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A Qualitative Study of Fungi Adhered to some Aquatic Plants in Baghdad, Al-jadriya

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Abstract:

A study was conducted on water's physical and chemical properties at five sites along the water channel within the University of Baghdad in Baghdad's Al-Jadriya district. All sites drew water from the Tigris River, adjacent to the university. The present study aimed to determine aquatic plant types inhabiting the study area and the diversity of fungi associated with these plants and fungi present in water during three seasons of the year: spring, autumn, and winter (2022 - 2023), considering five locations.

The results of the current study showed that the water became alkaline and the oxygen level was good, four types of aquatic plants were diagnosed and isolated from the aqueducts that derive their water from the Tigris River: *Ceratophyllum demersum*, *Najas marina*, *Hydrilla verticillata*, and *Lemna minor* (duckweed). Also diagnosed 1141 fungal isolates belonging to 23 families were acquired. The family Trichocomaceae had the highest percentage at 21.42%, followed by Pleosporaceae and Mucoraceae with 9.52 % and 7.14 %, respectively. The families Saprolegniaceae and Nectriaceae also recorded significant rates. The result found the presence of forty-two fungal species, which include *Aspergillus niger* and *A. Terreus,* which had the very best appearance percentage in the collected water samples. This indicates an excessive level of fungal biodiversity in the study area because of favorable environmental situations for fungal increase. Furthermore, 255 fungal isolates were isolated from aquatic plants belonging to fourteen families. The Trichocomaceae family had the highest percentage at 16.6%, followed by 11.11% of Pleosporaceae and Chaetomiaceae families. The study also diagnosed 18 fungal species, *Aspergillus niger,* and *A. Flavus*, which had the highest percentage of appearance compared to other species collected. The important intention of this study was to conduct a qualitative assessment of the fungal families and the type of aquatic plants accrued from the Tigris River in Baghdad's Al-Jadriya district. This study also aimed to identify the aquatic flora to apprehend the biodiversity of fungi and plant life in the study area.

Keywords: Tigris River; aquatic plants; biodiversity; fungi.

دراسة نوعية للفطريات الملتصقة ببعض النباتات المائية في بغداد, الجادرية

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الخلاصه:

أجريت دراسة على بعض الخصائص الفيزيائية والكيميائية للمياه في خمسة مواقع على طول القناة المائية داخل جامعة بغداد في منطقة الجادرية ببغداد، وجميع المواقع تستمد المياه من نهر دجلة المجاور للجامعة. تهدف هذه الدراسة إلى تحديد أنواع النباتات المائية التي تعيش في منطقة الدراسة وتنوع الفطريات الملتصقة بهذه النباتات والفطريات الموجودة في المياه خلال ثلاثة فصول من العام الربيع والخريف والشتاء (2022 –2023) وفي خمسة مواقع. اظهرت نتائج الدراسة الحالية أن المياه أصبحت قلوية وكان مستوى الأكسجين جيدا، تم تشخيص أربعة أنواع من النباتات المائية وعزلها عن القنوات التي تستمد مياهها من نهر دجلة وهي: *Ceratophyllum demersum* ،*Najas marina* ،*Hydrilla verticillata* ، و *Lemna minor* (طحلب البط). بالإضافة إلى ذلك، تم تشخيص 1141 عزلة فطرية تابعة إلى 23 عائله. سجلت عائلة Trichocomaceae أعلى نسبة عند 21.42٪، تليها عائلات Pleosporaceae و Mucoraceae بنسبة 9.52٪. و 7.14 % على التوالي .كما سجلت العائلات Saprolegniaceae و Nectriaceae معدلات كبيرة . اظهرت النتائج وجود اثنين واربعين نوعًا فطرياً، بما في ذلك جنس *Aspergillus niger* و *A. terreus*، والتي كان لها افضل نسبة ظهور في عينات المياه المجموعة . يشيرهذا الى التنوع البيولوجي الفطري في منطقة الدراسة بسبب العوامل البيئية المواتية لزيادة نمو الفطريات. علاوة على ذلك، تم الحصول على 255 عزلة فطرية من النباتات المائية التي تنتمي إلى اربع عشرة عائلة. حصلت عائلة Trichocomaceae أعلى نسبة عند 16.6٪، تليها عائلات Pleosporaceae و Chaetomiaceae بنسبة 11.11٪. وشخصت الدراسة ايضاً 18 نوعًا، *Aspergillus niger* و *A. flavus* والتي كان لها أعلى نسبة ظهور مقارنة بالأنواع الأخرى التي تم جمعها. .ان الهدف المهم من هذه الدراسة هو اجراء تقييم نوعي للعوائل الفطرية وانواع النباتات المائية المستوطنة من نهر دجلة من منطقة الجادرية في بغداد .ان هدف هذه الدراسة كذلك هو للتعرف على التنوع البيولوجي للفطريات والحياة النباتية في منطقة الدراسة .

