

FIFTEEN NEW RECORDS FOR FRESHWATER ALGAE OF IRAQ

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Abstract

Samples were collected at 6 stations, situated on rivers and Hadithah Reservoir in the Iraqi upper sector of Euphrates River, between April to October 2013. Fifteen new records for freshwater algae of Iraq were determined. Among these fifteen phytoplankton species, 5 were Chlorophyta, 3 Charophyta, 2 Dinoflagellata, 2 Euglenophyta, and 3 were Chrysophyta. Most species were recorded within the reservoir.

Key words: new records, algae, Euphrates, Iraq

1. INTRODUCTION

Iraqi algologists have spent a great effort on algae distribution in the different aquatic ecosystems, but a complete list of the phytoplankton flora of Iraq has not yet been completed. So far, only four checklists have been published. The first one was in 1983 by Hinton and Maulood (1983), which 1296 species were included; while 1900 species were listed in the second checklist by Maulood et al. (1993), and the recent one was by Maulood and Toma (2004) in which 2312 species were included, in addition to that a checklist was published by Hadi et al. (2009) included 722 algal species only in Diyala River one of Tigris River tributaries.

The freshwater algae of the upper region of Euphrates River in Iraq is still poorly investigated, few papers being published in this region, such as Al-Lami et al. (1997); Al-Lami et al. (1999); Al-Saadi et al. (2000); Kassim et al. (2000) and Al-Kaabi et al. (2010). Therefore, we expect that there are many species of algae still unrecorded. Thus, this study was carried out to contribute to the knowledge of freshwater algae in Iraq for the upper region of Euphrates River including Hadithah Reservoir in Iraq.

2. MATERIALS AND METHODS

Six stations were chosen in different areas of the river and reservoir (Fig. 1), and Table (1) shows the stations coordinates. The samples were taken from these six stations monthly between April to October 2013. Several vertical hauls in each station were made for phytoplankton sampling by plankton net with a pore diameter of 20 µm was used. Samples were poured to dark bottles to keep them live and transferred to the laboratory; subsamples were taken into objective slides for microscopic analysis. The specimens were identified and photographed using a compound Olympus-CH microscope equipped with a camera. Stage and ocular micrometers were used for the measurement of algal dimensions.

Table (1): Sampling stations positions

Stations	Coordinates	
	North	Este
St. 1	34°31'48.57"	41°46'44.03"
St. 2	34°24'16.32"	42° 0'26.88"
St. 3	34°20'13.17"	42°18'12.94"
St. 4	34°14'17.93"	42°21'57.83"
St. 5	34° 5'40.51"	42°22'11.96"
St. 6	33°54'39.08"	42°31'58.35"

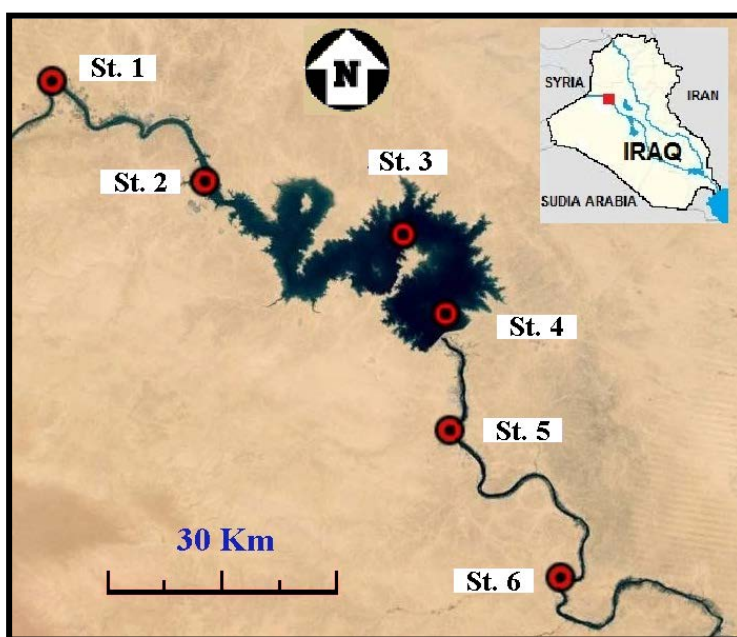


Figure (1): Aerial photograph (Google Earth) for the upper region of Euphrates River in Iraq and sampling stations.

