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Survey the Microbial Load in the Tigris River in South of Baghdad City and Some of the Physiochemical Parameters

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Abstract: This study included an analysis of three stations (Al Dora, Al Za'franiya, and Arab Ejbur) chosen to study the Physiochemical and microorganism (Fungi and Bacteria) loud of the Tigris River in the southern section of Baghdad city. The result of this research shows that the highest temperature recorded in summer in Al Za'franiya was 37Co, while the lowest temperature recorded in winter in Al Dora was 9Co. and the value of pH recorded the highest in summer it was 7.9 in Arab Ejbur, and the lowest value was in winter 7.1 in Al Dora regions, While Total Organic Carbon (TOC) shows the highest values found in the summer was 6.7 Mg L^{-1} in Al Za'franiya Samples, and the lowest values were 2.0 Mg L-1in Arab Ejbur during the winter. The more frequently isolated fungi were *Aspergillus niger*, and the lowest frequently was *Chrysosporium was* observed during the survey period. At the same time, Bacteriological analysis of water resources showed that *Escherichia coli* and *Pseudomonas aeruginosa* were more frequently isolated bacteria and the lowest frequently bacteria were *Klebsiella ornithinolytica* and *Proteus mirabilis*.

Key words: Fungi, Bacteria, Temperature, TOC, pH, Tigris River.

Introduction

Over the last few decades, understanding the mechanisms that determine microbial biodiversity in aquatic environments has been a significant focus of freshwater ecology research. Migratory microbial communities, which are found in freshwater environments, are made up of a diverse group of bacteria, fungi, and archaea responsible for various processes that are critical to ecosystem functioning. These processes include carbon cycling and biological nitrogen fixation as well as denitrification and methane production, sulfate reduction, and the transformation of metals and various molecules that are found in the environment[1]. In the absence of treatment, the release of untreated effluents can limit the microbiological diversity of natural environments, which may have a detrimental impact on the functioning and health of aquatic ecosystems. According to the findings of many research, both changes in local circumstances and the presence or absence of biotic interactions may impact the formation of microbial communities in fluvial networks. To measure the health of an ecosystem, it has been proposed that microbial diversity and community composition be used as sensitive indicators of ecosystem health since they may be impacted by water pollutants[2]. The contamination of natural water bodies by industrial, agricultural, and urban wastewater can affect the composition, structure, and microbial activity of the water body on a local and global scale, resulting in a decline in aquatic life and soil fertility; as a result consequence.

As a consequence of drastic changes in the structure and composition of these communities, unanticipated alterations in nutrient flow may occur[3]. The diversity and composition patterns of aquatic fungal communities have been influenced by pollution. The amount of nutrients dissolved in water, for example, has a significant influence on the diversity and composition patterns of aquatic fungal communities[4]. Despite this, most environmental microbiology sequencing investigations have concentrated on prokaryotic species, with microbial eukaryotic communities being generally ignored in the process[5]. Apart from their contribution to aquatic environments, bacterial populations play an essential role in transforming and demineralizing nutrients[6]. To keep the energy flow going. A significant role in the biodegradation of allochthonous compounds, such as pollution originating from human activities, is played by surface-associated bacterial communities, which are especially prevalent in rivers[7]. A river's importance to civilization is shown by the fact that it provides water for consumption, agriculture, and the removal of human waste. However, in contrast to our understanding of marine and freshwater lake microbiology, the ecological influence of planktonic and attached bacteria within river ecosystems is still understudied and underappreciated[8]. As the primary supply of irrigation for Iraqi land, the Tigris River has significant significance for Iraqi environmental researchers due to the negative impact of pollutants arising from treated and untreated home waste and agricultural pollutants[9]. However, according to a previous study conducted on the Tigris River in Baghdad city, the quality of water becomes worse when it reaches the city's southern cross because the study area is densely populated along its banks, as well as having some industrial activities present, as well as having some wastewater fallings that are distributed on both sides of the river and discharge the waste into a stream of Tigris River[10]. As a result, this research aims to

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survey the microorganisms (fungi and bacteria) in the south Tigris River in Baghdad city and examine their appearances and characteristics.

