# Some physical, chemical and biological characteristics of tigris river waters passing through Al-Ishaqi district/Iraq

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**Abstract**

The study aimed to investigate Physical, Chemical and invertebrate organisms as biological test in water samples collected from the waters of the Tigris River passing through Al-Ishaqi District / Salah Al-Din Governorate, for the period from October 2020 to March 2021.

Physical and Chemical test Changes in water temperatures were recorded, as the lowest value was 11.5 $C^{O}$ in December 2020 and January 2021 in the river stations 3 and 1, respectively, while the highest value recorded was 20.8 $C^{O}$ for October 2020 in station 4. Varying levels of turbidity appeared, as its highest value was 292,294 in January 2021 in stations 1 and 5, and its lowest value was 240 in October in station 3. The results showed different values for conductivity, the highest value was 506 µS/cm for March 2021 in station 1, and the lowest value was 361 µS/cm for October 2020 in Station 5. The highest value of the average dissolved solids was 209 ppm in March in Station 4, and the lowest value was 173 ppm for October 2020 in Station 2. It was found that the pH values recorded the highest value of 8.4 in October 2020 in station 1, and the lowest value was 7.2 for March in station 5. The lowest value of dissolved oxygen was 6.7 ppm for March in Station 1, and the highest value for November 2020 in the river station 5. The highest value of the biological oxygen demand was 4.4 ppm for March in Station 2, and the lowest value for it was 0.6 ppm for December 2020 in Station 1.

Biological test for invertebrate organisms shows Three types of invertebrates were diagnosed are *Daphnia*, *Stentor* and *Amoeba proteus*. The highest number of samples was recorded during January and March in Stations 2and 1 respectively, and the lowest number of samples was in October in Station 2 and November in Station 3.

**Keywords:** invertebrate organisms, Tigris river, Al-Ishaqi district, Iraq

## Introduction

Fresh water, including river water, is important for vital activities, especially human activities such as drinking and watering plants (UNEP, 2008; Abbas and Hassan, 2017) [14, 1]. And its quality affects the environmental system and its sustainability (OCED, 2008) [11].

The Tigris River contributes to providing fresh water to many Iraqi cities and districts, and this water is used for drinking and other uses, but the disposal of polluted waste and the sewage network contribute to its pollution, and that 34.6% of Iraqi cities are served by the sewage water network system in 2017 (Central Statistical Organization 2017) [4].

There are several indicators that determine the quality of river water, and these criteria may be biological, chemical or physical, especially since the qualitative characteristics are reflected in the uses of water for various purposes (Sargaonkar and Deshpande, 2003) [12]. The physical, chemical and biological properties of water are among the most important factors determining the use of water for different purposes, and the organisms in the water show great sensitivity to any change in the physical and chemical characteristics of the water medium in which they live, and these factors affect the nature of life of living organisms in which they live (Melo and Hazar, 2000) [10].

Invertebrates are characterized as animals that do not have a backbone, and they constitute 97% of the species in the animal kingdom, divided into two groups, the first includes single-celled invertebrates called protozoa, while the second group includes invertebrates whose bodies are called metazoans, such as *Stentor*, *Daphnia*, and *Amoeba proteus* (Wells *et al*., 1983; Kotpal, 2009) [16, 8].

## Materials and methods

### 1. Places and duration of sample collection

Water samples were collected from five locations from the Tigris River passing through the Al-Ishaqi district in Salah Al-Din Governorate North Baghdad 34.0384, 44.05156 (Figure 1), for the period from October 2020 to March 2021, Five Stations (St.) and water samples were taken monthly with a volume of 250 ml from each location in a random manner, marked and taken to the laboratory.


**Fig 1:** Tigris River passing through the Al-Ishaqi district

## 2. Chemical and physical tests

**2.1 Measuring the water temperature:** It was measured using a mercury thermometer with a range of (0-200) C°.

**2.2 Measuring turbidity values:** It was measured by a Turbidity meter type HANA Lp 2000 after it was calibrated with standard solutions and Naphthalene Turbidity units (N.T.U).

**2.3 Measuring of Electrical Conductivity (EC):** It was measured by using the Electrical conductivity meter type H/99300 HANNA, micro-Siemens/cm.

**2.4 Measuring of Total Dissolved Solids (TDS) concentration:** The measurement was done using the electronic T.D.S meter, type H/99300 HANNA, after calibration before use, Part per million (PPM) (APHA, 1999) [2].

**2.5 Measuring of pH:** Using lovibond Senso-Direct 150 electronic pH meter after calibrating it before use with a buffer solution.

**2.6 Measuring of Dissolved Oxygen (DO) concentration:** Using Lovibond -senso Direct 150 electronic D.O. meter after calibration before use.

**2.7 Measuring the Biological Oxygen Demand (BOD):** They are filled with opaque bottles with a capacity of 250 ml and incubated in a water bath for 5 days at a temperature of 22 °C, then the dissolved oxygen method is applied using the same DO meter and using the following equation:

$$BOD = DO_1 - DO_5$$

## 3. Biological test (Invertebrates)

Two methods of isolation, staining and identification of invertebrates (Satoskar *et al.*, 2009) [13].

