Determining The Qualitative Differences of Algae in Heterogeneous Aquatic Environments Within Nineveh Governorate -Iraq

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ABSTRACT

The results of the current study showed a significant increase in the rates of the measured values of organic pollutants in the stations of-Khosar River compared to their values in the stations of the Tigris River, and it was noted that these values increased in general during the summer and decreased during the winter. The study showed the diagnosis of (108) species of algae, divided into eight groups. The dominance was for the diatomaceous algae, followed by green algae, then blue-green algae. The first station recorded the highest number (67 species) in the diversity of algae, while the second station had the lowest number (41 species) in the diversity of algae.

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1. Introduction

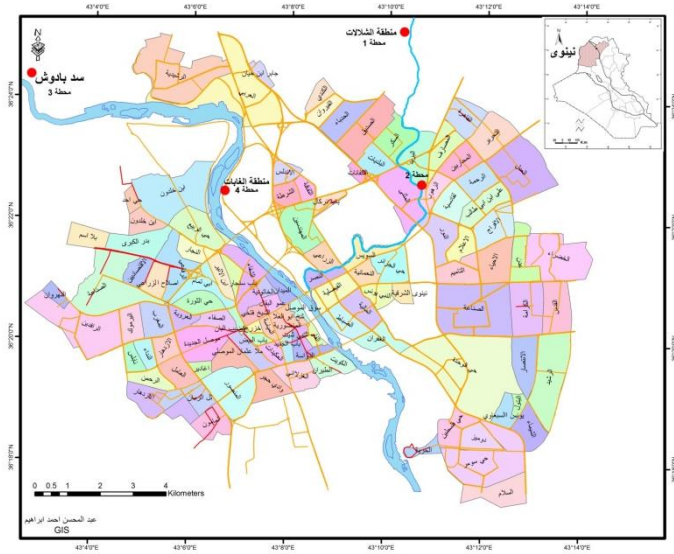
Algae are a wide and diverse group of eukaryotic organisms, varying in shape, size, and lifestyle. They are autotrophic because they contain the chlorophyll pigment, which enables them to absorb light energy and convert it into chemical energy. [1]. Algae, whether fresh, salty, or saline, are generally found in the water. May be found in moist soil or on the bark of trees, and some of them live free on the surface of the water, forming a superficial layer of phytoplankton, while others live attached to stones. Studying algae in those environments is one of the main things when one wants to know the algae's environment. One of the things to be studied is to identify the species of algae and then classify them and know the factors that determine or help their growth and then study all plants in each environment and the relationship between different plant life and the biological, physical, and chemical factors that directly or indirectly affect the environment.

Accordingly, the current study aimed to conduct diagnostic, environmental studies of algae for heterogeneous sites on the Tigris and Al-Khosar rivers within Nineveh Governorate and to observe the variations in the algal diversity, as well as to make a comparison between the studied stations and link the algal diversity with the variance in qualitative characteristics.

2. Materials and methods

The location of the study area

Four different stations were selected, distributed as two stations on (the Tigris River) and two stations on (Al-Khosar River).



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Picture (1) The stations selected for study within Nineveh Governorate

- Al-Khosar River Stations

1- First station (Al-Shallalat station):

It is located in the north of Mosul city on the Mosul-Shekhan road

Picture (2) The station Al-Shallalat

2- Second station (Al-Zuhor station):

It is located in the center of Mosul city; this station is about (12 km) from the first station (Al-Shallalat):

Picture (3) The second station (Al-Zuhor neighborhood)

- Tigris River Stations

3- Third station (Badush Dam):

This area is about 24 km away from the center of Mosul city on the northwestern side.

Picture (4) The third station (Badush Dam)

4- Fourth station (Mosul woods):

This station is located in the center of Mosul city and in the tourist woods of Mosul.

2521

Picture (5) the fourth station (Mosul woods)

Samples Collection

The process of collecting samples from the stations under study started from August of the year 2021 until the month of May of the year 2022. The physical and chemical properties of the water of the study stations were measured, and the averages were taken for the values of these factors. The physical properties such as air and water temperature and electrical conductivity were measured. The chemical properties of water were measured for the following factors: pH, dissolved oxygen, biological oxygen demand, total hardness, and concentration of chlorides, sulfates, phosphates, and nitrates. Standard methods were used to measure the above factors and use mathematical equations, as described in [2].