Materials and methods

Study area

This study was included an analysis of three stations (Al Dora, Al Za'franiya, and Arab Ejbur) that were chosen to study the Physiochemical and microorganism (Fungi and Bacteria) loud of the Tigris river in the southern section of Baghdad city figure (1), for a period of twelve months from November 2017 to October 2018. Obtaining representative samples has proven to be problematic due to the heavily populated nature of the study location along the river's banks, as well as the presence of diverse industrial activities, making it necessary to get these samples, in addition to several fallings the wastewater, which are distributed on both sides of the river and throw the waste to the Stream of Tigris River.

Collection of water samples

The water samples taken from south of Tigris River from three regions(Al Dora, Al Za'franiya, and Arab Ejbur) were collected in the morning every month using sterile polyethylene containers to (10).

Isolation and Identification of Fungi

Isolation of fungi was carried out by standard isolation techniques[11]. Some drops of water samples were separated using a spreader on Potato Dextrose agar (PDA) and Sabrouid Dextrose agar (SDA) and then incubated at room temperature for one week in a dark place. After one week, the fungi appeared on the surface of the agar. Fungi colonies were identified according to the shape of the colony and microscopically identified according to their spores and fungal filaments according to the fungi manual[12] with support of various standard references and monographs[13].

The Percentage of Occurrence and Frequency

The percentage of occurrence and frequency is defined as follows in equation[14]:

$$\text{Occurence\%} = \frac{\text{No. of positive samples}}{\text{Total number of samples}} \text{ X } 100$$

Isolation and Identification of Bacteria

Bacterial surveys of water samples, including total viable bacterial count, were carried out in accordance with the general standard methodology for the study of water and wastewater, as previously described[15]. A conventional coliform fermentation procedure, comprising presumptive, confirmed, and finished tests, was used to detect total coliform, fecal *E. coli*, and *Pseudomonas aeruginosa*[16]. A variety of dilutions of water samples from various sources were distributed over a variety of agars, including Eosin-Methylene Blue Agar (EMB), Nutrient agar, Thiosulfate citrate bile sucrose Agar (TCBS) medium, Macconkey agar, and Blood Agar, to identify additional harmful enteric bacteria at 37°C, the plates were incubated overnight, and the cultures were inspected for different colonies the next day after incubation. After being streaked on nutrient agar slant and cultured for 24 hours at 30°C, these colonies were retained as stock cultures. Bacteriological techniques that are currently in use[17] and API_{20E} were employed to determine the identity of each isolate.