**3.1 Sedimentation method:** 20 ml of each sample of water was taken and placed in the centrifuge at 3000 round / 5 minutes, after which a drop of the sediment was taken by means of a loop and placed on the glass slide and stained with Lugol's iodine or carmine stain to distinguish invertebrate organisms, Then the glass slide was loaded and then the slides were examined by light microscope under 40x and 10x magnification.

**3.2 The direct method:** It was fixed on the glass slide with a drop of Lugol's iodine or carmine stain for laboratory examination. Invertebrates were diagnosed according to (Marshall, 1985).

## Results and discussion

### a) Chemical and physical tests

The results showed changes in the water temperature, as it recorded different values affected by the weather, as the lowest value was 11.1 C° in December 2020 in St. 2, while the highest value recorded was 20.8 C° for October at St.4. The first of 2020 at the river station 3 (Table 1).

The results showed varying levels of Turbidity, as the highest value was 292 and 294 NTU in January 2021 in stations 1 and 5 respectively, and the lowest value was 240 and 246 NTU in October in stations 3 and 2 respectively (Table 2).

The results showed different values of E.C. the highest value was 506 µS/cm for the month of March 2021 in St.1, and the lowest value was 361 µS/cm for the month of October 2020 in St. 5 (Table 3).

The results showed that the highest concentration of T.D.S concentration was 209 ppm in March in St. 4, and the lowest concentration was 173 ppm for October 2020 in St. 2 (Table 4).

The results showed that the pH values recorded the highest value of 8.4 in the October 2020 in St. 1, and the lowest value was 7.2 each of October and March in St. 5 (Table 5).

The lowest concentration of D.O. were 6.7 ppm at March in St. 1, and the highest concentration was 9.5 and 9.6 ppm for October and November 2020 in the river St. 5 (Table 6).

The highest concentration of the BOD was 4.4 ppm for March in St. 2, and the lowest concentration was 0.6 ppm for December in St. 1 (Table 7).

Solids that are not dissolved in water and other organic

materials, elements and microorganisms hinder the light passing through the water section by scattering and absorbing it and preventing it from traveling straight (Manca *et al*, 2014) [9]. The decrease in the values of electrical conductivity depends on the decrease in the concentrations of negative and positive ions in the water (Yuping *et al*, 2016) [17]. It was found that the electrical conductivity increases by 2% when the water temperature is increased by one degree Celsius (APHA, 1999) [3]. Electrical conductivity is one of the general indicators of water quality and is the fastest approximation of total dissolved substances in water (Guilfoos *et al*, 2016) [6]. The rates of Turbidity are affected by the suspended materials in the water, the water level rises and the speed of flow, which causes an increase in suspended matter in the water, and that the reason for the rise in turbidity is attributed to the rise in the water level (Sadalla *et al.*, 2000). The pH values have a significant impact on aquatic organisms because they affect the biochemical processes in the water, and the pH is directly related to the carbon dioxide concentration in the water (Weiner, 2000) [15]. The decrease in dissolved oxygen concentrations in water is due to the high temperatures, which led to the acceleration of the organic decomposition processes that consume dissolved oxygen and raise the values of biological oxygen Demand (Ezekiel *et al.*, 2011; Arimoro *et al*., 2006) [5].

**b) Biological test (invertebrates)**

During this study, 228 water samples were collected from five stations along the Tigris River passing through in Al-Ishaqi district, Salah Al-Din Governorate, during six months, from October 2020 to March 2021 (Table 8).

Three types of Invertebrates were diagnosed, which are *Daphnia*, *Stentor* and *Amoeba proteus* (figures 2, 3 and 4). The highest number of samples collected contain Invertebrates was recorded during the months of January and March in St. 2 and St.1 respectively, were as the lowest number of samples at October and November in St. 2 and 3 respectively (Table 8). Hashim (2022) [7] showed from two sites were selected from Adhamiya / Baghdad the total density of benthic invertebrates was 775 ind/$m_2$, which is divide into 15 taxa. The reason for the difference in the species and numbers recorded is due to the different geographical locations and what results from a difference in temperature and the rest of the physical and chemical characteristics of the water samples under study.

**Table 1:** Water Temperature (°C) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 20.4 | 20.1 | 20 | 20.8 | 20.2 |
| | November | 16.7 | 15.6 | 15 | 15.6 | 15.3 |
| | December | 13.9 | 13.2 | 11.5 | 11.9 | 11.5 |
| 2021 | January | 14.6 | 11.1 | 12.3 | 12.7 | 10.2 |
| | February | 15.7 | 11.6 | 13.5 | 13.6 | 12.3 |
| | March | 14.9 | 13.2 | 14.1 | 13.9 | 13.5 |
| Total | | 16.03 | 14.1 | 14.4 | 14.75 | 13.83 |