Identification of algae was carried out according to Taft (1945), Smith (1950), Prescott (1962), Hilliar and Asmund (1963), Hinton and Maulood (1982), Wehr and Sheath (2003), Pasztaleniec and Poniewozik (2004); Misra et al. (2005) and Zarina et al. (2007). Identified taxa were checked with the checklist of Maulood and Toma (2004) and that of Hadi et al. (2009), and determined as new taxa for Iraqi algal flora.

3. RESULTS AND DISSCUTION

During the sampling period, mean values of the physic-chemical properties for the sampling stations were as follows: water temperature varied from 20.0 to 23.8°C; pH ranged from 6.62 to 7.91. Dissolved oxygen was varied from 4.80 to 11.10 mg/L, while BOD₅ was between 1.50 to 10.40 mg/L, electrical conductivity varied between 646 to 1395 µS/cm. Total hardness ranged from 319 to 945 mg CaCO₃/L. Nitrate and phosphate were varied between 130–419 and 17–50 mg/L respectively (Table 2). Total number of new records in this study was 15, in which 5 were Chlorophyta, 3 Charophyta, 2 Dinoflagellata, 2 Euglenophyta, and 3 Chrysophyta.

Phylum: **Chlorophyta**

Class: **Chlorophyceae**

Order: **Chloroellales**

Family: **Chloroellaceae**

Genus: ***Actinastrum*** Lagerheim, 1882

Actinastrum hantzschii* var. *fluvatile Schroder 1899 (**Plate 1: a**)

Prescott (1962) Page 791 Plate 65 Figure 1)

Description:

This variety is different than the typical species, colony of 16 of 16 fusiform spindle-shaped sharply pointed cells. The dimensions of the cells ranged from 36–41 µm long and 5.5–6 µm wide. Found at stations 3 and 5 during July and August 2013.

Family: **Oocystaceae**

Genus: ***Oocystis*** Nägeli ex A.Braun, 1855

***Oocystis gloeocystiformis* Borge, 1906 (Plate 1: b)**

Prescott (1962) P 763 Pl. 51 Fig. (13)

Description:

Colony of 2 to 4 ellipsoid cells within the old mother cell wall, cells with narrowed and sharply rounded ends, each cell with 1 parietal chloroplast. Cell with 7 µm in diameter and 10 µm long. Our specimens close to that of Prescott (1970). Found at station 1 during June 2013.

***Oocystis nodulosa* West & West, 1894 (Plate 1: c)**

Prescott (1962) P 769 Pl. 54 Figs.(6 and 7)

Description:

Ellipsoid to oblong-ellipsoid single to two cells, within expanded mother cell wall, Apices are rounded bearing a thickening papillate and projects both inward and outward; cell 15 -19 µm in diameter and 25 – 27 µm long. Found at stations 3 and 4 during August and September 2013.

***Oocystis pyriformis* Prescott, 1944 (Plate 1: d)**

Prescott (1962) P 763 Pl. 51 Figs. (8 and 9)

Description:

Pyriform-ovoid broadly cells, apiculation is prominent at one end, the other end broadly rounded, 2 – 4 united chloroplasts and the partial one with 1 pyrenoid. Cells up to 19 µm long and colony of 4 cells up to 47 µm long. Found at station 4 during June 2013.