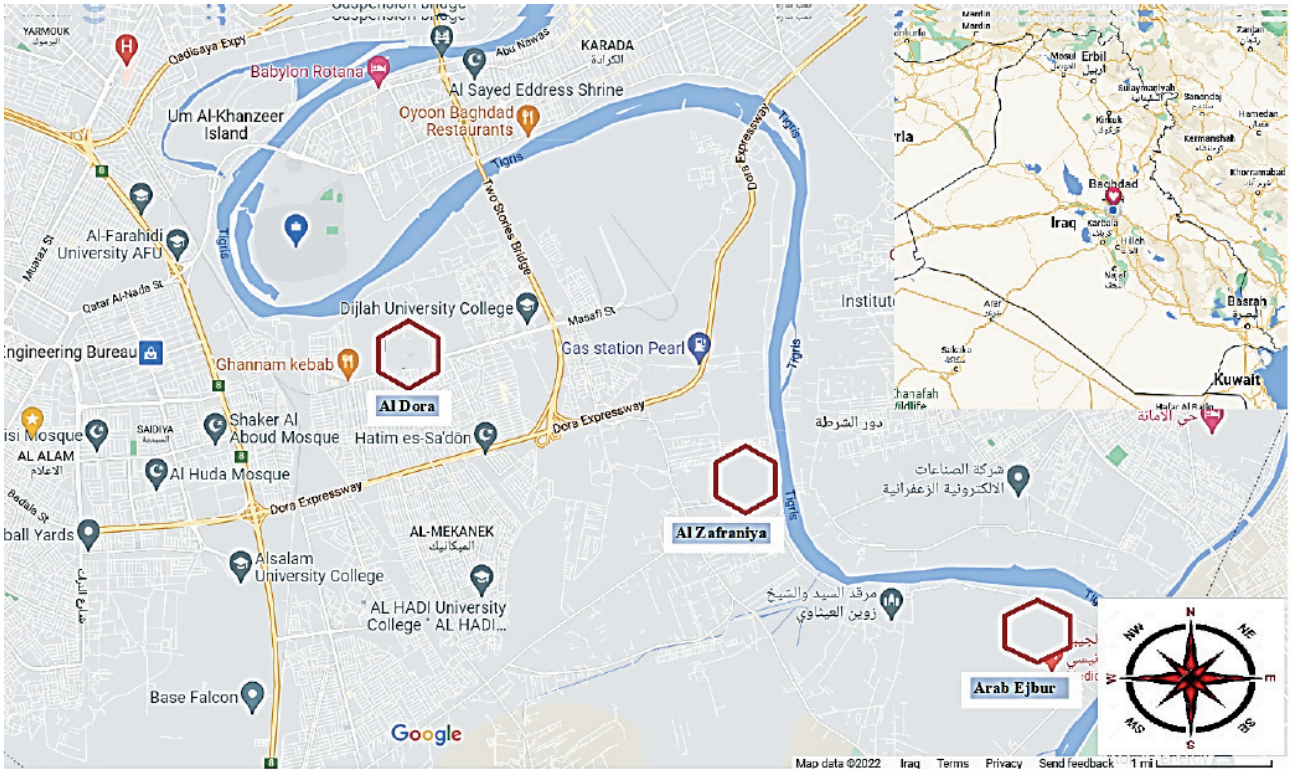

Figure 1. Shows the selected study areas within the city of Baghdad.

Results

Temperature

The obtained results showed that the highest temperature was 37Co in summer in Al Za'franiya, while the lowest temperature was 9 Co in Al Dora in winter, as in Table (1).

Although there were statistically significant differences between the stations, no statistically significant differences existed between the seasons except the spring season, which had significant differences that reached 3.97 at the level of (P≤0.05) and no statistically significant differences between the seasons.

Hydrogen Ion (pH)

The maximum (7.9) and minimum (7.1) values of pH were recorded in the Arab Ejbur and Al Dora region during Summer and Winter, respectively these values agree with Iraqi standards for maintenance of rivers No. 25 of 1967, which was 6.5-8.5[18] as shown in Table (2).

According to the statistical study, there were no statistically significant differences across the seasons, but that there were statistically significant differences between the two stations of Al-Dora and Arab Al-Jabour, with differences reaching up to 0.613 and 0.627 respectively at the level of (P≤0.05).

Total Organic Carbon (TOC)

The highest values for drinking water found in summer were 6.7 Mg L-1in Al Za'franiya.

Samples and the lowest values were with 2.0 Mg L-1for Arab Ejbur in winter. Table (3).

Following the statistical analysis, it was discovered that there were no statistically significant variations between the seasons, and that there were no statistically significant differences between the stations at the level of (P≤0.05).

Isolation and Identification of microorganisms

The obtained results revealed that 18 fungal species were identified in the (Al Dora, Al Za'franiya, and Arab Ejbur) stations and their appearances threw the study season as explained in Table (4). While the number of bacteria species was 14 in the study station and study season Table (5).

Fungus isolation and Identification

The fungus species were isolated throughout four seasons. *Aspergillus niger* was the fungus that was isolated the most often. *Rhizopus sp.*, *Fusarium sp.*, *Trichophyton megnini*, and *Mycelia sterilia* are among the pathogens that have been identified, Table (4).

18 fungal genera are isolated; *Aspergillus niger* is the most common genus and is always represented during the study period, followed by the *Rhizopus genus*. The fungal genera *Aspergillus*, *Rhizopus*, *Fusarium*, *Trichophyton*, *Mycelia*, *Mucor*. *Penicillium*, *Microsporum*, *Trichoderma*, *Alternaria*, *Ulocladium*, *Phialophora*, *Epidermophyton* and *Chrysosporium* were observed during the survey period.

Isolation and Identification of bacteria

The total viable bacterial counts, total coliforms, total *E. coli*, and total *Pseudomonas aeruginosa* were found to be the most prevalent bacteria in water resources, according to a bacterial investigation, Table (6).

According to the data in the paper, at least 14 species

Season	Al Dora	Al Za'franiya	Arab Ejbur	LSD value
Autumn	27	24	25	3.02 NS
Winter	9	11	12	3.17 NS
Spring	27	23	25	3.97 *
Summer	35	37	34	3.26 NS
LSD value	6.49 *	6.07 *	5.92 *	---
* (P≤0.05), NS: Non-Significant.				

Table 1. Effect of Station and Season on Temperature.

