Research Article

To assess the fresh water algal diversity in relation to water quality from river Panjkora, district Dir lower, Pakistan

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Abstract
Thirty-five species belong to fresh water are taxonomically identified with the quality of water bodies from the remote areas. The samples are collected from the river Panjkora different sites during February 2015 to August 2016. Algae are collected, identified and describe in the area for the first time and exploration of the local species are presented in this article. The total 35 species belongs to 16 Genera, 15 Families, 12 Orders, 9 classes and 5 Phylum’s having phylum Chlorophyta includes 22 (63%) species, Charophyta 6(17%) species, Euglenophyta 4 (11%) Species, Ochrophyta 2 (6%) species and Rhodophyta 1 (3%) species. The most dominant are Genus Euglena 4 species (24%), Genera Ankistrodesmus, Microspora, Spirogyra and Ulothrix has 3 Species (17%), Genera Chaetophora, Chlamydomonas, Cladophora, Nitella, Oocystis, Stigeoclonium and Volvox has 2 species (12%), Asterococcus, Batrachospermum, Chlorochromonas, Synura, Zygogonium each has 1 species (6%). It is the first inclusive taxonomical study in river Panjkora and its surrounding area, the river Panjkora is rich of algal species further investigations were needed.

Keywords: Physico-chemical characteristics; Algal diversity; Freshwater; River Panjkora; Dir lower; Pakistan

Introduction
Algae are widespread in their existence found in every moist place including moist soil throughout the year. In the world lot of taxonomic work is done to classify the algal species but the most promising work is done on freshwater algal species. Algae are the important group of the organism and affect
human life both positively and negatively and it is a source of food [1]. Algae are the unicellular or multicellular most important photosynthetic life on earth having no true roots, stems and leaves, mostly found in the fresh water and moist places [2]. Algae contribute oxygen to the environment [3]. It is the primary producers and found in all ecosystems help in the different food chains. It is a direct and indirect source of food for fish, aquatic animals, and men also. Many algae were identified from the freshwater habitats by Hussain et al. [4], Hussain et al. [5] and Leghari et al. [6]. From Karachi fresh water algae revealed by Aliya et al. [7], Leghari, [8], the taxonomic survey of freshwater algae from Multan by Ghazala et al. [9]. A checklist of freshwater algae from Baluchistan by Hussain et al. [4]. From Azad Kashmir and Panjab Taxonomic studies were done [10]. Algae are different form and shapes, some are one cell and some are combining together and live in the form of colony and these worked independently. Dir lower is rich of plant diversity [11]. The current literature revels that there is no study done before on fresh water algal diversity from River Panjkora.

**Materials and methods**

**Study area**

District Dir lower is situated with the longitudes and Latitudes of 34°, 37° to 35°, 07° North and 71°, 31° to 72° to 14° East. District Dir is approximately 830 meters above the sea level, experiencing the annual rain falls is 1468mm. It has a boundary with district Chitral on the Northern side, With Bajour and Afghanistan on the Western side, with district Malakand on the southern side, with district Swat on the eastern side. The river Panjkora is a river in Khyber Pakhtunkhwa, Pakistan. It originates from the Kohistan Dir upper mountains passing upper and Lower Dir. River Panjkora then joins with river Swat at Sharbatti Bosoq Pull, behind the Totakan district Malakand and then connects with River Kabul at Charsadda in the Peshawar valley.

**Collections**

More than 70 samples were collected from different locality of river Panjkora and its surrounding. Algal species were collected in a clean plastic bottle with a capacity of 1 liter from the different site of fresh water bodies in river Panjkora. The collected water is from the depth of 1-3 feet’s below the surface waters. The species is collected through hands picking, forceps, direct put the water in bottles.

**Preservations and identifications**

The algal species is preserved with 4% formalin [12]. Aquatic algal species were preserved with 8%feramlin, and phytoplankton was preserved with 2%feramilin. The algal species were identified with the available literature like [13-16].