Introduction:

Most aquatic fungi are microscopic organisms that cannot form fruiting bodies but are capable of asexual reproduction (anamorphic fungi) [1]. Its presence in the water is considered important and complex at the same time due to its overlapping relationship with the rest of the neighborhoods [2]. Fungi play an important role in ecosystems, where the primary and secondary metabolites produced by fungi are important in industrial uses such as the manufacture of organic acids, chemicals, antibiotics and other drugs, proteins and enzymes, meat alternatives, vitamins, polyunsaturated fatty acids and even composite materials and vegan leathers are existing fungal products., and these primary and secondary metabolites productions of raw materials as citric acid and enzymes are considered economical and cheap methods [3]. Aquatic fungi need specialized studies to study their diversity, population structure, and the environmental functions they perform. There is a need to detect fungi adhering to aquatic plants, other animal species, and ecosystems, such as soil and air, to determine the percentage of agent presence in the isolation zone [4]. Measure the frequency and presence of fungal species adhering to plants and the environment, such as soil, water, and air, in addition to studying the complexities of interactions between plants and fungal species to obtain an integrated view of the biodiversity present in the area [5].

Fungi whose livelihood is associated with water are known as "Phycomycetes," which is a group containing “true fungi” or Eumycota belonging to Oomycetes and Chytridiomycetes [6]. Fungi play an important role as analyzers (decomposers) along with other analyzing organisms, such as bacteria, which are active in analyzing and breaking down plant and animal residues and turning them into essential food chain elements. Aquatic plants play an important role in the water environment as a source of primary productivity and habitat for algae communities. The variety that sticks to it [7, 8,9].

A few studies are available on isolated species of fungi from aquatic plants in Iraq and the association between fungi and plant parts. This study aimed to show the species and frequency of fungi associated with some aquatic plants collected from the Tigris River in Baghdad, Al-Jadriya.

MATERIALS AND METHODS

I. The study area:

This study was conducted at five water sites along the water channel within the University of Baghdad's Al-Jadriya district. The sites were adjacent to the Tigris River, near the university, as shown in Figure 1. Water samples were collected from these channels, which are habitats for various aquatic plants. The plants were collected, identified, and examined for associated fungi at all five sites.

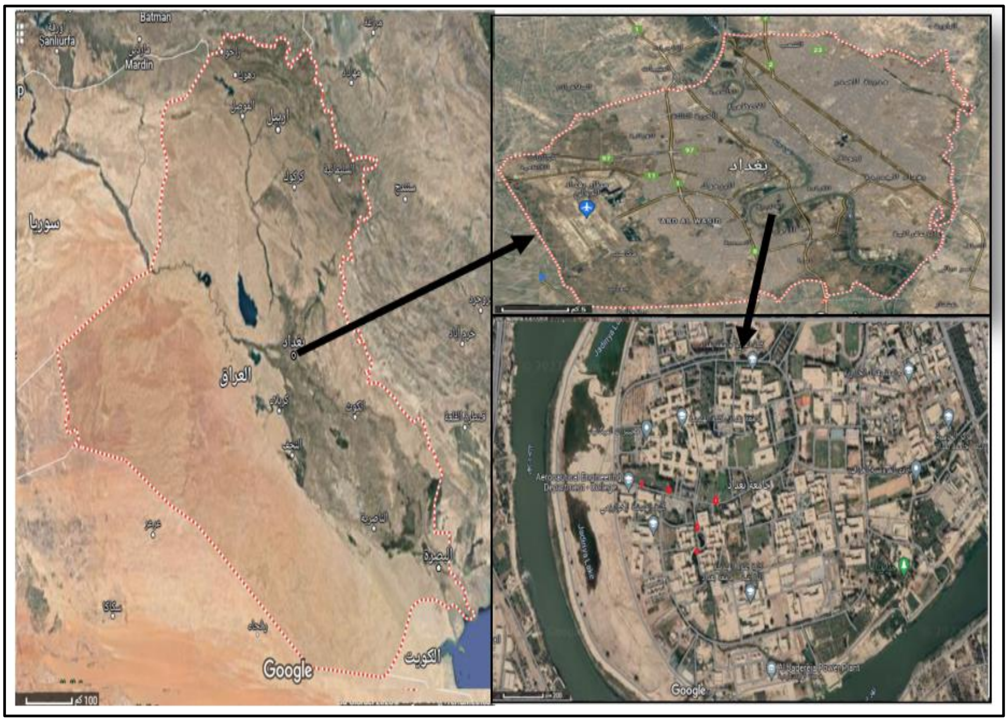


Figure 1: The study area from Baghdad Al-Jadriya.The GPS coordinator of five sites: N: 33.270271-E: 44.376563 , N: 33.269680-E:44.376149 , N: 33.271667-E: 44.376468, N: 33.274533-E: 44.372102 , and N: 33.272413-E: 44.379996

II. Sampling Collection:

Aquatic plant specimens were collected once a week over approximately 10 months, spanning three seasons: spring, autumn, and winter (2022 – 2023). The plants were collected using nets and then placed in plastic bags filled with a small amount of the same environmental water [8]. In addition, water samples were collected from the same sites and transported to the laboratory in sterile vials to isolate fungi from water [10].

