Algal study in springs and streams from Shaqlawa district, Erbil Province, Iraq
I- Euglenophyta

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Abstract:
In an intensive study of the various species of the Euglenophyceae under different environmental conditions, the algal samples were collected monthly in twelve springs and six related streams from September 2019 to August 2020 within Shaqlawa district-Erbil Province in virgin areas for phycomnoligical study. Twenty species of Euglenophyceae are identified as a new record for the algal flora. These taxa consist of Colacium vesiculosum, Lepocinclis salina and L.wangi, Eutreptia viridis, Euglena chlamydophora, E. clavata, E. geniculata, E. intermedia var klebsii, E. limnophila, E. oblonga, E. sociabilis, E. stellate and E. variabilis, Peranema saccatus, Phacus circumplexus, Ph. dangeardii, Ph. peteloti, Petalomonas mediocanella var disomata, Trachelomonas manginii, and T. volvocina var derephora. All of these new records are described and illustrated as much as possible. According to physicals and chemicals characteristics, water temperature varied from 14.942˚C to 18.475˚C, pH lies on alkaline side of neutrality, electrical conductivity ranged between (627.472–2092.306μS/cm) and high concentration of salinity recorded in Azarian spring.

Keywords: Algae, Erbil, Euglenophyta, Springs, Properties, physic-chemical, Streams.

Introduction:
Aquatic systems are considered the main sources to the remaining of life for almost organisms that live in aquatic environment. Algalflora is one of the most important organisms that are found in the aquatic ecosystems especially which is the main source of oxygen and food chain. Recently algae entered nano-technology and micro-technology for industrial purposes, antibiotics, toxicity, productivity, water quality assessment and water pollution indicators. Euglenophyta is very diverse algae; all species are unicellular, cosmopolitan in distribution living in fresh, saline water and in moist soils or mud rich in organic matter. They are autotrophic species, while a few of them are heterotrophic. Euglenophyta relatively responses to eutrophication. A total number of Euglenoids recorded in Iraq and Kurdistan Region are 54 and 21 taxa respectively. Despite worldwide importance of Euglenophyta; it receives little attention in Iraq. Recently few investigations and survey of Euglenophyta have been done by many authors in Iraq and in Kurdistan Region-Iraq. The aim of the present study is to explain more knowledge about Euglenophyta in this area as database in this area, also water quality in addition to their effect on the availability of Euglenophyta.

Materials and Methods:
Description of the study area
Erbil is the capital of Kurdistan Region and its population is about two millions people, situated in the northeast of Iraq at the coordination of 36° 11´28˝N 44° 0´33˝E/ 36° 19´11˝N 44° 0917´17˝E, Erbil boundaries extended from latitude 36° 42´ to 36° 23´ N and longitude 44° 29´ to 44° 08´ E. Information about geology, water resources, climate and soil conditions in the studied area within Erbil Province are described by more authors. Both studied sites (Aquban and Sarkand villages) belong to Shaglawa District, located 32 Km northeast of Erbil city. Aquban village area covers various types of shallow springs including sites 1, 2, 3, 4 and 5 distributed among Oak forests in the mountain...
areas, rich in some aquatic plants like Salix. Thirteen sites in Sarkand village which distributed as six sites 6, 7, 8, 9, 11 and 14 along stream while the remaining seven sites 10, 12, 13, 15, 16, 17 and 18 are springs located outside of stream flow within high mountain area. The length of area in this study is about 40Km Fig 1 and Tab 1

![Figure 1](image_url)