**Results and discussion**

The present’s research work is focusing on the exploring of algal species from the river Panjkora district Dir Lower, KPK, Pakistan. The algal diversity in the River Panjkora and its surrounding lakes and streams are rich. The algal species were collected, identified in the river Panjkora for the first time. In our collection, the most dominant Phylum Chlorophyta includes 22 (63%) species, Charophyta 6 (17%) species, Euglenophyta 4 (11%) Species, Ochrophyta 2 (6%) species and Rhodophyta 1 (3%) species shown in (Figure 1). While the Genus Euglena 4(24%), Genera Ankistrodesmus, Microspora, Spirogyra and Ulothrix has 3 Species (17%), Genera Chaetophora, Chlamydomonas, Cladophora, Nitella, Oocystis, Stigeoclonium, and Volvox has 2 species (12%), Asterococcus, Batrachospermum, Chlorochromonas, Synura, Zyogonium each has 1 species (6%) Shown in the (Figure 2) the same results from the various freshwater habitats algal species is taxonomically identified and
explored from various parts of Pakistan by Hussain et al. [5], Leghari et al. [6] and Hussain et al. [4]. The same results from Karachi in fresh water fresh water algae habitats revealed by Aliya et al [7], Leghari [8], the taxonomic survey of freshwater algae from Multan by Ghazala et al. [9]. A total of 68 blue green algal species belonging to 29 genera documented from various habitats like rivers, streams, ponds, stagnant water and waste water documented from district Malakand KPK, Pakistan by Hussain et al. [17]. The same results from Baluchistan a checklist of freshwater algae documented and identified by Hussain et al. [4]. The pH of different water bodies from various freshwater algal habitats, stagnant and running water and waste water bodies explain by Hussain et al. [18]. The algal diversity observed in wastewater bodies which is dominated in algal blooms during summer seasons by Hussain and Shah [19]. Freshwater algal species belong to 6 genera from the various site of Peshawar valley documented by Hussain et al. [20].

![Phylum Percentages](image1)

**Figure 1.** It shows us the Phylum percentages, number of species in the river Panjkora KPK, Pakistan

![Genera Percentages](image2)

**Figure 2.** It shows us the number of Genus and its percentages in river Panjkora KPK, Pakistan
Hajiabad
The total algae species in record Hajiabad near river Panjkora are Nitella flexilis, Spirogyra aequinoctialis, Spirogyra scrobiculata, Zygogonium ericetorum, Ankistrodesmus fractus, Ankistrodesmus falcatus, Asterococcus limneticus, Chlamydomonas angulosa, Chlamydomonas glohosa, Cladophora glomerata, Microspora flocose, Microspora loefgrenii, Oocystis elliptica, Stigeclonium flagelliferum, Stigeclonium lubrium, Ulothrix zonata, Volvox globator, Euglena acus, Euglena oxyuris, Euglena proxima and Batrachospermum moniliforme shown in (Table 1). The pH 7.90, conductivity 700.00μS/cm, Total solids (TS) 890mg/L, Total dissolved solids (TDS) 900mg/L, Total suspended solids (TSS) 4mg/L, Total hardness (TH) 220mg/L, Calcium as CaCO$_3$ 164.50mg/L, Magnesium as CaCO$_3$ 156mg/L, M-alkalinity as CaCO$_3$ nil mg/L, Sulphate as SO$_4^{2-}$ 305mg/L, Potassium as K$^+$ 21.3mg/L, Chlorides as Cl$^-$ 3.50mg/L, Sodium as Na$^+$ 120mg/L and Nitrates as NO$_2^{-}$ 1.8mg/L Show in the (Table 2).

Table 1. Relative distribution of algal species in among the different sites of river Panjkora

<table>
<thead>
<tr>
<th>S.No</th>
<th>Algal species</th>
<th>Hajiabad</th>
<th>Daab</th>
<th>Kandaroo</th>
<th>Tarai</th>
<th>ShagoKaas</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Nitella flexilis</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>Nitella tenuissima</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>Spirogyra aequinoctialis</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>4</td>
<td>Spirogyra scrobiculata</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>5</td>
<td>Spirogyra weberi</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>6</td>
<td>Zygogonium ericetorum</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>Ankistrodesmus fractus</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>8</td>
<td>Ankistrodesmus convolutes Corda</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>Ankistrodesmus falcatus</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>Asterococcus limneticus G.M. Smith</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>11</td>
<td>Chaetophora attenuate Hazen</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>12</td>
<td>Chaetophora elegans F. Schrank, 1783</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>13</td>
<td>Chlamydomonas angulosa</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>14</td>
<td>Chlamydomonas glohosa</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>15</td>
<td>Cladophora fracta</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>16</td>
<td>Cladophora glomerata</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>17</td>
<td>Microspora crassior</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>18</td>
<td>Microspora flocose</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>19</td>
<td>Microspora loefgrenii</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>20</td>
<td>Oocystis crassa</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>21</td>
<td>Oocystis elliptica</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>22</td>
<td>Stigeclonium flagelliferum</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>23</td>
<td>Stigeclonium lubrium</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>24</td>
<td>Ulothrix equalis</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>25</td>
<td>Ulothrix cylindricum</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>26</td>
<td>Ulothrix zonata</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>27</td>
<td>Volvox aureus</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