III. Measuring chemical and physical properties:

Water temperature(C):

The Portable Multi-Parameter device (HI9811-5) was used to measure the water temperature directly.

Electrical Conductivity (EC):
The electrical conductivity of water in the field was measured using a Portable Conductivity Meter mS/cm.
Chloride (Cl):
Chlorides in the water were measured according to method 15, and the results were expressed in units of milligrams per liter (mg/L).
pH:
The pH level was directly measured in the field using a Portable pH Meter after calibrating it with standard buffer solutions.
Dissolved Oxygen (D.O):
Based on the [11] method, the D.O. was measured, and the results were expressed in milligrams per liter.
Biological Oxygen Demand (BOD):
The BOD value is calculated using the following equation:
BOD5 (mg/L) =Initial sample dissolved-oxygen (DO) concentration (in mg/L) - sample DO (in mg/L) after 5 days.
Calcium, magnesium, and potassium:
The calcium (Ca^{++}) and magnesium (Mg^{++}) were estimated according to the method reported by American public Health Association, 2003 [11]. The flame spectrophotometer was used to quantify potassium (K) following the method mentioned by Mahmood et al., 2018 [12].

IV. Isolation of fungi from water:

Fungi were isolated from water using the baiting technique with sesame seeds and fly insect parts, then placed in a glass Petri dish and autoclaved at 121 °C [14]. Three replicates were used using sterile plastic containers, each containing 20 ml of water taken from five sites in the Al-Jadriya region at 50 cm from the water surface. Sesame seeds, as well as parts of sterilized fly insects, were placed in a Petri dish, and 1 ml of water samples were placed on top of them, with three replications for each site, after incubation at a temperature of 25 °C for seven days. Cultured samples were purified and placed on potato dextrose agar, during which the growing colonies were examined, identified, and counted [15]. The classification of fungi was done according to [16,17].

V. Isolation of fungi from plant part samples:

Fungi were isolated from the aquatic plants using the cutting and segmentation technique, where the plants were cut into small parts after gently washing the plant parts with sterilized distilled water to remove other impurities and keep the fungi attached to the aquatic plants [18]. Then, they were placed in the center of the potato dextrose agar and incubated at 25 °C for 7 days, with three replications for each plant and each site. After growing, the fungi were purified for examination and diagnosis [19].

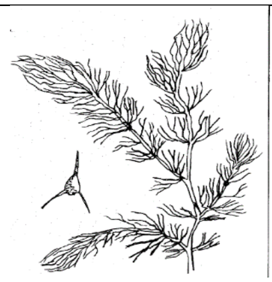
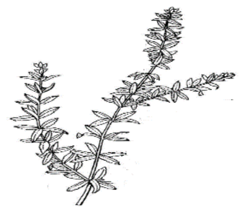
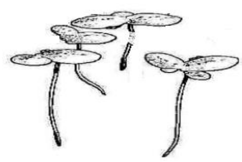
Statistical Analysis:
The statistical analysis software SAS (Statistical Analysis System) was used to analyze the data. The Least Significant Difference (LSD) method was utilized to compare the means of different treatments according to Abbas *et al.,* 2020 [20].

Results & Discussion

I. Plant diagnosis:

Four species of aquatic plants were identified in water samples collected from five study stations [21and 22], as shown in table (1).

Table 1: The type of aquatic plants in five study stations

Plant group	Scientific name	Family	
Submerged plants	*Ceratophyllum demersum*	ceratophyliacae	
	Najas marina	Najadaceae	
	Hydrilla verticillata	Hydrocharitaceae	
Free-floating plant	*Lemna minor*	Lemnaceae	

II. Chemical and physical properties of water

The results illustrated in Table (2) show the average values of physical and chemical properties calculated from five sites within the study area throughout the winter, spring, and summer seasons in the morning period. The highest water temperature values were recorded during the summer, while the lowest value was observed during winter. This is attributed to the arid climate, which tends to be hot, dry in the summer, cold, and rainy in the winter. The recorded temperatures during this study represent point measurements and do not reflect variations throughout the day. These results are consistent with other findings reported by Mohammed and Al-Hussieny, 2022 [23].