Algal plankton was diagnosed by making temporary slides, and a light microscope examined the samples. The species was

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diagnosed using a digital camera attached to the microscope, and the samples were diagnosed based on the following sources: [3][4][5][6][7][8][9].

3. Results and discussion

The current studies showed clear differences in the studied water sites' physical, chemical, and biological properties within the Nineveh Governorate. The results (Table 1) showed that the air and water temperature values were clearly close, with a slight difference between the average water temperature in Al-Khosar River (20.70°c for the first station) and the Tigris River (21.2°c for the third station) due to the capacity and the flow rate between the two rivers.

As the results of (Table 1) showed a clear increase in the rates of values of organic pollutants in Al-Khosar River (station 2) compared with the rates of values of the Tigris River (station 3), as the values of (1381.1 $\mu S.cm^{-1}$, 7.45, 3.583 mg/L, 13.981 mg/L, 545.8 mg/L, 289.5 mg/L, 256.3 mg/L, 356.4 mg/L, 229.5 mg/L, 256.3 mg/L, 0.838 mg/L, 0.345 mg/L, 34.9 mg/L for electrical conduction E.C., pH, dissolved oxygen in water D.O., biochemical oxygen demand BOD_5, total hardness T.H., calcium and magnesium hardness, total base, sulfates, nitrates, phosphates and chlorides for the second station of Al-Khosar River, respectively, and (358.5 $\mu S.cm^{-1}$, 7.562, 8.368 mg/L, 1.155 mg/L, 249.8 mg/L, 141.2 mg/L, 108.6 mg/L, 185.8 mg/L, 64.4 mg/L, 0.324 mg/L, 0.052 mg/L, 18.4 mg/L for electrical conductivity, pH, dissolved oxygen and biochemical oxygen demand, total hardness, calcium and magnesium hardness, total base, sulfates, nitrates, phosphates and chlorides of the third station of the Tigris river, respectively as the flow rate and the amount of wastewater between the two rivers is one of the main reasons for the high values of pollutants in the Al-Khosar River compared to the Tigris River. This was confirmed by many environmental studies of inland waters [10][11][12].

The results of (Table 2) showed a clear diversity in the dominant algae in the Tigris River, compared with a lack of diversity in the studied area in the Al-Khosar River.

2522

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Table (1) values of the measured chemical and physical parameters rates for the studied stations during the study period

Station	Temp. of Air	Temp. of water	E.C.	pH	DO	BOD_5	T.H	Ca. H	Ma. H	TA.	SO_4	NO_3	PO_4	Cl
1	20.7	18.2	1357.6	7.935	7.897	4.367	610.5	323.6	286.6	330.1	310.2	0.305	0.146	25.3
2	21.4	18.4	1381.1	7.49	3.583	13.981	551.9	292.2	256.3	356.4	229.5	0.838	0.345	34.9
3	21.2	12.9	385.5	7.562	8.368	1.155	249.8	141.2	108.6	185.8	64.4	0.324	0.052	18.4
4	21.3	13	378.5	7.82	7.381	1.511	292.6	203.2	89.4	197.4	69.4	0.473	0.068	25

2523

Table (2) Distribution of the diagnosed algae for the four studied stations during the study period