**Figure 1.** Shown. A- Map of Iraq and Erbil province shaded   B- Map of Erbil C- Aquban village   D- Sarkand village

| Site | X_Field | Y_Field | Elevation | Location | Name of Village |
|------|---------|---------|-----------|----------|----------------|
| 1    | 447065.42 | 4024114.692 | 905m | Sard Spring | Aquban  |
| 2    | 448620.345 | 4025272.842 | 902m | Piawan Spring | Aquban |
| 3    | 449343.633 | 4023623.880 | 887m | Zhnan Spring | Aquban |
| 4    | 450681.287 | 4022479.770 | 902m | Darmanawa Spring | Aquban |
| 5    | 452251.64 | 4022654.189 | 912m | Mink Spring | Aquban |
| 6    | 439655.001 | 4031776.001 | 736m | Stream1 | Aquban |
| 7    | 437278.463 | 403076.147 | 709m | Stream2 | Aquban |
| 8    | 435814.981 | 403419.117 | 707m | Stream3 | Aquban |
| 9    | 434042.001 | 4035935.001 | 648m | Stream4 | Aquban |
| 10   | 434707.036 | 4037048.419 | 713m | Prenga Spring | Sarkand |
| 11   | 432436.724 | 403653.074 | 669m | Stream5 | Sarkand |
| 12   | 432416.266 | 4034657.028 | 712m | Nawkand Spring | Sarkand |
| 13   | 429994.136 | 4036337.350 | 651m | Chemma Spring | Sarkand |
| 14   | 430060.282 | 4036321.729 | 668m | Stream6 | Sarkand |
| 15   | 431498.957 | 4038387.875 | 743m | Sarkand Spring | Sarkand |
| 16   | 432287.344 | 4039126.466 | 737m | Benwan Spring | Sarkand |
| 17   | 430142.964 | 4039528.893 | 707m | Azarian Spring | Sarkand |
| 18   | 428765.729 | 4039143.230 | 595m | Razga Spring | Sarkand |

**Sample collection and identification of algae**

Algal samples were collected in vials, and then 1 ml of Lugal’s solution was added to 100ml of collected both lentic and lotic water sample for persevering until identification. To keep the true color of algae, a few drops of CuSO₄ solution was
added\textsuperscript{19}. In this study, algal identification was based on the \textsuperscript{7,20-23}. Euglenophyta were identified as soon as possible to avoid loss of the taxonomic characters by light Microscope (Hund Wetzel S200) at 10X, 40X magnification. Water temperature was measured immediately in the field by placing a clean mercury thermometer (0\textdegree - 60\textdegree C) graduated up to 0.1 \textdegree C inside the water. EC & pH were measured by using (pH-EC-TDS meter, HI 9812, Hanna instrument).

**Results and Discussion:**

Collected data on water temperature, pH, EC and salinity for each sample of water sites have been represented in Tab2. Via 38 species of Euglenophyceae were identified, among them 20 species are new records in various springs and streams sites, attributed to 8 genera, 4 families, 3 orders and one class Tab 3. In this study *Euglena* is considered the dominant genus (19 species, 9 of them are new records. New addition of *Lepocinclis*, *Phacus* and *Trachelomonas* are 2, 2, and 3 with 10% 10% and 15% percentage respectively. Only one new record observed for each remaining genera *Colacium*, *Peranema*, *Eutreptia* and *Petalomonas* Tab 4. Generally, most species of Euglenophyceae thrive in warm water, alkaline and neutral pH Tab 2. As shown in results, high species diversity of Euglenophyceae depended on many ecological factors, such as temperatures above 20\textdegree C because they prefer warm water\textsuperscript{24-26}. The most abundant genera in this study was *Euglena*, *Lepocinclis*, *Phacus* and *Trachelomonas* identified in most sites, while two species *Lepocinclis salina* and *Euglena stellate* confined with high total dissolved solids and more saline water found in Nawkand, Chemma and Azarian springs. This is in accordance with\textsuperscript{27}. In this study Euglenophyceae was observed in summer and autumn a season which was similar to conclusion by \textsuperscript{27}. The differences of various species found in sites under study may be due to the geology of the area, depths of sites, seasonal variations and environmental conditions\textsuperscript{28}.