Season	Al Dora	Al Za'franiya	Arab Ejbur	LSD value
Winter	7.1	7.3	7.2	0.419 NS
Spring	7.7	7.6	7.7	0.335 NS
Summer	7.8	7.8	7.9	0.296 NS
Autumn	7.5	7.5	7.4	0.301 NS
LSD value	0.613 *	0.548 NS	0.627 *	--
* (P≤0.05), NS: Non-Significant.				

Table 2. Effect of Station and Month on pH.

Season	Al Dora Mg L^{-1}	Al Za'franiya Mg L^{-1}	Arab Ejbur Mg L^{-1}	LSD value
Autumn	4.7	4.9	4.6	1.06 NS
Winter	2.2	2.7	2	0.893 NS
Spring	4.9	5.2	4.8	0.904 NS
Summer	6.2	6.7	6	0.822 NS
LSD value	2.371 *	2.084 *	2.177 *	--
* (P≤0.05), NS: Non-Significant.				

Table 3. Effect of Station and Month in (TOC).

Fungi	Winter			Spring			Summer			Autumn		
	Al Dora	Al Za' franiya	Arab Ejbur	Al Dora	Al Za' franiya	Arab Ejbur	Al Dora	Al Za' franiya	Arab Ejbur	Al Dora	Al Za' franiya	Arab Ejbur
Alternaria sp.	-	+	-	+	+	+	+	+	+	+	+	-
Aspergillus versicolor	-	-	+	-	+	+	+	+	+	-	+	+
Aspergillus niger	+	+	-	+	+	+	+	+	+	+	+	-
Chrysosporium sp.	-	-	+	+	+	+	+	+	+	-	+	+
Cladosporium sp.	-	-	-	-	-	+	-	+	+	-	+	-
Epidermophyton	-	-	-	+	-	+	-	-	+	-	-	-
Fusarium sp.	-	+	+	-	+	+	+	+	+	-	+	+
Microsporium ferrugineum	-	+	-	-	-	-	+	-	+	+	-	-
Microsporium nanum	-	-	-	-	-	+	-	-	+	-	-	-
Mucor sp.	-	-	-	-	-	+	-	+	+	-	-	+
Mycelia sterilia	-	-	-	+	+	+	+	+	+	-	+	
Penicillium sp.	+	+	+	+	-	+	+	+	+	+	+	+
Phialophora sp.	-	-	-	-	-	-	-	+	+	-	-	-
Rhizopus sp.	-	+	+	+	+	+	+	+	+	+	+	-
Trichoderma sp.	-	-	+	-	+	+	+	+	+	-	-	+
Trichophyton megnini	-	+	-	+	+	+	+	+	+	+	+	-
Trichophyton Vubrum	-	+	-	+	+	+	+	-	-	-	-	-
Ulocladium sp.	-	-	-	-	+	-	-	+	+	-	-	+

+ = Fungi found in the station
- = Fungi not found in the station

Table 4. Prevalence of fungal species isolated during the study period from (Al Dora, Al Za'franiya, and Arab Ejbur) stations.

of bacteria belonging to the family Enterobacteriaceae are present and several additional species belonging to the family Pseudomonadaceae Table (7). The bacteria *E. coli* and *Pseudomonas aeruginosa* were the most often seen.

Discussion

The main reason for the lower degree measured during the winter and higher degree in the summer months is linked directly with air temperature[19]. The relatively low pH value obtained in the river during winter may be due to the high levels of free CO_2 that is dissolved in water by diffusion from the atmosphere and may be due to the dilution effect[20], while in the summer, CO_2 levels are decreased by moving to the atmosphere or consumed via the photosynthesis process of algae or water plants and so, the pH value is raised[21]. The research findings indicate that the most considerable fungus abundance was found in a river with a high concentration of organic matter, while the highest microorganism taxonomic biodiversity was found in waters with a high concentration of organic matter. The majority of potentially harmful fungus is found in the water of pollu-