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Table 2. Physico-chemical analysis of water samples taken from various algal water bodies in river Panjkora various sites Dir Lower, Pakistan

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Collection sites</th>
<th>WHO Suggested limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Hajjabad Daab Kandaro Tarai Shago Kaas</td>
<td></td>
</tr>
<tr>
<td>Conductivity µS/cm</td>
<td>7.90 8.02 7.21 7.39 8.50</td>
<td>6.5-9.2</td>
</tr>
<tr>
<td>Total solids (TS) mg/L</td>
<td>890 1250 910 1025.1 975</td>
<td>1000</td>
</tr>
<tr>
<td>Total dissolved solids (TDS) mg/L</td>
<td>900 720 800 2010 1098.64</td>
<td>1000</td>
</tr>
<tr>
<td>Total suspended solids (TSS) mg/L</td>
<td>4 5 5.636 4.362 14.232</td>
<td>5</td>
</tr>
<tr>
<td>Total hardness (TH) mg/L</td>
<td>220 338.6 615 517 425</td>
<td>500</td>
</tr>
<tr>
<td>Calcium as CaCO₃ mg/L</td>
<td>164.50 192 184 172 179</td>
<td>248.00</td>
</tr>
<tr>
<td>Magnesium as CaCO₃ mg/L</td>
<td>156 164 172 133 156</td>
<td>150</td>
</tr>
<tr>
<td>M-alkalinity as CaCO₃ mg/L</td>
<td>302.25 308.50 335.50 320.50 323</td>
<td>500</td>
</tr>
<tr>
<td>P-alkalinity as CaCO₃ mg/L</td>
<td>305 95.5 280 200 312</td>
<td>250</td>
</tr>
<tr>
<td>Sulphates as SO₄²⁻ mg/L</td>
<td>21.3 6.293 7.273 20.00 13.7</td>
<td>75</td>
</tr>
<tr>
<td>Chlorides as Cl⁻¹ mg/L</td>
<td>73.50 72 26 45 36.75</td>
<td>250</td>
</tr>
<tr>
<td>Sodium as Na⁺¹ mg/L</td>
<td>120 250 166.5 180 230</td>
<td>200</td>
</tr>
<tr>
<td>Nitrates as NO₂⁻¹ mg/L</td>
<td>1.8 0.5 2.0 1.6 0.8</td>
<td>.5</td>
</tr>
</tbody>
</table>

**Daab (College Khawar)**

The total algal species recorded in Daab are *Nitella flexilis*, *Nitella tenuissima*, *Spirogyra aequinoctialis*, *Spirogyra scrobiculata*, *Spirogyra weberi*, *Ankistrodesmus falcatus*, *Chaetophora attenuata*, *Chaetophora elegans*, *Chlamydomonas angulosa*, *Cladophora fracta*, *Microrypha crassior*, *Microspora floccose*, *Oocystis elliptica*, *Ulothrix equalis*, *Ulothrix cylindricum*, *Volvox globator*, *Euglena gracilis*, *Euglena proxima*, *Synura vella* and *Batrachospermum moniliforme* shown in (Table 1). The pH 8.02, conductivity 680 µS/cm, Total Solids (TS) 1250mg/L, Total dissolved solids (TDS) 720mg/L, Total suspended Solids (TDS) 5mg/L, Total Hardness (TH) 338.6mg/L, Calcium as CaCO₃ 192mg/L, Magnesium as CaCO₃ 164mg/L, M-alkalinity as CaCO₃ 308.50mg/L, P-alkalinity as CaCO₃ nil mg/L, Sulphate as SO₄²⁻ 95.5mg/L, Potassium as K⁺¹ 6.293mg/L, Chlorides as Cl⁻¹ 72mg/L, Sodium as Na⁺¹ 250mg/L and Nitrates as NO₂⁻¹ 0.5mg/L shown in (Table 2).