| Site | Place of Collection | Habitat type | Water Temperature °C | pH | EC µs.cm\textsuperscript{-1} | Salinity ppt |
|------|---------------------|--------------|-----------------------|----|---------------------------|-------------|
| 1    | Sard                | Spring       | 14.942                | 7.233 | 988.111                  | 0.065       |
| 2    | Piawan             | Spring       | 15.439                | 7.249 | 1124.778                 | 0.056       |
| 3    | Zhnan              | Spring       | 15.700                | 7.367 | 830.111                  | 0.058       |
| 4    | Darmanawa          | Spring       | 14.108                | 7.479 | 1611.667                 | 0.052       |
| 5    | Mink Spring        | Spring       | 14.039                | 7.764 | 627.472                  | 0.059       |
| 6    | Along Stream 1     | Stream 1     | 16.211                | 7.844 | 786.250                  | 0.072       |
| 7    | Along Stream 2     | Stream 2     | 17.517                | 7.875 | 785.222                  | 0.071       |
| 8    | Along Stream 3     | Stream 3     | 17.381                | 7.894 | 782.972                  | 0.076       |
| 9    | Along Stream 4     | Stream 4     | 17.272                | 7.992 | 764.056                  | 0.078       |
| 10   | Prenga             | Spring       | 18.231                | 7.401 | 810.639                  | 0.059       |
| 11   | Along Stream 5     | Stream 5     | 17.397                | 7.823 | 841.778                  | 0.077       |
| 12   | Nawkand            | Spring       | 17.917                | 7.235 | 1392.583                 | 0.110       |
| 13   | Benwan             | Spring       | 18.475                | 7.309 | 1419.139                 | 0.085       |
| 14   | Along Stream 6     | Stream 6     | 17.542                | 7.816 | 911.167                  | 0.080       |
| 15   | Sarkand            | Spring       | 18.033                | 7.330 | 924.972                  | 0.059       |
| 16   | Benwan             | Spring       | 18.169                | 7.372 | 975.639                  | 0.055       |
| 17   | Azarian            | Spring       | 16.108                | 7.297 | 2092.306                 | 0.155       |
| 18   | Razga              | Spring       | 16.628                | 7.817 | 989.222                  | 0.084       |
Table 3. List of identified species of Euglenophyceae in the study sites during the studied period

| Phylum: Euglenophyta | *E. stellate* Stocks 1851 |
|----------------------|--------------------------|
| Class: Euglenozoa    | *E. variables* G.A. Klebs 1883 |
| Order: Euglenales    | *E. viridis* (O.M. Muller) Ehrenberg 1830 |
| Family: Euglenaceae  | *Phacus* Dujardin 1841 |
| Colacium Ehrenberg1834 | *Ph. acuminatus* A. Stokes 1885 |
| *C. vesiculosum* Ehrenberg 1833 | *Ph. caudatus* Hubner 1886 |
| Lepocinalis Perry 1852 | *Ph. circumflexus* Pochmann 1942 |
| L. fusiformis (H.J. Carter) Lemmermann | *Ph. dangeardii* Lemmermann 1910 |
| L. playfairiana Deflandre 1932 | *Ph. peteloti* M. Lefevre 1933 |
| L. vesiculosum (O.M. Muller) Ehrenberg 1833 | *Ph. playfairiana* Deflandre 1932 |
| *Colacium vesiculosum* Ehrenberg 1834 | *Ph. peteloti* M. Lefevre 1933 |
| *Euglena* Ehrenberg1830 | *Ph. circumflexus* Pochmann 1942 |
| *E. acus* (O.F. Muller) Ehrenberg 1830 | *Ph. peteloti* M. Lefevre 1933 |

