bacterial count, total coliform count, pH, and turbidity were determined. **Results**. The results showed that both total bacterial count and total coliform count increased progressively along the river course, with the highest values recorded in Basra city. Similarly, pH and turbidity values increased downstream after Baghdad, and the highest levels were observed in Basra. These findings indicate a deterioration in water quality as the river flows through successive urban areas. **Conclusion**. The General Estuary River exhibited increasing bacterial contamination and deterioration in physical water quality along its course, with Basra recording the highest levels. Continuous monitoring and effective pollution control measures are recommended to preserve water quality and reduce potential health risks.

Key words: General Estuary River, Water Quality, Bacterial Contamination, Total Coliform Count, pH, Turbidity, Iraq.

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Introduction

The microorganism is typically the cause of microbiological pollution of water, which is a naturally occurring type of water pollution, many microbes can be found in water and can infect humans, fish, and land animals, water-dwelling microbes, including bacteria, viruses, and protozoa, are the source of hazardous diseases like cholera, people in less developed countries typically suffer from such diseases because they lack the resources for purifying contaminated water [18]. Microbial causes of water contamination are microorganisms that live in water and cause diseases in fish, land animals and humans. They can get in drinking water at the water's source or in the distribution system after the water has already been treated, some of the sources of microbial contamination are fertilizers, pesticides, or other chemicals that have been applied to land near the water [12]. The high numbers of bacteria in the water of the Tigris and Euphrates rivers is a major problem, and its cause is attributed to the disposal of civil waste and the accompanying excesses in throwing heavy water with wastewater. Studies have indicated that the total numbers of bacteria and coliform bacteria reach 10^6 and 10^4 cells/1 ml, respectively. Wastewater is thrown into the river, which has negative effects on the safety of the water quality

of the Tigris River and the transmission of diseases to humans [7, 9, 22].

The water quality index is defined as a numerical expression used to convert a large number of data into one simplified number that can indicate the level of water quality, or it is a collection of water quality data at different times and places, and the possibility of converting it into a single numerical value [5]. pH is one of the very important characteristics of the aquatic ecosystem. For example, the acidic environment has negative effects on living organisms due to the dissolution of heavy elements and other effects on the growth and development processes of aquatic organisms, which negatively affects biodiversity [17], and this decrease was shown. The pH values are due to the products of the biological decomposition processes of organic substances that lead to the formation of carboxylic acids and mineral acids. As for the values of the Tigris River water, they ranged between (8.09-7.36). Able [3] Noted that there are relative effects of the liquid excreta drained into the river, even if it were not for the susceptibility of the equation. Acid Neutralization Capacity (ANC) would have been a significant decrease in the river water, thus increasing the negative effects on the aquatic ecosystem [8, 22]. Turbidity is another term for the clarity and the purity of water, and it is a crucial physical water condition, it is an intrinsic characteristic that enables light lines to reflex or absorb rather than transmit by particles and suspended pollutants dissolved in water, Significant evidence reveals that turbidity management is a good and reliable neutralization against bacteria, especially pathogenic bacteria, in drinking water, contrary to what was previously regarded to be solely an aesthetic element.[2, 13, 19] The main drain canal of general estuary or the Third River in Iraq is a project of the Iraqi Ministry of Water Resources, is a major trocar established due to the expansion of the establishment of irrigation, where it collects the water of the trocar network for agricultural projects and prevent mixing with the water of the Tigris and Euphrates rivers, and secure its transfer to the Shatt Basra and then the Arabian Gulf, the construction of the general estuary has been done since 1964 and completed in 1992, the biggest drain canal, a wide, shallow canal that flows among the Tigris and Euphrates rivers and its purpose is to carry polluted water used for irrigation that would otherwise be returned to the two rivers, the general canal project is one of the major development projects in Iraq because of its crucial role in transporting saltwater received from the restoration agricultural land in central and southern Iraq through an interconnected network of secondary and main trocars that eventually flow into the general estuary [4, 15]. The aims of the study to assessment of water bacterial contamination and physical quality of General Estuary River in Iraq at three cities locations (Baghdad, Dhi Qar, and Basra) during 2023-2024.

MATERIALS AND METHODS

Period of the study: The main study was carried out at the College of Veterinary Medicine, University of Baghdad during the period between 1/11/2023 to 1/5/2024 (7 months period).

Location of the study as shown in Figure 1, where the study included the general estuary river, starting from the city of Baghdad and ending in the city of Basra.