Order: **Sphaeropleales**

Family: **Hydrodictyaceae**

Genus: ***Pediastrum*** Meyen, 1829

***Pediastrum simplex* var. *echinulatum* Wittrock, 1833 (Plate 1: e)**

Pasztaleniec and Poniewozik (2004) P1. Fig. (11)

Description:

Coenobia circular when composed of 4-8 cells and irregular in outline when composed of 32 cells. Coenobia always with holes, marginal cells with one narrowed lobe. Cell walls prominent elongated granules. Marginal cells of 20-23 µm long and of 10-12 µm diameter, inner cells of 13 µm diameter. Found at stations 2, 3, 4 and 5 during June, July, August and September 2013.

Phylum: **Charophyta**

Class: **Conjugatophyceae**

Order: **Desmidiales**

Family: **Desmidiaceae**

Genus: ***Staurastrum*** Meyen 1829

***Staurastrum inflexum* Brébisson, 1856 (Plate 1: f)**

Zarina et al. (2007) P. 1813 Fig. (11)

Description:

The cell body is short and radiate in shape, cell apical view is triangular, polygonal, ellipsoidal or spindle-shaped. Cell body dimensions 30-32 µm long and 27-29 µm width. Specimens were collected from stations 2 and 4 during July and October 2013.

***Staurostrum leave* Ralf (Plate 1: g)**

Misra, et al. (2005) P. 79 Fig.(4)

Description:

Cells slightly longer than broad with radiate process; cells 22 µm long, 20 µm broad. Found at stations 2 and 3 during July, September and October 2013.

Class: **Zygnematophyceae**

Order: **Zygnematales**

Family: **Desmidiaceae**

Genus: ***Euastrum*** Ehrenberg Ex Ralfs, 1848

***Euastrum bidentatum* Nägeli, 1849 (Plate 1: h)**

Taft (1945) P.189 Pl. II Figs.(11 and 12)

Description:

Cell characterized by a deep apical incision of the semi cell. The occurrence of lateral semi cell lobes is in between the basal lobes and the apical lobes. The lateral lobes are placed about half-way the height of the semi cell. Cell dimensions of 65-70 µm long and 55-57 µm width. Found at station 2 during October 2013.

Phylum: **Dinoflagellata**

Class: **Dinophyceae**

Order: **Peridiniales**

Family: **Glenodiniaceae**

Genus: ***Glenodinium*** Ehrenberg ex Ralfs 1837

***Glenodinium palustre* (Lemm.) Schiller, 1937 (Plate 2: a)**

Prescott (1962) P. 841 Pl. 90 Figs.(15 and 16)

Description:

Globe-shaped spiral cells with slightly broad furrow. Longitudinal furrow expanding from the epic one through the upper hypo-cone with one apical plate, three intercalary and six precingular plates, hypotheca with five posteingular and one anapical plates. Cells of 35 µm long and 25 µm in diameter. The specimens collected from station 4 during June 2013.

***Glenodinium penardiforme* (Linde.) Schiller (Plate 2: b)**

Prescott (1962) P 841 Pl. 90 Fig.21)

Description:

Broadly oval cells, the epicone sharply rounded and slightly apiculate, dorsiventrally flattened, while the hypocone broadly rounded. and emarginate at the pole. Transversal furrow broad and the longitudinal furrow elongated into the epicone. Cells of 23-25 µm in diameter and 30-32 µm long. Specimens sampled at stations 3 and 4 during June and August 2013.