During the study period, pH values consistently tended towards alkalinity across all three seasons. This trend is likely due to excessive carbonates and bicarbonates in natural water. This study's results align with AL-Dulaimi and Younes, 2017 [24], who documented the alkaline nature of Iraqi waters.

The results indicated that electrical conductivity (EC) peaked (28.2 cm/M) in the summer, as shown in Table (2), possibly due to high temperatures increasing water evaporation rates and dissolved salts. Conversely, the lowest EC (6.4 cm/Min) was recorded in the winter, likely caused by rain-diluting salt concentration [25]. These results are consistent with the findings reported by Rasheed, 2019 [26].

The results also showed seasonal variations in dissolved oxygen (DO) values during the study period, with the lowest being 7.1 mg/L in summer, rising to 10 mg/L in winter. Cold water's ability to dissolve gases may explain this fact. During summer, reduced dissolved oxygen levels are likely due to higher temperatures, leading to increased microbial activity and organic matter decomposition, leading to increased oxygen consumption. Additionally, higher temperatures decrease oxygen solubility in water. These results are in line with the findings demonstrated by Alsaadoon *et al*., 2023 [27].

The results show that calcium and magnesium concentrations are highest recorded in the summer, with calcium at 3.2 mg/L and magnesium at 10.2 mg/LAs. Potassium also recorded the highest values at 3.1 mg/L, as shown in Table (2). These increases may be due to higher evaporation rates, which cause the concentration of salts in the water [28]. The study revealed the lowest chloride value of 3.5 mg/L in spring, while the highest value was 5.8 mg/L in summer, as depicted in Table (2). Variation in chloride concentrations is likely linked to changes in salt content in water. Iraqi rivers typically have high chloride ion levels resulting from the mineral components of rocks. The chloride concentration in water increases with increasing calcium concentration through the ion exchange with the soil [13].

Table 2: The average values of physical and chemical properties for five sites within the study area throughout the winter, spring, and summer seasons.

factors	seasons			
	winter	spring	summer	average
Temperature (C)	0.8±9	0.25±19.2	0.10±32.5	20.23
pH	0.14±7.5	0.5±7.1	0.20±7.4	7.3
EC	0.03±6.4	0.24±8.8	0.17±28.2	14.46
O.D	0.54±10	0.38±8.9	0.68±7.1	8.6
BOD	0.21±13	0.7±7.5	0.38±5.2	8.56
Cl	0.17±4.4	0.78±3.5	0.08±5.8	4.56
K	0.09±0.8	0.37±2	0.2±3.1	1.96
Ca++	0.3±1.2	0.78±2.5	0.54±3.2	2.3
Mg++	1.1±6.7	0.12±9.2	0.08±10.2	8.7

III. Diagnosis of fungi from water:

Table (3) presents the various fungal families identified in water samples from the study area during the seasonal studies. Twenty-three fungal families were identified, with the Trichocomaceae family exhibiting the highest prevalence rate at 21.42%. The Pleosporaceae and Mucoraceae families had similar prevalence rates of 9.52%, followed by the Saprolegniaceae and Nectriaceae families at 7.14%.

Table 3: The fungal families in the water and the frequency rates during the collection seasons.