Table 4. New records with their percentages in the study sites during the studied period

| Name of Algal species | Genera | Species | % | Number of Euglenoids species | % |
|-----------------------|--------|---------|---|-------------------------------|---|
| Division: Euglenophyta |        |         |   |                               |   |
| Class: Euglenozoa     |        |         |   |                               |   |
| Order: Euglenales     |        |         |   |                               |   |
| Family: Euglenaceae   |        |         |   |                               |   |
| Colacium Ehrenberg1834 | 1      | 1       | 2.6 | 1                              | 5.0 |
| Lepocinalis Perry 1852 | 1      | 5       | 13.2 | 2                              | 10.0 |
| Euglena Ehrenberg1833 | 1      | 19      | 50.0 | 9                              | 45.0 |
| Phacus Dujardin 1841  | 1      | 6       | 15.8 | 3                              | 15.0 |
| Trachelomonas Ehrenberg 1833 | 1 | 4 | 10.6 | 2 | 10.0 |
| Peranema Dujardin, 1841 | 1      | 1       | 2.6 | 1                              | 5.0 |
| Eutreptia Perry 1852  | 1      | 1       | 2.6 | 1                              | 5.0 |
| Petalomonas F. Stein 1859 | 1 | 1 | 2.6 | 1 | 5.0 |
| Total                 | 8      | 38      | 100| 20                            | 100 |

Descriptions of new records:
*Colacium vesiculosum* Ehrenberg1834 (Pl.1, Fig.1)
Cell spindle-shaped, sometimes pear appeared, free swimming cells when solitary. Cells 8-19µm in width, long varied from 18 to 29µm. Found in Piawan in December-2019 (Water temp 15°C, pH 7.5, Conductivity 1305 µs/cm, Salinity 0.054ppt) and Chemma springs in May-2020 (water temp 20 °C, pH 7.5, Conductivity...
1312µs/cm, Salinity 0.097ppt) (P211, Pl54, Fig T-U).

*Lepocinclis salina* Fritsch (Pl.1, Fig.2)

Cells of green color, ovoid in shape, short projection found in the anterior end, chloroplast marginal, numerous and discoid 29. Cell 30-43.3µm long and 22 to 34.2 µm wide .Identified in Nawkand in March-2020 and Chenna springs in May-2020 respectively(Water temp16 °C and 20 °C, pH 7.05 and 7.11, Conductivity 1394 µs/cm and1592 µs/cm, Salinity0.093ppt,0.097ppt). (P69, Pl.3 Fig. 1).

*Lepocinclis wangii* Chu and Perty1966 (Pl.1, Fig.3)

Cells body less or more ovo-cylindrical, pellicle spirally striated,spinus projection see in the posterior end only or may tapered at very small tail , while round shape found in the anterior end, sometimes stigma present , chloroplast take discoid form 29. Cell 21-27.3µm width, 42-70µm length. Only recorded in along Stream 2 in June-2020.(23°C, pH 7.8, Conductivity795 µs/cm, Salinity 0.057ppt)(P69,Pl. 3 Fig. 2).

*Euglena chlamydophora* Mainx 1928(Pl. 1, Fig. 4)

Cell spindly in shaped, anterior end is rounded, narrowing to a tail at posterior end, numerous discoid chloroplasts, pyrenoids absent 21 .cells9-20µm in width and 32.2-45-54 in long. Found in Stream 2,3 and 6 in August-2020 ( Water temp 24°C, 23°C, pH 7.7,7.8,7.3, conductivity 880 µs/cm,820 µs/cm,910 µs/cm, Salinity 0.086,0.072,0.072)and in Chenna spring in July-2020.(Water temp 20°C; pH 7.3; conductivity 1313 µs/cm, Salinity 00.101ppt) (P188, Pl45, Fig. I, J).

*Euglena clavata*Skuja1948 (Pl.1, Fig.5)

Cell is dark green color, fusiformis, ovoid and spindly in shaped, anterior end was conically to elliptical, taped to tail in posterior end, chloroplast was many, small and round in shape 30. Cell 40-80 µm length and 15-30 µm width. Found in Stream 4, 5 in 7-2020 (23.8°C, 24.2°C, pH8.4, 8.00, Conductivity 782 µs/cm,1010 µs/cm, Salinity 0.054ppt) respectively.