Phylum: **Euglenophyta**

Class: **Euglenophyceae**

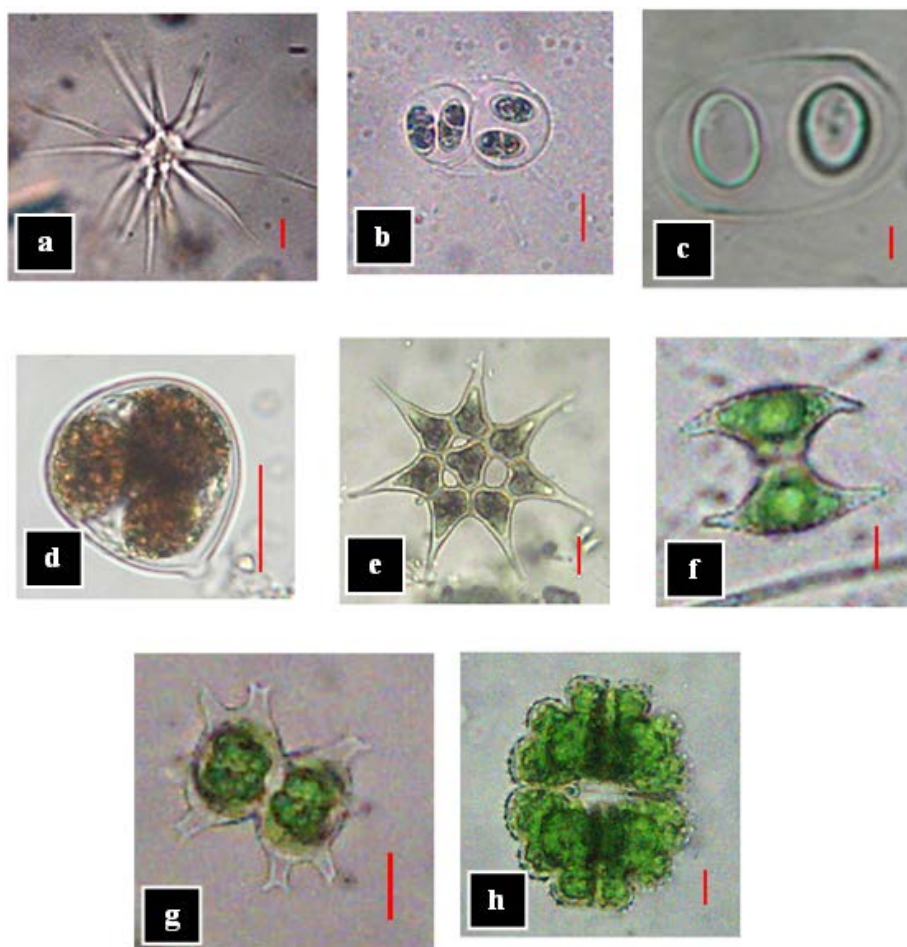


Plate (1): (a)-*Actinastrum hantzschii* var. *fluviatile*, (b)-*Oocystis gloeocystiformis*, (c)-*Oocystis nodulosa*, (d)-*Oocystis pyriformis*, (e)-*Pediastrum simplex* var. *echinulatum*, (f)-*Staurastrum inflexum*, (g)-*Staurastrum leave*, (h)-*Euastrum bidentatum* .(Red scale bar = 10 µm)

Order: **Euglenales**

Family: **Colaciaceae**

Genus: ***Colacium*** Ehrenberg, 1834

Colacium vesiculosum Ehrenberg, 1832 (**Plate 2: c**)

Prescott (1962) P 839 Pl. 89 Figs. (18 and 19)

Description:

Cells are fusiform to pyriform, single or two cells attached by short stalks to micro-fauna such as *Daphnia* or *Cyclopse*. Several ovoid discs chloroplasts without pyrenoids, cells of 35 long and 15 in diameter. Found at station 3 during October 2013.

Family: **Euglenaceae**

Genus: ***Phacus*** Dujardin, 1841

Phacus asymmetrica Prescott, 1944 (**Plate 2: d**)

Prescott (1962) P 837 Pl. 88 Fig. (19)

Description:

Cells are irregularly oval-fusiform, posterior half of the cell spirally twisted and bilaterally asymmetrical, chloroplast numerous. Cells of 52-55µm long and 22-25 µm broad. Identified at stations 3 and 4 during October 2013.