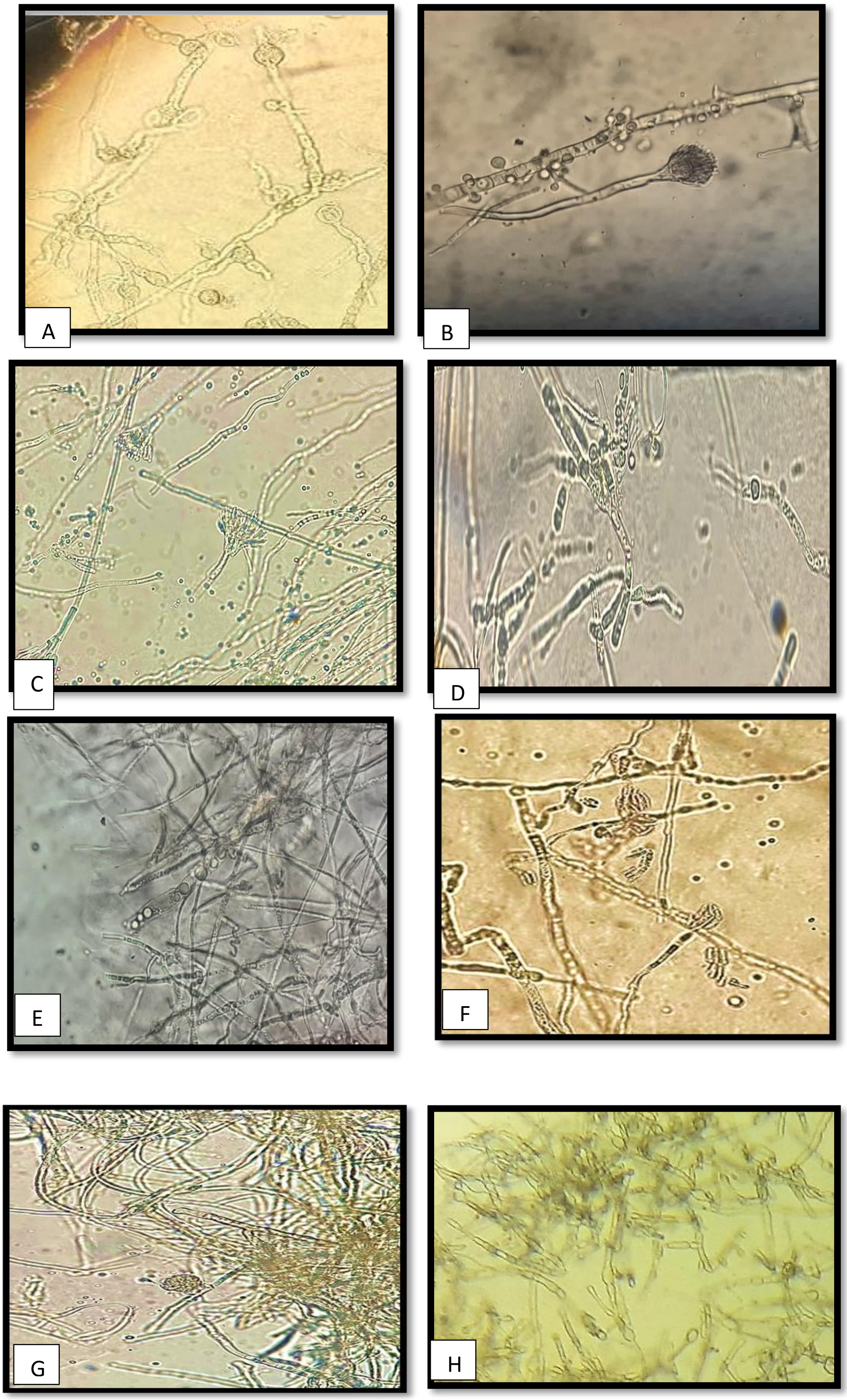
N.	Family	N. of species	Frequency%
1.	Trichocomaceae	9	21.42%
2.	Pleosporaceae	4	9.52%
3.	Mucoraceae	4	9.52%
4.	Saprolegniaceae	3	7.14%
5.	Nectriaceae	3	7.14%
6.	Pythiaceae	2	4.7%
7.	Chytridiaceae	1	2.38%
8.	Blastocladiaceae	1	2.38%
9.	Botryosphaeriaceae	1	2.38%
10.	Leptolegniaceae	1	2.38%
11.	Davidiellaceae	1	2.38%
12.	A group of families	1	2.38%
13.	Hypocreaceae	1	2.38%
14.	Cunninghamellaceae	1	2.38%
15.	Chaetomiaceae	1	2.38%
16.	Microascaceae	1	2.38%
17.	Phaeosphaeriaceae	1	2.38%
18.	Cordanaceae	1	2.38%
19.	Herpotrichiellaceae	1	2.38%
20.	Thermoascaceae	1	2.38%
21.	Chaetomiaceae	1	2.38%
22.	Saccharomycetaceae	1	2.38%
23.	Incertae sedis	1	2.38%
Total	**23**	**42**	**100%**

A total of 1141 fungal isolates were obtained, representing 23 different families. The analysis revealed the presence of 42 distinct species, as shown in Table 4 and Figure 2. Notably, the genus *Aspergillus niger* had the highest recurrence rate of isolates, at 7.79%, followed closely by *A. terreus* at 7%. In contrast, *Mucor racemosus* had the lowest recurrence rate of isolates, at 0.59%.

These findings highlight the significant fungal biodiversity in the region, which is crucial for its sustainability and vitality. Fungi play a vital role in decomposing organic compounds into raw materials consumed by plant and animal populations within the aquatic environment of water channels fed by the Tigris River. These microorganisms are essential for maintaining the ecosystem's ecological balance and health.