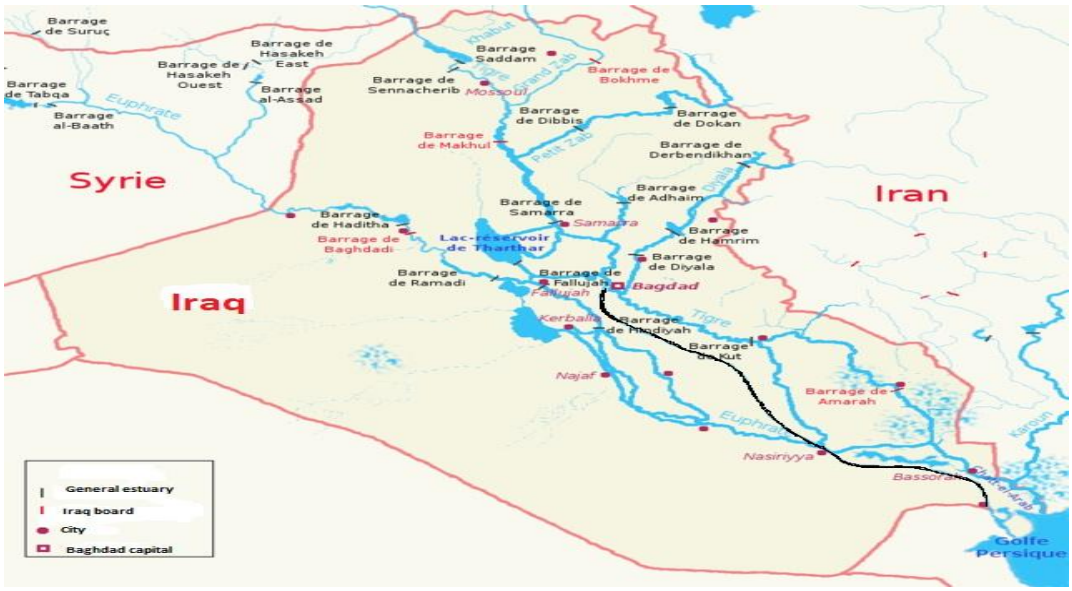

Figure 1: Map of the location study of general estuary river in Iraqi.

Samples Collection: Water samples were collected from three cities of general estuary river which were, Baghdad (The start of general estuary), Dhi Qar city and Basrah City (The end of general estuary).

Water Samples: Three bottled sample (100ml) Biweekly were collected from each city location during the study. The collected samples were transported in cool boxes to the laboratory.

Total bacterial count: The number of bacteria were counted using the pour-plate method mentioned by [14], by transferring (1 ml) of each decimal diluent with a sterile pipette into two empty and sterilized Petri dishes (Duplicate) and add dirctly to each dish. (15 ml) of the sterile culture medium (Nutrient Agar, Accumix company) stored in a bath of water at (46 °C), then the culture medium is mixed with the dilution of the bacterial suspension well by rotating the dishes towards the right and towards the left with stirring it each time and after the culture medium hardened, the dishes were preserved inverted in the incubator at (37°C) for 24 hours, after which the growing colonies were counted in dishes containing (30-300) colonies, and the number of bacteria was estimated by multiplying the number of colonies by the reciprocal of dilution to extract the number in one milliliter of water.

Coliform bacterial count: Coliform bacteria were counted using the pour-plate method mentioned by [14] to estimate the numbers of coliform bacteria by transferring (1 ml) of each decimal diluent with a sterile pipette into two empty and sterilized Petri dishes (Duplicate) and directly (15 ml) of sterile culture medium (MacConkey Agar, Accumix company) kept in a water bath at (46°C) is added to each plate, then the culture medium is mixed with the dilution of the bacterial suspension well by rotating the plates towards the right and towards the left with stirring each time and after the medium hardens The culture dishes were kept upside down in the incubator at (37°C) for 24 hours after which the growing colonies were counted in the dishes containing (30-300) colonies, and the numbers of bacteria were estimated by multiplying the number of colonies by the reciprocal of dilution to extract the number in one milliliter of water.

pH: The pH of water samples were measured according to [11] with a portable pH meter by immersing the bulb of the device (electrode) in the container containing the water and recording the value it indicates at the river site, then we

replicate the measurement in the laboratory few hours later with digital pH meter.

Turbidity: The samples were analyzed for turbidity according to [1] using a turbidity meter, model ME-PZD-2A, which gives the degree of turbidity as NTU stands for Nephelometric Turbidity unit.

Statistical analysis: Statistical analysis of data was performed using SAS]20]. Two-way ANOVA and Least significant differences (LSD) post hoc test were performed to assess significant differences among means. Pearson correlation coefficient was also estimated. $P < 0.05$ is considered statistically significant. The data of total bacterial count were inverted to log no. before statistical analysis.

RESULTS

Bacterial contamination

Table (1) shows the total bacterial count in water samples collected from Baghdad, Dhi Qar, and Basra during the study period. The bacterial count increased significantly downstream, with Basra recording the highest values. The counts declined toward the end of the study period.Table (2) shows the total coliform count in the three locations. Coliform counts also increased along the river course and were highest in Basra.