Plate 1. Photomicrographs of Algae species recorded in the study area: 1. *Colacium vesiculosum*, 2. *Lepocinclis salina*, 3. *Lepocinclis wangii*, 4. *Euglena chlamydophora*, 5. *Euglena clavata*. Scale bar=10µm
**Euglena geniculata** (F. Schmitz) Dujardin 1841 (Pl. 2, Fig. 1)

Cell approximately cylindrica to blunt shape, both ends different in shapes, round in anterior end and narrow to sharped tail in posterior end, with two star shaped chloroplast, small eye spot\(^{21}\). Length of cell was 50-85 µm while width was 9.5-12.5-22 µm. This species were identified in Razga spring in July-2020 (Water temp 24.8°C, pH7.5, Conductivity 1250 µs/cm, Salinity 0.072 ppt) (P192, Pl 47, Fig. C).

**Euglena deses** var intermedia G.A.Klebs 1883 (Pl. 2, Fig. 2)

Anterior end was long and cylindrica, narrow and round at apex to short and small tail at posterior end, numerous, lens to disc chloroplast shaped. Paramylon rod shapes and short\(^{21}\). Cells 5-6-8-15µm in width and 45-54-100-130µm length. This species was present in Razga spring in July-2020 (Water temp 24.8°C, pH7.5, Conductivity 1250 µs/cm, Salinity 0.072 ppt) (P192, Pl 47, Fig. C).

**Euglena limnophila** Lemmermann 1898 (Pl. 2, Fig. 3)

Shape of cells changes from cylindrica to spindle or spindle form, anterior end was slightly truncate and tapered to sharped end at posterior end, numerous of disc and small chloroplast, paramylon bodies was elongated and large\(^{21}\). Cell 40-90µm length and 7.5-12-13.6µm width. Only found in stream in July and August-2020 (Water temp 24°C, pH7.7, Conductivity 900 µs/cm, salinity 0.086ppt) (P 199, Pl49, Fig. B).

**Euglena oblonga** Schmitz 1884 (Pl. 2, Fig. 4)

Cells green in color, cylindrical to fusiform or elongated, anteriorly tapered into round at the end, in the posterior end see broad and blunt\(^{21}\). Cells 45-54-79µm long a11-30 µm width. Presented in Prenga spring septemer-2019 (Water temp 22°C, pH7.4, Conductivity 810 µs/cm, Salinity 0.050ppt) and Benwan spring in August-2020 (Water temp 19.2°C, pH 7.2, Conductivity 1080 µs/cm, salinity 0.050ppt) (P191, Pl 46, Fig. H).

**Euglena sociabilis** Dangeard, 1902 (Pl. 2, Fig. 5)

Cell color is of deep green, shaped as spindly or ellipsoidal, conical form in anterior end and tapered tail or process at the posterior end, chloroplast numerous\(^{20}\). Cell 50-80µm long and 20-30 their wide found in stream 4, 5 in 8-2020 (Water temp 22°C, pH7.7,6.9, Conductivity 900 µs/cm,930 µs/cm, Salinity 0.090,0.080ppt) (P85, Pl 8, Fig. 15).

**Plate 2. Photomicrographs of Algae species recorded in the study area: 1. Euglenas geniculata, 2. Euglena deses var. intermedia, 3. Euglena limnophila, 4.a Euglena oblonga, 4.b- Euglena oblonga (Cyst) 5. Euglena sociabilis, Scale bar=10µm**

*Euglena stellate* Mainx, 1926 (Pl. 3, Fig. 1)
Cells spindly and broader in shaped, chloroplast was many aggregated, cells (25-50 µm) long and (8-14 µm) in wide 31. Identified only in Nawkand spring in May and June-2020 (Water temp 17°C, 18.8°C, pH 7.05, 7.10, Conductivity1395 µs/cm, 1383 µs/cm, Salinity 0.075, 0.079ppt) respectively (P87, Pl7, Fig. 5).