Table 4 : The presence of fungal species in the water and the frequency rates during the collection seasons

N.	Fungal species	Family	N. of isolation	Frequency%
1.	*Aspergillus niger*	Trichocomaceae	79	7.79
2.	*Aspergillus terreus*		71	7.00
3.	*Aspergillus Flavus*		67	6.60
4.	*Penicillium regulosum*		65	6.41
5.	*Penicillium Crustosum*		53	5.22
6.	*Aspergillus fumigatus*		29	2.85
7.	*Aspergillus. Oryzae*		24	2.36
8.	*Penicillium chrysogenum*		17	1.67
9.	*Aspergillus ochraceous*		18	1.77
10.	*Chytridium alba*	Chytridiaceae	50	4.93
11.	*Fusarium xysporum*	Nectriaceae	47	4.63
12.	*Fusarium solani*		31	3.05
13.	*Fusarium begonia*		15	1.47
14.	*Saprolegnia* spp.	Saprolegniaceae	46	4.53
15.	*Achlya* spp		42	4.14
16.	*Dictyuchus* spp.		21	2.07
17.	*Alternaria altarnata*	Pleosporaceae	40	3.94
18.	*Curvularia lunata*		26	2.56
19.	*Ulocladdium* spp.		11	1.08
20.	*Phoma* spp.		11	1.08
21.	*Allomyces* spp.	Blastocladiaceae	35	3.45
22.	*Macrophomina phaseolina*	Botryosphaeriaceae	22	2.16
23.	*Aphanomyces* spp.	Leptolegniaceae	21	2.07
24.	*Cladosporium* spp.	Davidiellaceae	20	1.97
25.	Mycelia sterilia	A group of families	15	1.47
26.	*Trichoderma* spp.	Hypocreaceae	13	1.28
27.	*Rhizopus stolonifer*	Mucoraceae	12	1.18
28.	*Rhizoctonia solani*		11	1.08
29.	*Rhizopus oryzae*		8	0.78
30.	*Mucor spp.*		6	0.59
31.	*Absidia* spp.	Cunninghamellaceae	3	1.14
32.	*Tricocladium acrosporium*	Chaetomiaceae	5	1.90
33.	*Graphium* spp.	Microascaceae	6	2.28
34.	*Leptosphaeria agnita*	Phaeosphaeriaceae	8	3.04
35.	*Cordana verruculosa*	Cordanaceae	11	4.18
36.	*Exophiala jeanselmei*	Herpotrichiellaceae	15	5.70
37.	*Byssochlamys nivea*	Thermoascaceae	15	5.70
38.	*Scytalidium thermophilum*	Chaetomiaceae	18	6.84
39.	*Pythium aphanidermtum*	Pythiaceae	59	5.81
40.	*Pythium prolifera*		28	2.76
41.	yeast	Saccharomycetaceae	38	3.74
42.	*Cephalosporium*	Incertae sedis	9	088
Total	42	23	1141	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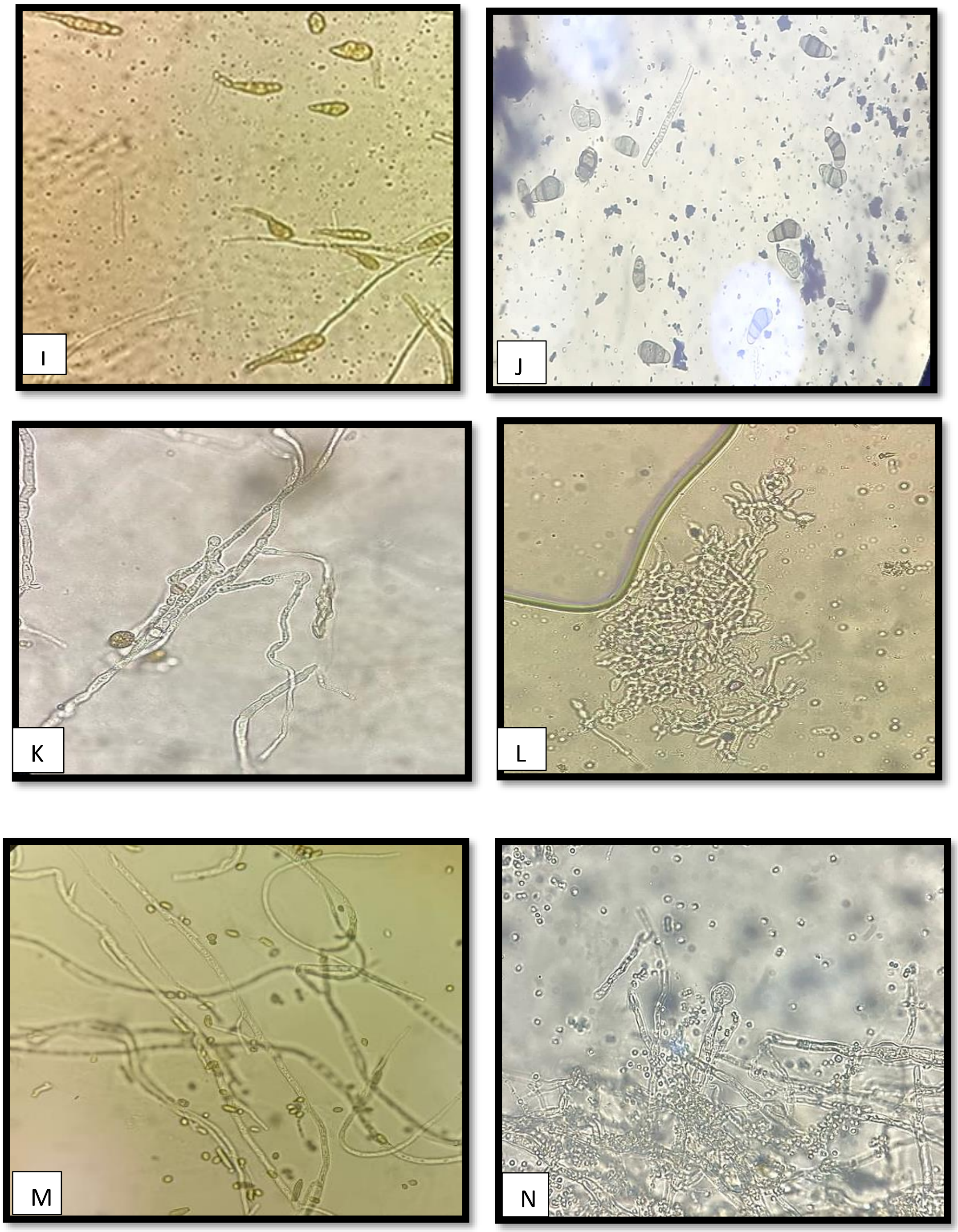