Phylum: **Chrysophyta**

Class: **Chrysophyceae**

Order: **Chromulinales**

Family: **Dinobryaceae**

Genus: *Epipyxis* Ehrenberg, 1838

Epipyxis utriculus Ehrenberg, 1838 (**Plate 2: e**)

Hilliar and Asmund (1963) P. 375 Pl. III Figs. (3 and 4)

Description:

Lorica vase-shaped, cell attached to base of lorica by a fine contractile protoplasmic strand. There are two unequal flagella. Cell usually with one band-shaped or bilobed chloroplast. The apex at the base of short flagellum, usually with swelling eyespot. Lorica dimensions of 65 µm long and 25 µm diameter. Found at stations 3 and 4 during October 2013.

Class: **Xanthophyceae**

Order: **Mischococcales**

Family: **Characiopsidaceae**

Genus: *Characiopsis* Borzi, 1895

Characiopsis pyriformis Borsi, 1895 (**Plate 2: f**)

Wehr and Sheath (2003) P 456 Pl. 88 Fig.(10 A)

Description:

Oval cells, anterior end broadly rounded, while posterior end narrowed gradually into a long stipe and terminated with a disc. Cell with 2-4 chromatophores, dimensions are 44-50 µm long and 16-27 µm in diameter. Found at station 3 during September 2013.

Family: **Ophiocytaceae**

Genus: *Ophiocytium* Nägeli, 1849

Ophiocytium mucronatum Rabenhorst, 1868 (**Plate 2: g**)

Prescott (1962) P 849 Pl. 94 Fig.(16)

Description:

Cells are somewhat curved cylinder, posterior end a short stipe and a semispherical disc, apical end slightly swollen terminated with slender spine. Cells dimensions 50-55 µm long and 10-12 µm diameters. Specimens collected from station 5 during June 2013.

This study is a part of Ph.D. degree project of the second author, on the effects of Hadithah Reservoir on the phytoplankton community structure in the Iraqi upper region of Euphrates.

Review of Iraqi algal species checklists shows that more than fifty algal species in water bodies were recorded; yearly. In this study Chlorophyta contains the highest records with 5 taxa. These taxa are dispersed into genus *Actinastrum* (with 1 species), *Oocystis* (with 3 species) and *Pediastrum* (with 1 species). These genera are cosmopolitan and widespread worldwide (John et al., 2003; Wehr and Sheath, 2003; Pasztaleniec and Poniewozik, 2004), these taxa were found in both environments, the reservoir (lentic water) and the river (lotic water).

Charophyta, represented by 2 genera *Straurastrum* (with 2 species) and *Euastrum* (with 1 species), all the species were mainly recorded in station 2 which represents the transitional environment from running water to stagnant water.

In this study, Dinoflagellata represented by one genera *Glenodinium* (with 2 species), Euglenophyta represented by two species belonging to two genera (*Colacium* & *Phacus*), while Chrysophyta represented by three species belonging to three genera (*Epipyxis*, *Characiopses* and *Ophiocytium*), all species of those divisions were found within the reservoir (stations 3 and 4) except *Ophiocytium mucronatum* which found in the riverbed (station 5) down the dam.

Generally, most species recorded in this study were found within the reservoir in which depths range from 18-20 m. Al Hassany (2010) found in their study, that the effect of Himreen Dam is allowing the appearance of new species. Table (2) shows some physic-chemical properties of sampling stations. Obviously, station (6) seems to be polluted to some extent because it is situated near the sewage discharge of Al-Baghdadi area, so it not logged any new records in that station.

The identified species in this study were observed to be widespread and sometimes rare in oligotrophic and mesotrophic media in European and American waters (John et al., 2003; Wehr and Sheath, 2003).

4. CONCLUSIONS

The following conclusions can be drawn through this study:

- environment of upper Euphrates in Iraq needs more algal taxonomic studies.
- the possibility of recording new algal species in the lake is greater than in the river.