**Kandaroo**

The algal species recorded in Kandroo on the side of river Panjkora are *Nitella tenuissima*, *Spirogyra aequinoctialis*, *Spirogyra weberi*, *Ankistrodesmus convolutes*, *Ankistrodesmus falcatus*,
Chaetophora attenuate, Chaetophora elegans, Cladophora fracta, Cladophora glomerata, Microspora floccose, Oocystis crassa, Ulothrix equalis, Ulothrix zonata, Volvox aureus, Euglena acus, Euglena oxyuris and Chlorochromonas minuta Shown in (Table 1). The pH 7.21, Conductivity 680.00µS/cm, Total solids (TS) 910mg/L, Total dissolved solids (TDS) 800mg/L, Total suspended solids (TSS) 5.636mg/L, Total hardness (TH) 615mg/L, Calcium as CaCO$_3$ 184mg/L, Magnesium as CaCO$_3$ 172mg/L, M-alkalinity as CaCO$_3$ 335.50mg/L, P-alkalinity as CaCO$_3$ nil mg/L, Sulphate as SO$_4^{2-}$ 280mg/L, Potassium as K$^+$ 7.273mg/L, Chlorides as Cl$^-$ 26mg/L, Sodium as Na$^+$ 166.5mg/L and Nitrates NO$_2^-$ 2.0mg/L Shown in the (Table 2).

**Tarai**

The total algal species recorded in the Tarai in the side of River Panjkora are Nitella tenuissima, Spirogyra aequinoctialis, Spirogyra scrobiculata, Ankistrodesmus fractus, Ankistrodesmus convolutes, Asterococcus limneticus, Chlamydomonas angulosa, Chlamydomonas glohosa, Cladophora fracta, Microspora floccose, Oocystis crassa, Stigeoclonium flagelliferum, Stigeoclonium lubricum, Ulothrix cylindricum, Ulothrix zonata, Volvox globator, Euglena acus, Euglena proxima and Chlorochromonas minuta Shown in (Table 1). The pH 7.39, Conductivity 691.00µS/cm, Total Solids (TS) 1025.1mg/L, Total dissolved Solids (TDS) 2010mg/L, Total suspended Solids (TSS) 4.362mg/L, Total Hardness (TH) 425mg/L, Calcium as CaCO$_3$ 179mg/L, Magnesium as CaCO$_3$ 156mg/L, M-alkalinity as CaCO$_3$ 323mg/L, P-alkalinity as CaCO$_3$ nil mg/L, Sulphates as SO$_4^{2-}$ 312mg/L, Potassium as K$^+$ 13.7mg/L, Chlorides as Cl$^-$ 36.75mg/L, sodium as Na$^+$ 230mg/L and Nitrates as NO$_2^-$ 0.8mg/L as shown in the (Table 2).

**ShagoKaas**

The total species recorded in ShagoKaas near river Panjkora are Spirogyra aequinoctialis, Spirogyra scrobiculata, Spirogyra weberi, Ankistrodesmus fractus, Asterococcus limneticus, Chlamydomonas angulosa, Chlamydomonas glohosa, Microspora crassior, Microspora loefgrenii, Oocystis elliptica, Stigeoclonium lubricum, Ulothriz equalis, Volvox aureus, Euglena acus, Euglena gracilis, Euglena oxyuris, Chlorochromonas minuta and Synura vella shown in (Table 1). The pH 9.50, Conductivity 695µS/cm, Total Solids (TS) 975mg/L, Total dissolved Solids (TDS) 1098.64mg/L, Total suspended Solids (TSS) 14.232mg/L, Total Hardness (TH) 425mg/L, Calcium as CaCO$_3$ 179mg/L, Magnesium as CaCO$_3$ 156mg/L, M-alkalinity as CaCO$_3$ 323mg/L, P-alkalinity as CaCO$_3$ nil mg/L, Sulphates as SO$_4^{2-}$ 312mg/L, Potassium as K$^+$ 13.7mg/L, Chlorides as Cl$^-$ 36.75mg/L, sodium as Na$^+$ 230mg/L and Nitrates as NO$_2^-$ 0.8mg/L as shown in the (Table 2).

**Taxonomic description of algal species**

**Phylum Rhodophyta**

*Batrachospermum moniliforme* (Figure-3, Plate-1)

It is a freshwater alga species and found in cold running water. It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17µ in diameter and 11-16µ long.