**Euglena variabilis** G.A.Klebs1883 (Pl.3, Fig.2)

Cells shape ovoid to short cylindrical, round broadly in the anterior end, tapering to a blunt at posterior end with short tail, chloroplast many and disc in shaped 31. Cell 25-31-46µm length and 7-9-15-20µm width. Present in Darmanawa, Mink and Sarkand springs(Water temp 16.5°C, 17.0°C, 18.9°C, pH 7.4,7.7, 7.1, Conductivity1200 µs/cm,650 µs/cm, 984 µs/cm, Salinity 0.082ppt, 0.072ppt, 0.068ppt ), also in River 2 and 3 in July and August-2020 (Water temp, 23.5°C,24°C, pH,7.7,7.8, Conductivity 845 µs/cm,830 µs/cm,salinity 0.054, 0.058ppt )respectively (P77, Pl4, Fig. 8, 9).

**Phacus circumfleuxs** Pochmann1942 (PL3, Fig.3)

Cells ovoid and broader, posterior end twisted and terminate with medium shape tail. Cell70-93µm length and 32-45µm width 30. Presented in Sard, Piawan, Chemma and Sarkand Springs in February and August-2020 respectively(Water temp 13-15°C,14-16 °C,16.5-20°C,17.2-18.2 °C, pH 7.10-7.02,7.15-6.95,7.33-7.42, 7.6-7.15, Conductivity 1113-980 µs/cm,1065-1060 µs/cm,1353-1310 µs/cm,853-980 µs/cm,0.072-0.079,0.046-0.063,0.086-0.072,0.054-0.043ppt)(P 91, Pl 11, Fig 6).

**Phacus dangeardii** Lemmermann 1910 (PL3, Fig.4)

Cells ovoid shape, 1-2 ring of paramylon appears 30. Cells 6-14µm width, 17-25 µm length. Found in Piawan spring in February 2020. (Water Temp14°C, pH 7.15, Conductivity 1065, 0.046ppt) (P95, Pl 13, Fig. 4).

**Phacus peteloti** M.Lefevre 1933(PL 3, Fig.5)

Cell ovoid to orbicular shaped, boarder in posterior end and attenuated in other end30. Cell 25-35µm length and 20-30µm width. This genus recorded in Benwan spring in August-2019(Water temp19.2 °C, pH7.18, Conductivity 1080 µs/cm, 0.050ppt) (P 93, Pl 12, Fig. 3).

**Trachelomonas manginii** Deflandre 1926 (PL 3, Fig.6)

Lorica ellipsoid and broad, smooth wall, contain spine was very minute but not visible31. Cells 20.5-26.5µm length and 14-20µm width. This genus found in Azarian spring in July-2020 (Water temp 20.5°C, pH 6.9, Conductivity 2110 µs/cm, 0.144ppt) (P221, Pl 55, Fig. V).

Plate 3. Photomicrographs of Algae species recorded in the study area: 1. *Euglena stellate*, 2. *Euglena variabilis*, 3. *Phacus circumfleuxs*, 4. *Phacus dangeardii*, 5. *Phacus peteloti*, 6. *Trachelomonas manginii*, Scale bar=10µm
**Trachelomonas volvocina** var *derephora* W. Conrad 1916 (Pl. 4, Fig.1)

Loria spherical, smooth seen, pore in apical surrounded by small collar. Cell 11-21μm diameter. Found in Sarkand spring in June and July-2020 (Water temp 18.9°C, pH 7.10, Conductivity 990μs/cm, 0.065-0.097ppt). (P 225, Pl 57, Fig. B).

**Petalomonas mediocannellata** var. *disomata* (A. Stoks) Lemmermann 1910 (Pl. 4, Fig. 2)

Cells ovoid to fusiformis, posterior end was rounded; anterior end was attenuated with one flagella. Enumerate chloroplast and like disc shape. Cell 15-25μm length and 5-12μm width. Identified in Darmanawa Spring in September-2019 (Water temp 20.6 °C, pH 7.2, Conductivity 2663μs/cm, 0.072ppt) (P103, Pl17, Fig. 10).

