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Article

Assessment of The Water Quality of The Tigris River in The City of Mosul Using Some Chemical and Physical Indicators

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Abstract: The present study aimed to evaluate the water quality of the Tigris River in the city of Mosul based on some chemical and physical properties. To achieve this, water samples were collected monthly from three sites, namely Yarmja, Hawi al-Kanisa, and Al – Qubba, for a period of six months starting from October 2025 to March 2026.), turbidity, and temperature. After recording the results, they were statistically analyzed and the averages were compared with the Duncan Multi-Range Test at a 5% probability level. The results showed seasonal and localized variation in a number of indicators, as the Yarmja site recorded the highest value of electrical conductivity (EC) during March 762 µS/cm, and also characterized by the highest turbidity value of 19.70 NTU. While the highest value of dissolved oxygen (DO) at Al – Qubba site during the month of February was 12.00 mg/L, and during the study, it was observed that the change in water quality in the studied sites is related to the overlap of seasonal, geological and human factors.

Keywords: Tigris River, Water Quality, Physical and Chemical Properties, City of Mosul

1. Introduction

In recent years, environmental issues have received increasing attention by researchers, due to the direct challenges they pose that affect human life, living organisms, and the sustainability of natural resources. The expansion of human activities, the misuse of resources, and the continued pressure on the components of the environment have exacerbated the problems of pollution and the deterioration of the basic elements of the environment, including water, air, soil, and food resources [1], [2].

Water is one of the most sensitive environmental elements to pollution, as it is a medium capable of receiving and transporting many pollutants due to its physical and chemical properties. Water pollution occurs when there is a change in its composition or qualities, directly or indirectly, which is reflected in its quality and susceptibility to various uses [3].

Water pollution is one of the most prominent contemporary environmental problems, as it is directly linked to increased population, urban, and industrial pressures and mismanagement of water resources. These factors may contribute to changing the structure of aquatic ecosystems and reducing their ability to regenerate and adapt to various influences [4]. Pollutants from the air and soil may reach water bodies through runoff, sedimentation, or other pathways, contributing to the deterioration of water quality and the impact of freshwater systems [5].

With the growing need for fresh water and its limited resources at the global level, monitoring water quality and assessing its characteristics has become a scientific and environmental necessity. Changes in the physical, chemical and biological properties of water are an important indicator of how sensitive it is to pollutants and environmental factors. Assessing the water characteristics of the Tigris River within the city of Mosul is

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an important step to understand the state of water and monitor its spatial and temporal changes, due to the environmental and water importance of the river in the region [6], [7].

2. Materials and Methods

Study Area:

The current study was conducted on the water of the Tigris River within the city of Mosul in Nineveh governorate through three water sample collection sites, including Yarmja, Hawi al-Kanisa, and Al – Qubba.

Sample Collection:

Water samples were collected monthly from the studied sites, during the period from October 2025 to March 2026, for a period of six months. The total number of water samples studied reached 18, with one sample per month from all sites using clean and sealed plastic bottles, and after washing the sample with water before collection, then transferred to the laboratory for laboratory tests.

Physical and chemical examinations:

The study included the measurement of ten physical and chemical indicators to evaluate the water quality of the Tigris River in the studied sites, namely: pH, electrical conductivity(EC), TDS, chlorides, sulfates, sodium, potassium, dissolved oxygen(DO), turbidity and temperature. Based on the standard methods used in water analysis, according to [8].

3. Results and Discussion

pH

(Table 1) pH values observed on the water of the Tigris River in the sites under study

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	7.02 a	7.60 a	7.50 a	7.37 a
November	7.10 a	7.20 a	7.25 a	7.18 a
December	6.90 a	7.20 a	7.10 a	7.07 a
January	6.63 a	6.90 a	7.10 a	6.88 a
February	6.80 a	6.83 a	7.30 a	6.98 a
March	6.80 a	6.80 a	7.80 a	6.80 a
Rate	**6.88 a**	**7.09 a**	**7.10 a**	

Similar alphabets indicate no significant differences, while different letters indicate significant differences according to the Duncan multi-range test at a probability level of 5%.

The pH values in the water of the Tigris River ranged between 6.63 and 7.60 at the Yarmja, Hawi al-Kanisa, and Al – Qubba, respectively, as shown in Table 1, indicating that the water ranged from neutral to weak base. The relative decrease in pH values may be attributed to the increased dissolution of carbon dioxide resulting from the decomposition of organic matter, while the increase may be related to the effect of carbonate and bicarbonate salts in the water, and this is consistent with what both indicated [9], [10].