Fungi	Station frequency and they are average				Occurrence%
	Al Dora	Al Za' franiya	Arab Ejbur	Average	
Alternaria sp.	6	9	7	7.3	4.6
Aspergillus versicolor	4	4	6	4.7	3.0
Aspergillus niger	38	33	41	37.3	23.6
Chrysosporium sp.	2	0	3	1.7	1.1
Cladosporium sp.	8	8	6	7.3	4.6
Epidermophyton	2	2	1	1.7	1.1
Fusarium sp.	14	18	13	15.0	9.5
Microsporium ferrugineum	7	7	6	6.7	4.2
Microsporium nanum	4	6	5	5.0	3.2
Mucor sp.	9	10	12	10.3	6.5
Mycelia sterilia	12	9	12	11.0	7.0
Penicillium sp.	7	12	8	9.0	5.7
Phialophora sp.	3	3	3	3.0	1.9
Rhizopus sp.	16	14	14	14.7	9.3
Trichoderma sp.	6	8	8	7.3	4.6
Trichophyton megnini	12	10	10	10.7	6.8
Trichophyton vubrum	1	0	0	0.3	0.2
Ulocladium sp.	6	5	4	5.0	3.2

Table 5. Occurrences and frequency of fungal genera isolated from (Al Dora, Al Za'franiya, and Arab Ejbur) stations.

ted rivers. Furthermore, elements impacting the structure of microbes include the pH, temperature, and total organic carbon (TOC) of the water[20].

Conclusions

These microbial counts were far higher than the maximum limits permitted by international standards, particularly at the Al Za'franiya station. According to the water quality in (Al Dora, Al Za'franiya, and Arab Ejbur), a significant quantity of bacteria was found in the water in the southern Tigris River basin. For their part, the physical-chemical parameters were within acceptable ranges of values. This may be due to the contamination of raw water by urban garbage and other sources.

Conflict of interest

No conflict of interest.

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Funds

Self.

Bacteria	Winter			Spring				Summer			Autumn		
	Al Dora	Al Za' franiya	Arab Ejbur		Al Dora	Al Za' franiya	Arab Ejbur	Al Dora	Al Za' franiya	Arab Ejbur	Al Dora	Al Za' franiya	Arab Ejbur
Aeromonas hydrophila	-	-	-	-		-	+	+	-	+	-	-	-
Citrobacter freundii	-	+	-	-		+	+	+	+	+	-	-	-
Enterobacter cloacae	_	_	+	+		+	+	+	+	+	_	_	+
Escherichia coli	_	_	_	_		_	+	_	+	+	_	_	_
Klebsiella ornithiolytica.	-	-	-	-		+	-	+	+	+	-	-	-
Klebsiella pneumonia	+	+	+	+		+	+	+	+	+	+	+	+
Pantoea spp.	_	_	_	_		_	_	_	_	_	_	_	_
Proteus mirabilis	-	-	+	+		+	+	+	+	+	+	+	+
Pseudomonas aeruginosa	-	-	-	-		-	-	-	+	+	-	-	-
Pseudomonas fluorescens	_	_	_	_		_	+	_	_	+	_	_	+
Rahnella aquatilis	-	-	-	-		-	-	-	+	-	-	-	-
Serratia ficaria	_	_	_	_		_	+	_	+	+	_	_	+
Vibrio cholera	-	-	-	-		-	-	-	-	+	-	-	-
Vibrio fluvials	-	-	-	-		-	-	-	+	+	-	-	-

+ = Bacteria found in the station
- = Bacteria not found in the station

Table 6. Prevalence of bacteria species isolated during the study period from (Al Dora, Al Za'franiya, and Arab Ejbur) stations.

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Bacteria	Station frequency and they are average				Occurrence %
	Al Dora	Al Za' franiya	Arab Ejbur	Average	
Aeromonas hydrophila	2	0	2	1.3	1.3
Citrobacter freundii	5	7	6	6	5.8
Enterobacter cloacae	4	4	5	4.3	4.2
Escherichia coli	30	33	32	31.7	30.7
Klebsiella ornithiolytica.	1	1	1	1	1.0
Klebsiella pneumonia	14	12	14	13.3	12.9
Pantoea spp.	2	3	1	2	1.9
Proteus mirabilis	1	1	1	1	1.0
Pseudomonas aeruginosa	30	30	34	31.3	30.3
Pseudomonas fluorescens	2	5	1	2.7	2.6
Rahnella aquatilis	2	2	2	2	1.9
Serratia ficaria	1	0	1	0.7	0.7
Vibrio cholera	3	3	3	3	2.9
Vibrio fluvials	3	2	4	3	2.9

Table 7. Occurrence and frequency of bacterial isolated from (Al Dora, Al Za'franiya, and Arab Ejbur) stations.

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