**Eutreptia viridis** Perty 1852 (Pl.4, Fig. 3)

Cell broadly spindle, rounded in the anterior end, and narrow in the posterior end, chloroplast disc like and small in size. Cell 55-75μm length and 5-25μm width. Recorded in in Sarkand and Benwan Springs in July and August-2020 (Water temp 18.9°C-19.2°C) (Water temp 18.475°C, pH 7.1, Conductivity 990 μs/cm, 0.097ppt). (P149, Pl34, Fig C).

**Peranema cf. sacculus** Christen 1962 (Pl.4, Fig.4)

Cell slightly elongate, posterior end was broad round, and pointed to anterior end. Cell 20-30μm length, 12-20μm width. Found in Sarkand spring in July-2020 (Water temp 18.9°C, pH 7.1, Conductivity 990 μs/cm, 0.097ppt). (P105, Pl18, and Fig. 11).

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**Plate 4. Photomicrographs of Algae species recorded in the study area:**

1. *Trachelomonas volvocina* var *derephora*, 2. *Petalomonas mediocannellata* var. *disomata*, 3. *Eutreptia viridis*, 4. *Peranema sacculus*. Scale bar=10μm

**Conclusions:**

Thirty-eight species of Euglenozoa phylum are identified. In general, they were found in stagnant water and running water, twenty of them were first recorded in Iraq and Kurdistan Region. They are more abundance and have high diversity in warmer months of the year; they are favorable for their growth and development. Genus of *Euglena* considered most abundance one than other genus present within this study, while *Colacium*, *Peranema* and *Petalomonas* considered rare genera recorded in this study. Water temperature in this survey never increased more than 18.475°C, pH values never below than 7 and high electrical conductivity found in Azarian spring was 2092μs/cm.

**Authors' declaration:**

- Conflicts of Interest: None.
- We hereby confirm that all the Figures and Tables in the manuscript are mine ours. Besides, the Figures and images, which are not mine ours, have been given the permission for re-publication attached with the manuscript.
- Ethical Clearance: The project was approved by the local ethical committee in Salahaddin University.
Authors' contributions statement: F.H. Aziz and J.J. Toma both participated in the development of the idea of the search. F. Aziz developed the theory and performance the computation. J. Toma has done all the identification of Euglenophyta and other physicals and chemicals analysis but with supervising and encouragement by F. A. Aziz. Both authors participated to discuss the results to contribute to the final manuscript to become in better form.

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دراسة الطحالب في الينابيع والجداول في قضاء شقلاوة، محافظة أربيل، العراق

1- الطحالب اليوغلينية

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الخلاصة:
تمت دراسة مكثفة لأنواع مختلفة من الطحالب اليوغلينية تحت ظروف بيئية مختلفة. تم جمع الطحالب شهرياً من اثني عشر موقع للينابيع وست مواقع في الجداول من شهر أيلول 2019 إلى آب 2020 ضمن قضاء شقلاوة، أربيل، في منطقة لم يتم دراستها سابقاً من الناحية المورفولوجية والطحلبية. شخص عشرون نوعاً من الطحالب اليوغلينية تم وصفها وتم تقديرها قدر الإمكان. بالنسبة للعوامل الفيزيائية والكيميائية، حيث درجة حرارة المياه تتراوح من م 14.942 إلى 18.475 م، الأكسجين كان قاعدياً، التوصيل الكهربائي كان قاعدياً، التوسيع الهيدروجيني كان قاعدياً، التوسيع الكيميائي كان قاعدياً، التوسيع الكيميائي كان قاعدياً، التوسيع الكيميائي كان قاعدياً.

الكلمات المفتاحية: طحالب، أربيل، يوغلينوفايتا، ينابيع، الخصائص الفيزيائية والكيميائية، جداول.