EC Conductivity

(Table 2) Electrical conductivity (EC) values observed on the Tigris River at the study sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	704.00 b	473.00 k	482.00 j	553.00 d
November	461.00 l	523.00 h	565.00 f	516.33 e
December	627.00 d	511.00 i	523.00 h	553.67 d
January	621.00 d	595.00 e	523.00 h	679.67 c
February	690.00 c	693.00 c	563.00 f	648.67 a
March	762.00 a	535.00 g	513.00 i	603.33 b
Rate	**644.17 a**	**555.00 b**	**528.17 c**	

The EC values in the Tigris River waters ranged between 461.00 and 762.00 µS/cm at the Yarmja station during November and March, respectively, as shown in Table (2). The increase in EC values is due to increased concentrations of ions and dissolved salts in the water, as well as spatial and seasonal changes in the study sites. This is consistent with the points indicated by [11], [12].

Total Dissolved Solids (TDS)

(Table 3) Total Dissolved Solids (TDS) values observed on the Tigris River at the study sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	466.00 b	318.00 h	320.00 h	368.00 e
November	395.00 e	380.00 f	329.00 h	368.00 e
December	512.00 a	447.00 c	454.00 bc	471.00 a
January	446.00 c	393.00 e	373.00 f	404.00 b
February	396.00 e	411.00 d	322.00 h	376.33 d
March	450.00 c	370.00 f	347.00 g	389.00 c
Rate	**444.17 a**	**386.5**	**357.50 c**	

The TDS values in the Tigris River waters ranged between 318.00 and 512.00 mg/L at the Hawi al-Kanisa and Yarmja respectively, as shown in Table 3. The increase in TDS values may be attributed to an increase in salts and minerals dissolved in the water, as well as soil and sediment leaching and the transfer of dissolved salts downstream, which is consistent with [10].

Chlorides

(Table 4) The Cl-ion values observed on the Tigris River at the study sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	40.00 a	24.00 de	22.00 ef	28.67 a
November	30.00 b	26.00 cd	24.00 de	26.67 b
December	18.00 gh	15.00 i	14.00 i	15.67 f
January	26.00 cd	20.00 fg	19.00 g	21.67 d

February	25.00 d	28.00 bc	18.00 gh	23.67 c
March	22.00 ef	14.00 i	16.00 hi	17.33 e
Rate	**26.83 a**	**21.17 b**	**18.83 c**	

The Cl-ion values in the water of the Tigris River ranged between 14.00 and 40.00 mg/L with the lowest value recorded at Al – Qubba and Hawi al-Kanisa, while the highest value was recorded at Yarmja, as shown in Table 4. The increase in chloride values may be attributed to increased salt concentrations, relatively low water dilution, as well as the impact of human or agricultural sources near the study sites. [13], [14].

Sulfate Ion

(Table 5) sulfate ion SO_4^{-2} values observed on the Tigris River at the study sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	114.00 d	80.00 fg	77.00 g	90.33 b
November	97.00 e	84.60 f	70.40 h	84.00 c
December	53.00 j	40.00 k	43.00 k	45.33 f
January	67.00 h	32.00 l	54.00 j	51.00 e
February	102.00 e	128.00 b	145.00 a	125.00 a
March	121.00 c	61.00 i	55.00 j	79.00 d
Rate	**92.33 a**	**70.93 c**	**74.07 b**	

The sulfate ion (SO_4^{-2})values in the Tigris River water ranged between 32.00 and 145.00 mg/L at Hawi al-Kanisa and Al – Qubba respectively, as shown in (Table 5), indicating a clear variation in sulfate concentrations between the study sites, and the relative decrease in sulfate values may be attributed to increased water dilution during some months, while the rise may be related to the washing of soils and rocks containing sulfate salts during the rainy season, as well as The impact of runoff and agricultural or urban sources, and this is consistent with what both [15], [16].

Sodium Ion

(Table 6) Sodium Na^+ Ion Values Observed on the Tigris River at the Study Sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	22.00 ab	14.00 g	11.00 h	15.67 c
November	15.00 fg	14.00 g	11.00 h	13.33 d
December	23.00 a	19.00 cd	18.00 cde	20.00 a
January	22.00 ab	18.00 cde	17.00 def	19.00 a
February	19.00 cd	18.00 cd	15.00 fg	17.33 b
March	20.00 bc	17.00 def	16.00 efg	17.67 b
Rate	**20.17 a**	**16.67 b**	**14.67 c**	

The Na^+ sodium ion values in the water of the Tigris River ranged between 11.00 and 23.00 mg/L at the two stations of Al-Qubba and Yarmja respectively, as shown in Table 6, indicating that there is a variation in sodium concentrations between the study sites. The relative decrease in sodium values may be attributed to the increase in water dilution resulting from rainfall and water mixing, while the increase may be related to the increase

in dissolved salts and major ions in the water, and this is consistent with what has been pointed out. Each of the [3], [17], [18].