Figure. 2: Some of the fungal species isolated from aquatic plants in Baghdad, Al-Jadriya, under a microscope (40X) *A-Pythium prolifera*, B- *Aspergillus terreus*, C- *Penicillium chrysogenum*, D-*Chytridium alba*, E- *Saprolegnia spp*., F- *Fusarium xysporum* G- *Achlya spp*., H- *Dictyuchus spp*., I- *Alternaria alternata* J- *Curvularia lunata*, K- *Phoma* spp., L- *Allomyces* spp., M- *Cladosporium* spp., N- *Mucor* spp.

IV. Diagnosis of fungi from aquatic plants:

Table (5) presents the various fungal families identified from aquatic plants *Ceratophyllum demersum, Najas marina, Hydrilla verticillata*, and *Lemna minor* (duckweed) in the study area during the seasonal studies. A total of 14 fungal families were identified. The Trichocomaceae family exhibited the highest prevalence rate at 16.6%, followed by the Pleosporaceae and Chaetomiaceae families, which had prevalence rates of 11.11%.

Table 5: Shows the percentage of appearance of fungal families and adherent fungi on aquatic plants during the collection seasons

N.	Family	N. of species	Frequency%	Fungal species	N. of isolation	Frequency%
				Aspergillus niger	31	11.78
1.	Trichocomaceae	3	16.6	*Aspergillus Flavus*	32	12.16
				Penicillium chrysogenum	23	8.74
2.	Pleosporaceae	2	11.11	*Alternaria altarnata*	11	4.18
				Curvularia lunata	5	1.90
3.	Chaetomiaceae	2	11.11	*Tricocladium acrosporium*	5	1.90
				Scytalidium thermophilum	18	6.84
4.	Saprolegniaceae	1	5.55	*Dictyuchus* spp.	19	7.22
5.	Saccharomycetaceae	1	5.55	Yeast	9	3.42
6.	Davidiellaceae	1	5.55	*Cladosporium* spp.	8	3.04
7.	Mucoraceae	1	5.55	*Mucor racemosus*	5	1.90
8.	Culicidae	1	5.55	*niptodera margiration*	26	9,88
9.	Cunninghamellaceae	1	5.55	*Absidia* spp.	3	1.14
10.	Microascaceae	1	5.55	*Graphium* spp.	6	2.28
11.	Phaeosphaeriaceae	12. 1	13. 5.55	*Leptosphaeria agnita*	13	4.94
14.	Cordanaceae	1	5.55	*Cordana verruculosa*	11	4.18
15.	Herpotrichiellaceae	1	5.55	*Exophiala jeanselmei*	15	5.70
16.	Thermoascaceae	1	5.55	*Byssochlamys nivea*	15	5.70
Total	**14**	**18**	**5.55**	**18**	**255**	

Two hundred fifty-five fungal isolates were obtained from aquatic plants belonging to 14 different families. The results revealed the presence of 18 species, with the genus *Aspergillus flavus* exhibiting the highest prevalence rate at 12.16%. *Aspergillus niger* also showed a high frequency, with a prevalence rate of 11.78%, as shown in Table 5. In contrast, *Absidia* spp. was found to have the lowest prevalence rate at 1.14%. These findings highlight the diversity of fungal species in the sampled aquatic plants.