Table 1: Total bacterial count (log no.) in general estuary water at three cities location.

City / Month	Baghdad	Thi-Qar	Basra
November	B 7.48±0.27 a	A 8.21±0.20 a	A 8.01±0.12 b
December	B 6.23±0.24 b	A 8.32±0.23 a	A 8.49±0.15 ab
January	B 7.25±0.25 a	A 8.27±0.15 a	A 8.91±0.20 a
February	C 5.89±0.16 b	B 7.30±0.20 b	A 8.39±0.14 ab
March	C 4.05±0.22 c	B 5.76±0.08 b	A 8.29±0.37 b
April	C 1.99±0.20 e	B 3.81±0.20 c	A 5.76±0.23 c
May	C 2.67±0.17 d	B 3.71±0.03 c	A 5.65±0.30 c
LSD	0.59		

Means with a different small letter in the same column are significantly different ($P<0.05$)
Means with a different capital letter in the same row are significantly different ($P<0.05$)

Table 2: Total coliform count (log no.) in general estuary water at three cities location.

City / Month	Baghdad	Thi-Qar	Basra
November	B 5.67±0.06 b	A 7.41±0.25 a	A 7.41±0.22 b
December	C 5.61±0.27 b	B 6.68±0.19 b	A 8.34±0.30 a
January	C 6.43±0.24 a	B 7.83±0.03 a	A 8.72±0.24 a
February	C 4.24±0.17 c	B 5.64±0.20 c	A 6.46±0.15 a
March	C 2.61±0.19 d	B 4.86±0.30 d	A 6.20±0.07 a
April	B 1.93±0.01 e	B 2.15±0.21 f	A 3.63±0.23 e
May	C 1.28±0.04 f	B 3.63±0.03 e	A 4.36±0.03 d
LSD	0.54		

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

Physical quality of water

Table (3) presents pH values in the studied locations. Basra generally recorded the highest pH values. Table (4) presents turbidity values. Turbidity increased significantly downstream and reached the highest values in Basra.

Table 3: pH value of general estuary water at three cities locations.

City / Month	Baghdad	Thi-Qar	Basra
November	C 7.85±0.05 a	B 8.35±0.05 a	A 8.75±0.15 a
December	B 8.00±0.00 a	B 8.20±0.10 a	A 8.70±0.20 a
January	B 8.05±0.05 a	B 8.15±0.05 ab	A 8.45±0.05 b
February	B	B	A

	7.95±0.05 a	7.85±0.05 b	8.80±0.10 a
March	B 8.05±0.05 a	B 7.95±0.05 b	A 8.45±0.05 b
April	B 7.95±0.05 a	B 7.85±0.05 b	A 8.35±0.05 b
May	B 7.85±0.05 a	AB 7.90±0.10 b	A 8.10±0.10 c
LSD	0.23		

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

Table 4: Turbidity value (NTU) of general estuary water at three cities location.

City / Month	Baghdad	Thi-Qar	Basra
November	C 7.475±0.25 e	B 10.690±0.10 c	A 12.146±0.56 c
December	C 7.488±0.99 e	B 10.600±0.57 c	A 12.959±0.61 c
January	C 7.674±0.24 d	B 10.783±0.76 b	A 14.309±0.11 b
February	C 7.864±0.29 c	B 10.780±0.45 b	A 14.679±0.14 b
March	C 8.457±0.99 a	B 10.917±0.72 a	A 14.428±0.23 b
April	C 8.050±0.60 b	B 10.833±0.21 a	A 15.709±0.65 a
May	C 8.404±0.17 a	B 10.930±0.70 a	A 15.841±0.30 a
LSD	1.56		

Means with a different small letter in the same column are significantly different (P<0.05)
Means with a different capital letter in the same row are significantly different (P<0.05)

DISCUSSION

Bacterial pollution of water is often associated with different microorganisms that may affect humans, animals, and aquatic life. The increase in bacterial and coliform counts observed in this study may be related to sewage discharge, wastewater inputs, and agricultural activities along the river course. Previous Iraqi studies reported high bacterial loads in river water as a result of wastewater disposal, which negatively affects water quality and increases the risk of disease transmission. The pH values observed in

the present study remained within acceptable ranges for surface water. Variations may be associated with biological decomposition processes and dissolved materials in the water. The increase in turbidity values downstream reflects the presence of suspended particles and organic matter. High turbidity can reduce the effectiveness of water disinfection and adversely affect water quality.

CONCLUSIONS

This study indicates that the total bacterial count and total coliform count increased in the general estuary rivers as the river continued to pass, so that the water samples of the city of Basra recorded the highest number. pH and turbidity values increased in the general estuary rivers as flow progressed in the cities after Baghdad, and Basra city recorded the highest values.

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