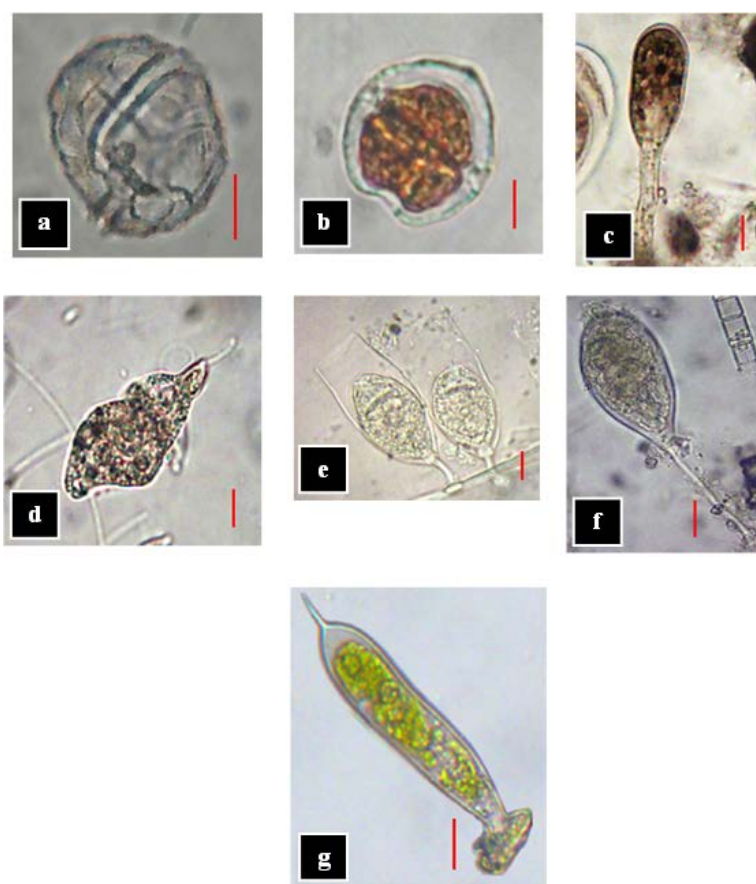


Plate (2): (a)-*Glenodinium palustre*, (b)-*Glenodinium penardiforme*, (c)-*Colacium vesiculosum*, (d)-*Phacus asymmetrica*, (e)-*Epipyxis utriculus*, (f)-*Characiopses pyriformis*, (g)-*Ophiocytium mucronatum*. (Red scale bar =10 μm).

Table (2): Mean of some physic-chemical characteristics of sampling stations.

Parameters	St. (1)	St. (2)	St. (3)	St. (4)	St. (5)	St. (6)
Temperature (°C)	20.2	21.3	22.4	22.1	20.0	23.8
pH	7.62	7.8	7.73	7.91	7.58	6.62
E.C. (μS/cm)	646	757	802	888	740	1395
D. O ₂ (mg/L)	9.75	11.10	9.62	9.65	10.33	4.80
BOD ₅ (mg/L)	1.76	1.50	1.86	1.93	3.08	10.40
Total Hardness (mg CaCO ₃ /L)	319	365	346	379	461	945
NO ₃ -N (mg/L)	281	130	139	189	260	491
PO ₄ -P (mg/L)	17	26	37	39	27	50