The results revealed the presence of fungal species from various aquatic plants, with *Ceratophyllum demersum* being one of the sources; as shown in Table 6, the genus *Aspergillus flavus* was among the species detected.

In addition, 13 species of fungi were isolated from *Najas marina*, and 10 species were identified from *Lemna minor* (duckweed). In contrast, *Hydrilla verticillata* yielded the lowest recurrence rate of isolates, suggesting a relatively lower fungal diversity in this plant species.

Table 6: Species of fungi and their aquatic plants host:verticillatum. (+) present, (-) absent

N.	Family	Fungal species	*C. demersum*	*N. marina*	*H. verticillate*	*L.minor*
1.	Trichocomaceae	*Aspergillus niger*	+	+	+	+
		Aspergillus flavus	+	+	+	-
		Penicillium chrysogenum	+	+	-	+
2.	Saprolegniaceae	*Dictyuchus* spp.	+	-	+	-
3.	Pleosporaceae	*Alternaria alternate*	+	+	-	+
		Curvularia lunata	-	+	-	+
4.	Saccharomycetaceae	yeast	+	+	+	+
5.	Davidiellaceae	*Cladosporium* spp.	+	-	-	+
6.	Mucoraceae	*Mucor racemosus*	+	+	-	+
7.	Culicidae	*niptodera margiration*	+	-	-	+
8.	Cunninghamellaceae	*Absidia* spp.	+	+	-	-
9.	Chaetomiaceae	*Tricocladium acrosporium*	-	+	-	-
		Scytalidium thermophilum	+	+	+	-
10.	Microascaceae	*Graphium* spp.	-	-	+	-
11.	Phaeosphaeriaceae	*Leptosphaeria agnita*	-	-	-	+
12.	Cordanaceae	*Cordana verruculosa*	+	+	+	-
13.	Herpotrichiellaceae	*Exophiala jeanselmei*	+	+	-	-
14.	Thermoascaceae	*Byssochlamys nivea*	+	+	+	+
Total	14	18	15	13	8	10

The appearance of fungi, which includes *Rhizoctonia sp.*, *Rhizopus*, *Fusarium sp.,* and *Aspergillus sp.*, was notable in water samples throughout the study period. This occurrence is probable due to their nature as soil fungi, which can transferred to water during plant irrigation processes in the university gardens [28]. The excessive incidence of *Aspergillus* sp. is attributed to its potential to produce a large number of asexual reproductive systems. Additionally, *Aspergillus* sp. it can spread and thrive in various environments by secreting various enzymes that help exploit the nutritional resources available in its surroundings [29,30].

The variety and increase of fungi discovered within the water samples show this area's chemical and bodily situations. The common temperature during the study period was 18 C°, along with a pH value of 7.3, creating an environment favorable for growth fungi [31,32]. According to the Haider *et al.,* 2023, a pH variety between 3 and 8 is suitable for the growth of most fungi in aquatic environments [33]. Furthermore, Al-Ameen and Al-Jaff, 2023 reported that many fungi, including *Aspergillus* sp., *Penicillium* sp., *Cladosporium* sp., and *Pythium* sp., can grow at pH 6.5-8 [31].

Several studies have indicated that fungi exhibit a certain tolerance level to salts. During the study period, the levels of calcium, magnesium, and chloride salts in the water were suitable for the growth of fungi isolated in this study [34]. These findings are consistent with a previous study conducted by Rasheed, 2019 [26]. The appearance of fungi, which includes *Rhizoctonia sp.*, *Rhizopus*, *Fusarium sp.,* and *Aspergillus sp.*, was notable in water samples throughout the study period. This occurrence is probable due to their nature as soil fungi, which can transferred to water during plant irrigation processes in the university gardens [28]. The excessive incidence of *Aspergillus* sp. is attributed to its potential to produce a large number of asexual reproductive systems. Additionally, *Aspergillus* sp. it can spread and thrive in various environments by secreting various enzymes that help exploit the nutritional resources available in its surroundings [29,30].

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Conclusion:

This study provides comprehensive data on the physical, chemical, and biological properties of the Tigris River in Baghdad's Al-Jadriya district. It highlights fungal biodiversity and conducts a qualitative assessment of the fungal families and types of aquatic plants, such as *Ceratophyllum demersum*, *Najas marina*, *Hydrilla verticillata*, and *Lemna minor*, which play a vital role in maintaining ecological balance. This study identified 23 fungal families, with Trichocomaceae having the highest occurrence. Fungal species adhered to aquatic plants, showing a high recurrence rate, including *Aspergillus flavus* and *Aspergillus niger*. These findings reflect the seasonal variation in water properties. Identification of aquatic flora is crucial for understanding the biodiversity of fungi and plant life in the study area, which is essential for maintaining and protecting the aquatic ecosystem.

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