Algae diagnosed	**Study station**			
	1	**2**	**3**	**4**
Division:Cyanophycophyta **Class: Cyanophcophycae** **Order: Chroococales** **Family:Chroococaceae** 1- *Aphanocapsaelechista*	✳			
2- *Chroococcus disperses*	✳			
3- *Chroococcus giganteus*			✳	✳
4- *ChroococcusLimneticus*	✳		✳	✳
5- *Gloeocapsa punctate*	✳	✳		
6- *Gloeocapsarupestris*		✳		
7- *Merismopedia punctata*			✳	✳
Order:Oscillatoriales **Family:Oscillatoriaceae** 8- *Lyngbyadiguetii*	✳	✳		✳
9- *Lyugbyataylorii*	✳	✳		
10- *Oscillatoria acutissima*		✳	✳	✳
11- *Oscillatoria agardhii*	✳	✳	✳	✳
12- *Oscillatoria amphigranulata*	✳			
13- *Oscillatoria angusta*		✳		
14- *Oscillatoria chalybea*		✳		
15- *Oscillatoria ornata*	✳		✳	✳
16- *Phormidiumfvarosum*	✳	✳		
17- *Phormidiumincrustatum*	✳	✳		
18- *Spirulialaxa*	✳	✳		✳
19- *Spirulia major*		✳		
Order: Nostocales **Family: Nostocaceae** 20- *Anabaena circinalis*		✳	✳	✳
21- *Nostoc muscorum*	✳			
Division:Chlorophycophyta **Class:Chlorophycophyceae** **Order:Volvocales** **Family:Chamydomonadaceae** 22- *chlamydomonasglobosa*	✳	✳	✳	✳
23- *chlamydomonaspolypyreoideum* Prescott. 1944	✳			
Family:Volovcaceae 24- *Eudorina elegans*		✳		
25- *Gonium pectorate*		✳	✳	✳
26- *Pandorina morum*	✳	✳		
Order:Chlorococales **Family: Ooscystaceae** 27- *Ankistrodesmusconvolutus*	✳		✳	✳
28- *Ankistrodesmusfalcatus*	✳	✳		✳
29- *Chlorella ellipsoidea*	✳	✳		✳
30- *Chlorella vulgaris*		✳		✳
31- *Chlorococcumhumicola*		✳		✳
32- *Tetraedron minimum*	✳		✳	✳
Family:Characiaceae 33- *Charaaciumambiguum*			✳	✳
Family:Scenedesmiaceae 34- *Scenedesmus abundans*	✳			
35- *Scenedesmus abundans* var. *brevecauda*	✳			
36- *Scenedesmus dimorphus*	✳	✳		✳
37- *Scenedesmusquadricauda*		✳		
Family:Dictosphaeriaceae 38- *Pediastrum boryanum*	✳		✳	✳
39- *Pediastrum simplex*	✳		✳	

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Algae diagnosed	**Study station**			
	1	**2**	**3**	**4**
40- *Pediastrum tetras*			✳	
Order:Chaetophorales **Family:Chaetophoraceae** 41- *Gongrosiralacustris*	✳			
42- *Aphanochaetepolychaete*				
43- *Stigeocloniumflagelifeum*				✳
Order:Ulotrichales **Family:Ulotricaceae** 44- *Ulothrix variabilis*	✳			
45- *Ulothrix aequalis*	✳		✳	✳
46- *Stichococcusbacillaris*	✳			
Order:Oedogoniales **Family:Oedogoniaceae** 47- *Oedogonium macrandrous*	✳		✳	✳
48- *Oedogonium nannandrous*	✳		✳	✳
Order:Cladophorales **Family:Cladophoraceae** 49- *Cladophora glomerata*	✳		✳	✳
50- *Rhizocloniumfontanum*	✳		✳	✳
Order:Zygnematales **Family:Desmidiaceae** 51- *Closterium lunula*	✳			
52- *Closterium moniliforme*		✳		
53- *Cosmariumpanamense*			✳	✳
54- *Cosmariumquainarium*	✳	✳		✳
Family:Zygnemataceae 55- *Mougotia sp.*	✳			
56- *Spirogyra collinsii*			✳	✳
57- *Spirogyra dubia*	✳			
58- *Spirogyra borgeana*	✳		✳	✳
59- *Spirogyra tripticata*	✳		✳	✳
60-*Zygnem sp.*	✳		✳	✳
Class:Charophycophyceae **Order:Charales** **Family:Characeae** 61- *Chara vulgaris*	✳		✳	
62- **Nitellaopaco*	✳			
Division:Englenophycophyta **Class:Englenophycophceae** **Order:Englenales** **Family:Englenaceae** 63- *Euglena acus*		✳		
64- *Euglena convolute*		✳		
65- *Euglena promixa*	✳	✳		
66- *Phacusacuminatus*		✳		
67- *Phacuscaudatus*		✳		
68- **Phacuscurvicauda*		✳		
Division:Chrysophycophyta **Class:Xanthophycophyceae** **Order:Vaucheriales** **Family:Vaucheriaceae** 69- *Vaucheriageminata*	✳			
Division:Bacillariophycophyta **Class:Bacillariophycophyceae** **Order:Centales** **Family:Thalassiosiraceae** 70- *Cyclotella meneghiniana*			✳	✳
71- *Cyclotella meneghiniana* var. *plana*			✳	✳
Family:Melosiraceae 72- *Melosiragranulata*			✳	✳
73- **Melosiraarctica*.			✳	
Order:Pennales **Family:Achnanthaceae** 74- *CoccoeisKlamathensis*				✳
75- *Coccoeis pediculus*			✳	✳
76- **Coccoeis rugose*	✳		✳	✳
Family:Cymbellaceae 77- *Cymbellaaffinis*	✳		✳	✳
78- *Cymbella aspera*			✳	✳
79- *Cymbellaminuta*	✳			