REFERENCES

- Al Hassany, J. S.; Zahrawi, Z.; Murtadeh, A.; Ali, Hassan & Sulaaيمان, N. (2012). Study of the Effect of Himreen Dam on the Phytoplankton Diversity in Dyala River, Iraq Journal of Environmental Protection, 3: 940-948.
- Al-Kaabi, K.M.; Al-Shamma'a, A.A.; Al-Mahdawi, M.M. & Salman, S.K (2010). Seasonal variations of phytoplankton community and it's relationship with occurrence of zebra mussel *Dreissena polymorpha* (Pallas, 1771) at Haditha reservoir. Biology Journal of Al-Kufa University, 2: 236-245.
- Al-Lami, A.A.; Al-Saadi, H.A.; Kassim, T.I. & Farhan, R.K. (1999). Seasonal Change of Epipellic Algae Communities in North part of Euphrates River, Iraq. J. Coll. Educ. For Women, Univ. of Baghdad, 10 (2): 236-247.
- Al-Lami, A.A.; Al-Saadi, H.A.; Kassim, T.I. & Al-Dulymei, A.A. (1997). Seasonal Variation of The Limnological Characters in Qadisia Lake, Iraq. Journal of Research and Studies, 12 (1): 132-147.
- Al-Saadi, H.A., Kassim, H.A, Al-Lami, A.A. & Salman, S.K. (2000). Spatial and seasonal variation of phytoplankton in the upper region of the Euphrates river. Iraq. Limnologica, 30: 83-90.
- Hadi, R. A., Ismail, A. M. & Talib, A. H. (2009). Check List of the algae in Diyala River, Iraq. Um-Salama Science Journal, 6 (2): 329-345.
- Hilliar, D.K. & Asmund, B.C. (1963). Studies on Chrysophyceae from some ponds and lakes in Alaska, II. Notes on the genera *Dinobryon*, *Hyalobryon* and *Epipyxis* with descriptions of new species. Hydrobiologia 22: 331-397.
- Hinton, G.C.F. & Maulood, B.K. (1982). Contribution to Algal the Flora of Iraq : the Non-Diatom Flora of the Southern Marshes. Nova Hedwigia . 37: 49-63.
- Hinton, G.C.F. & Maulood, B.K. (1983). Checklist of the algae from inland water in Iraq. J of University of Kuwait, 10: 191-256.
- John D M, Whitton B A & Brook A J (2003). The Freshwater Algal Flora of the British Isles, An Identification Guide to Freshwater ;2ed Terrestrial Algae. Cambridge: Cambridge University Press.
- Kassim, T.I.; Al-Saadi, H.A. & Al-Lami, A.A. (2000). On the epiphytic algae in the northern part of Euphrates river. Iraq. J. Coll. Educ. Women Univ. Baghdad, 11: 180-193.
- Maulood, B.K & Toma, J.J. (2004). Checklist of algae in Iraq. Scientific Journal of Babylon Univ. 9(3): 1-62.
- Maulood, R.A.M. Hadi B.K; Saadalla, H.A.A.; Kassim, T.I. & Al-Lami, A.A. (1993). ;Checklist of algae in Iraq. Marina Mesopotamica, 1: 1-28.
- Misra, P.K.; Srivastava, A.K.; Prakash, J.; Asthanal, D.K. & Rai, S.K. (2005). Some fresh water algae of eastern Uttar Pradesh, India. Our Nature 3: 77-80.

- Pasztaleniec, A. & Poniewozik, M. (2004). *Pediastrum* Species (Hydrodictyaceae, Sphaeropleales) in Phytoplankton of Sumin Lake (Leczna-Wlodawa Lakeland). *Acta Soc Bot Pol* 73(1): 39-46.
- Prescott, G.W. (1962). *Algae of the Western Great Lakes Area*. Michigan: W. M. C. Brown Company Publishers.
- Smith, G.M. (1950). *Fresh Water Algae of United State of America*. Mc Graw Hill, New York.
- Taft, C.E. (1945). The Desmids of the West End of Lake Erie. *Ohio Journal of Science*, 45 (5): 179-205.
- Wehr, J.D. & Sheath, R.G. (2003). *Freshwater Algae of North America : Ecology & Classification* Academic Press, 918 pp.
- Zarina, W.A.; Ul-Hasan, M. & Shameel, M. (2007). Taxonomic study of the family Mesotaeniaceae (Desmidiophyceae Shameel) in certain northeastern areas of Pakistan. *Pak. J. Bot.*, 39 (5): 1807-1815.