**Table 2:** Water Turbidity (N.T.U) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 260 | 246 | 240 | 263 | 261 |
| | November | 276 | 270 | 266 | 270 | 263 |
| | December | 280 | 276 | 271 | 276 | 289 |
| 2021 | January | 292 | 281 | 283 | 279 | 294 |
| | February | 280 | 273 | 261 | 275 | 262 |
| | March | 271 | 276 | 261 | 266 | 259 |
| Total | | 276.5 | 270.3 | 263.6 | 271.5 | 271.3 |

**Table 3:** Water Electrical Conductivity (µS/cm) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 377 | 429 | 417 | 380 | 361 |
| | November | 400 | 441 | 402 | 388 | 403 |
| | December | 406 | 469 | 423 | 402 | 426 |
| 2021 | January | 427 | 472 | 437 | 417 | 437 |
| | February | 482 | 486 | 441 | 442 | 455 |
| | March | 506 | 499 | 460 | 460 | 477 |
| Total | | 433 | 466 | 414.8 | 414.8 | 426.5 |

**Table 4:** Water Total Dissolved Solid (ppm) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 182 | 173 | 197 | 182 | 193 |
| | November | 193 | 179 | 200 | 196 | 200 |
| | December | 199 | 184 | 202 | 199 | 206 |
| 2021 | January | 203 | 189 | 202 | 202 | 204 |
| | February | 206 | 193 | 205 | 204 | 207 |
| | March | 206 | 196 | 207 | 209 | 206 |
| Total | | 163.8 | 185.6 | 202.1 | 198.6 | 202.6 |

**Table 5:** Water pH at river stations

| Sample | | | | | | Stations |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 8.4 | 7.7 | 8.9 | 7.9 | 7.2 |
| | November | 8 | 7.9 | 7.9 | 7.7 | 7.6 |
| | December | 7.9 | 8 | 7.4 | 7.9 | 7.8 |
| 2021 | January | 8 | 8 | 7.6 | 8.1 | 8.1 |
| | February | 8.2 | 8.1 | 7.8 | 8.1 | 8.1 |
| | March | 8 | 8 | 8.1 | 8 | 7.2 |
| Total | | 8.08 | 7.95 | 7.95 | 7.95 | 7.66 |

**Table 6:** Water Dissolved Oxygen (ppm) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 8.2 | 8.1 | 8.6 | 8.2 | 9.5 |
| | November | 7.8 | 8.1 | 8.2 | 8.1 | 9.6 |
| | December | 7.6 | 7.8 | 8.5 | 8.1 | 8,8 |
| 2021 | January | 7.4 | 7.6 | 8.1 | 8.0 | 8.6 |
| | February | 7.2 | 7.3 | 8.2 | 7.9 | 8.3 |
| | March | 6.7 | 7.2 | 8.1 | 7.7 | 7.9 |
| Total | | 7.48 | 7.68 | 8.28 | 8 | 8.78 |

**Table 7:** Water B.O.D (ppm) at river stations

| Sample | | Stations | | | | |
|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 |
| 2020 | October | 2.8 | 2.9 | 4 | 2.7 | 2.5 |
| | November | 2 | 1.9 | 2.8 | 2.6 | 2.1 |
| | December | 0.6 | 2.1 | 2.4 | 3.1 | 2.1 |
| 2021 | January | 0.9 | 2.4 | 2 | 3.3 | 2.5 |
| | February | 1.7 | 2.9 | 2.8 | 3.6 | 2.7 |
| | March | 2.5 | 4.4 | 3.1 | 3.9 | 3.3 |
| Total | | 1.75 | 2.76 | 2.85 | 3.2 | 2.53 |

**Table 8:** Number of water samples examined according the months and stations contain Invertebrates organisms under study

| Sample | | Stations | | | | | Total |
|---|---|---|---|---|---|---|---|
| Months | | 1 | 2 | 3 | 4 | 5 | |
| 2020 | October | 7 | 5 | 8 | 8 | 9 | 37 |
| | November | 8 | 9 | 5 | 6 | 8 | 36 |
| | December | 6 | 7 | 7 | 8 | 7 | 35 |
| 2021 | January | 9 | 10 | 8 | 7 | 6 | 40 |
| | February | 8 | 7 | 9 | 8 | 7 | 39 |
| | March | 10 | 11 | 6 | 8 | 6 | 41 |
| Total | | 48 | 49 | 43 | 45 | 43 | 228 |

**Fig 2:** *Daphnia* (carmine stain, 100X)

**Fig 3:** *Stentor* (luogle iodine, 100X)

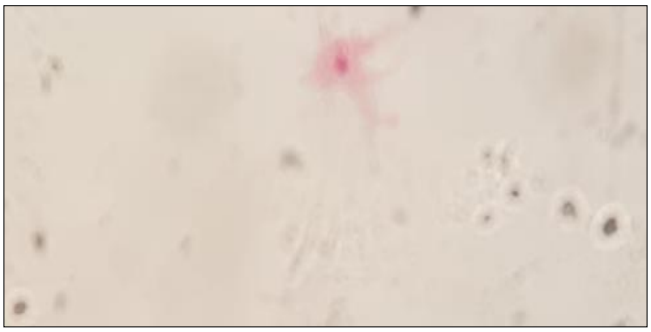

**Fig 4:** *Amoeba proteus* (carmine stain, 100X)

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