Algae diagnosed	Study station			
	1	2	3	4
80- *Gomphonema acuminatum*	✳			
Family:Navicullaceae 81- *Caloneis amphisbaena*	✳			
82- *Furstulia rhomboids*	✳			
83- *Gyrosigmamacrum*	✳			
84- *Navicullaatomus*	✳	✳		
85- *Navicullacanalis*	✳	✳		
86- *Navicullacryptocephale* var. *cryptocephale*	✳		✳	✳
87- *Navicullacryptocephale*	✳		✳	
88- *Navicullaramosissma*		✳		
89- *Pinulariaviridis*	✳	✳		
Family:Surirellaceae 90- *Surirella ovalis* var. *ovalis*	✳	✳	✳	
91- *Surirella ovata* var. *pinnata*	✳			
Family:Eunotiaceae 92- *Eunotiavanheurckii*			✳	✳
93- *Peronia intermedium*	✳		✳	✳
Family: Fragilariaceae 94- *Diatoma vulgare*		✳	✳	✳
95- *Fragilaria brevistriata*		✳	✳	✳
96- *Fragilaria vaucheriae*	✳		✳	
97- *Synedra acus*			✳	
98- *Synedra fasciculata*		✳	✳	✳
99- *Synedra gaillonii*			✳	
100- *Tabellariafenestrata*	✳	✳	✳	✳
Family:Nitizschiaceae 101- *Nitizschiaacicularis*	✳		✳	
102- *Nitizschiaobtus*	✳	✳	✳	
103- *Nitizschiatrybionella*	✳			
Family:Epithemiaceae 104- *Rhopalodiagibba*	✳			
105-*Rhopalodiaparallela*	✳			
Division:Pyrophycophyta **Class:Dinophycophyceae** **Order:Peridiniales** **Family:Glenodiniaceae** 106- **Glenodiniumpulvisculus*	✳			
Family:**Peridiniaceae** 107- *Peridiniumcincutum*				
108- *Peridiniumgatunense*	✳			
Total	67	41	47	45
Percentage	% 62	% 37.9	% 43.5	% 41.6

The biological diversity in any water site depends mainly on the purity and common pollutants in that site.

It was noted (Table 2) that diatoms are the dominant algae in Tigris and Al-Khosar Rivers, followed by green algae and then bluegreens, and this was confirmed by many studies related to local Iraqi waters [13][14][15]. (Table 2) shows the most prominent genera of algae diagnosed in the Tigris River: *Oscillatoria*, *Nastoc*, *Chlorella*, *Spirogyra*, *Cyclotella*, *Fragilaria*, *Tabellaria*.

As for the Al-Khosar River, the following genera were diagnosed: *Peridinium*, *Tabellaria*, *Nitizschia*, *Naviculla*, *Coccoeis*, *Caloneis*, *Nitella*.