Potassium Ion

(Table 7) Potassium Ion K^+ Values Observed on the Tigris River at the Study Sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	8.00 a	3.00 b	1.00 d	4.00 a
November	2.00 c	2.00 c	1.00 d	1.67 b
December	2.00 c	1.00 d	1.00 d	1.33 b
January	2.00 c	1.00 d	1.00 d	1.33 b
February	2.00 c	2.00 c	1.00 d	1.67 b
March	3.00 b	1.00 d	1.00 d	1.67 b
Rate	**3.17 a**	**1.67 b**	**1.00 c**	

The K+ potassium ion values in the water of the Tigris River ranged between 1.00 and 8.00 mg/L at the two stations of Al-Qubba and Yarmja respectively, as shown in (Table 7), indicating that there is a variation in potassium ion concentrations between the study sites. The relative decrease in potassium values may be attributed to the increase in water dilution caused by rainwater, while the increase may be related to the arrival of agricultural runoff or plant and organic residues into the water, and this is consistent with the following: Referred to by [19], [20], [21].

Dissolved Oxygen (DO)

(Table 8) Dissolved Oxygen Values (DO) Observed on the Tigris River at the Study Sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	4.70 f	9.60 bcd	8.10 de	7.47 d
November	9.80 bcd	9.20 cd	9.90 bcd	9.63 b
December	6.50 e	9.30 cd	11.30 ab	9.03 bc
January	6.40 e	10.70 abc	8.60 d	8.57 c
February	10.70 abc	10.60 abc	12.00 a	11.10 a
March	8.80 cd	8.60 d	9.00 cd	8.80 bc
Rate	**7.82 b**	**9.67 a**	**9.82 a**	

The DO values in the water of the Tigris River ranged between 4.70 and 12.00 mg/L at the Yarmja and Al-Qubba stations respectively, as shown in (Table 8), indicating that there is a variation in dissolved oxygen concentrations between the study sites. The relative decrease in DO values may be attributed to higher water temperature, increased microbial activity, and oxygen consumption in the presence of substances. organic, while the rise may be associated with a relatively lower temperature and increased water capacity to retain dissolved oxygen, this is consistent with what both [22], [23].

Turbidity

(Table 9) Turbidity values observed on the Tigris River at the study sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	1.28 i	1.20 i	0.10 j	0.86 e
November	0.70 ij	0.12 j	1.23 i	0.68 e
December	2.97 h	1.25 i	1.15 i	1.79 d
January	2.95 h	14.20 c	15.11 b	10.75 a
February	6.70 f	10.00 e	13.20 d	9.97 b
March	19.70 a	2.30 h	5.00 g	9.00 c
Rate	**5.72 a**	**4.85 b**	**5.97 a**	

The turbidity values in the water of the Tigris River ranged between 0.10 and 19.70 NTU at the two stations of Al-Qubba and Yarmja respectively, as shown in (Table 9), which indicates that there is a clear variation in turbidity values between the study sites. The relative decrease in the values of turbidity may be attributed to the decrease in the intensity of runoff and the lack of soil and sediment erosion into the riverbed, while the height may be related to the effect of rainfall, runoff, and the transfer of sediments and suspended materials to the water. Agrees with what all of the [24], [25].

Water Temperature

(Table 10) Water Temperature Values Observed on the Tigris River in the Study Sites

Location / The month	Yarmja	Hawi al-Kanisa	Al – Qubba	Rate
October	22.00 ab	21.20 b	22.60 a	21.93 a
November	16.40 d	15.70 de	16.40 d	16.17 a
December	13.50 f	11.40 g	11.30 g	12.07 d
January	8.70 h	9.10 h	11.30 g	9.70 e
February	16.30 d	12.30 g	11.40 g	13.33 c
March	17.70 c	15.00 e	15.40 de	16.03 b
Rate	**15.77 a**	**14.12 c**	**14.73 b**	

The water temperature values in the water of the Tigris River ranged between 8.70 and 22.60 °C at the Yarmja and Al-Qubba stations respectively, as shown in Table 10, indicating that the water temperature varies according to seasonal changes during the study period. The relative decrease in temperature may be attributed to the decrease in atmospheric temperatures during the winter, while the rise may be related to the normal monsoon pattern and the rise in temperatures during the month of October. What have pointed out [22], [23].

4. Conclusion

The study concluded that the water quality of the Tigris River in the city of Mosul showed seasonal and location variation in the physical and chemical characteristics that were highlighted during the study period, and this conclusion is based on the values of the statistical analysis that showed the existence of significant differences between some

months and locations at the level of 5% probability. The Yarmja site was characterized by a more pronounced rise in the indicators related to salts and dissolved substances, while the turbidity increased during the winter months and the beginning of spring. The rise in dissolved oxygen was associated with a decrease in temperature. The results indicate that the change in water quality is a result of the overlap of seasonal and human geological factors, stressing that the results represent only the duration of the study and do not represent all annual changes. These indicators alone cannot be adopted to make a final judgment on the water suitability of the swarm unless they are supported by additional microbial and chemical tests.

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