The algal diversity in the Al-Khosar River is limited to the Tigris River. The genera (*Chlamydomonas*, *Scenedesmus*, *Closterium*, *Nitella*, *Euglena*) prevail in the waters of the Al-Khosar River are indications of obvious pollution with organic matter; it is possible to exploit these algae as organisms that can treat heavy or polluted water resulting from industrial plants, agricultural purposes, or hospitals before throwing this water into the riverbed. This is what was indicated by several international and local studies[16][17]. It is concluded from the current study that the algae diagnosed in the Al-Khosar River are considered as vital indicators of the amount of water pollution, and this is confirmed by the results of measuring the physical and chemical properties of Al-Khosar River compared with the Tigress River.

The study showed that an abundance of algal diversity characterizes the water with relatively little organic pollution (station 1,3), as filamentous algae and algae belonging to all

algal divisions were observed, and this is the opposite of what was observed from the station (2), as it is one of the most polluted stations with organic water, as filamentous algae and many species have disappeared that are unable to adapt to a large number of organic pollutants in the water.

4. Conclusion

The study concluded that pollutant values were very high in Al-Khawser River stations compared to their values in the Tigris River. The results showed the dominance of diatomaceous algae over the rest of the diagnosed algae sections.

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References

1. Al-Shahery Y.J. and Al-Asady I.N. (2020) Molasses as anew natrition medium for *Scenedesmus quadricanda* growth and production of som bio compounds Res. Inves. 6(4): 2202-2028.

2. APHA. (2017). Standard Method of Examination of water and wastewater ,23rd, Washington DC, USA. pp: 1545.

3. Prescott, G. W. (1962). Algae of the Western Great Lakes Area.W.M.C Brown. Co. Pub., Iowa.

4. Patrick,R. and Reimer, (1966). The diatoms of the United State 1. Vol. 1 Monger. Acad. Nat. Sci. New York. USA.

5. Bold, H. C. and wynne, M. J. (1985). Introduction to the algae structure and Reproduction. (2ended) prentice-Hall, Inc. Englewood Cliffs. New jersey, USA.

6.MauloodB.K. Al-Saadi, H.A. and Sherif, H.A. (1991). Ecology and pollution. Univ. of Baghdad COll. Of Education for Women.

7. Edward, E.A. (2006). Ecology of harm full algae. University of newyork, USA.

8. Al -Husseini, Ahmed Idan. (2017). Algae in Iraq its environment and classification. Books and Documentation House, Baghdad, Iraq.

9. Al-Dulaimi, Heba Hamad Muhammad. (2021). Environmental study of the algae present in Tigris River passing through the city of Dhuluiya-Saladin Governorate, Master's thesis, College of Education for Girls, University of Tikrit.

10. Shehab, Heba Faris Ahmed (2021). Study of a number of physical, chemical and biological properties of the water of Tigris River within the city of Mosul-Iraq, Master's thesis, College of Science, University of Mosul.

11. Mahmoud, Nather Ghanem. (2021). An environmental study on phytoplankton for selected sites in Tigris River within Nineveh Governorate, Master's thesis, College of Science, University of Tikrit.

12. Ibrahim, Manal Abbas. (2022). Evaluation of the performance of three stations in the left side of Mosul / Nineveh and identification of algae species in water, PhD thesis, College of Education for Pure Sciences, University of Mosul / Iraq.

13. Shehab, Zakaria Nafie Mahmoud. (2017). Environmental impacts of wastewater discharges on Tigris River between Al-Rashidiya and Al-Qayyarah. Master's thesis, College of Environment, University of Mosul.

14. Al-Hadidi, Amina Faris Farhan. (2018). Evaluation of the water quality of Tigris River in the area between Mosul Dam and Al-Qayyarah for different uses. Master's Thesis, College of Environmental Sciences and Technologies, University of Mosul.

15. Al-Shahery Y.J. and Al-Asady I.N. (2021) Identification of Saturated and Unsaturated Fatty Acids Produced by *Chlorellavulgaris* as a Potential Candidate for Piodiesel Production. Trop. J. Nat. Prod. Res. 5(2):238-242.

16. Badar, Sharifah Najiha, Masita Masita Mohammad Zeynab Emdadi and Zahira Yaakob, (2021). Algea and their growth requirements for bioenergy: a review, Biofuels, Vol. 12, No. 3, pp. 307-325, doi.org/10.1080/17597269.2018.1472978.