**Phylum Ochrophyta**

*Synura vella* (Figure-3, Plate-2)

The cell is cylindrical, thallus is small and elongated. Cell size maximums 7-8µ in diameter and 6-7µ long.

**Chlorochromonas minuta** (Figure-3, Plate-3)

It is fresh water algae found in cold running water. It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17µ in diameter and 11-16µ long.
Phylum Euglenophyta

_Euglena acus_ (Figure-3, Plate-4)
The cell is green having chloroplast. Cell size maximums 13-17µ in diameter and 11-16µ long.

_Euglena gracilis_ (Figure-3, Plate-5)
The thallus is green and forms a large ball like structure. Cell size maximums 14-17µ in diameter and 12-16µ long.

_Euglena oxyuris_ (Figure-3, Plate-6)
The cell is green and forms a large ball like structure. Cell size maximums 13-17µ in diameter and 11-16µ long.

_Euglena proxima_ (Figure-3, Plate-7)
The body is green and forms a large ball like structure. Cell size maximums 14-17µ in diameter and 14-19µ long.

Phylum Chlorophyta

_Ankistrodesmiis fractus_ (West and G. S. West) Collins 1912 (Figure 4, Plate-8)
This species has needle like cells, rather spindle shaped, sometime clusters of 2-32individual or solitary. It has no colonial sheath chloroplast, a parietal plate without pyrenoids, the cell is 2-6 µ in diameter and 25-100 µ long, sometimes more than this. Ubiquitous; intermingled with other temperatures, where there is a dense collection of unicellular and colonial algae.

_Ankistrodesmiis convolutes_ (Figure-4, Plate-9)
It may be solitary or group of cells 2-4cells, fusiform in shape, warped and sigmoid. The tips is sharply pointed and sometimes twisted in opposite directions. Cell size maximums 3-5µ in diameter and 15-30µ long

Key to species
Cell may be straight, irregular in clusters, somewhat twisted about one another.

_Ankistrodesmus falcatus_ (Figure 4, Plate-10)
The thallus of this species is elongated and little bit fusiform. Cell size maximums 2-4µ in diameter and 4-10µ long.

_Asterococcus limneticus_ G.M. Smith (Figure 4, Plate-11)
The cell is cylindrical the cell wall of this species is cellulosic, Cell size maximums 3-4µ in diameter and 6-10µ long.

_Chaetophora attenuate Hazen_ (Figure 4, Plate-12)
Wall of the main axial cell is 5-6µ in diameter and 6-8µ long. Branching very irregular with long and tapering as well short, Arbuscular or rhizoidal branch produced throughout the length of the main axis.

*Chaetophora elegans* F. Schrank, 1783 (Figure 4, Plate-13)

Thallus pesudoparenchyma, stouter cell. Wall of main axial cell is 3-6µ in diameter and 5-8µ long.

*Chlamydomonas angulosa* (Figure 4, Plate-14)

Cell have flagella, chloroplast is present in form of cup-shaped. Cell size maximums 4-8µ in diameter and 8-10µ long.

**Figure 4. It include the species 8) Ankistrodesmus fractus, 9) Ankistrodesmus convolutus 10) Ankistrodesmus falcatus 11) Asterococcus limneticus 12) Chaetophora attenuate 13) Chaetophora elegans 14) Chlamydomonas angulosa**

*Chlamydomonas glohosa* (Figure 5, Plate-15)

Cell have flagella, chloroplast is present. Cell size maximums 2-6µ in diameter and 5-10µ long.

*Cladophora fracta* (Figure 5, Plate-16)

The thallus is green due to presences of chlorophyll. The cell is cylindrical there is great variability in this species and have many species and forms. Cell size maximums 5-6µ in diameter and 7-10µ long.

*Cladophora glomerata* (Figure 5, Plate-17)

Chlorophyll is present, thallus is cylindrical. Cell size maximums 5-8µ in diameter and 5-8µ long.

*Microspora crassior.* (Figure 5, Plate-18)

The thallus is small while the cells are rounded in outline. The majority of species have chlorophyll. The cell is cylindrical there is great variability in this species and have many species and forms. Cell size maximums 7-8µ in diameter and 3-7µ long.

*Microspora floccose* (Figure 5, Plate-19)

The cell is cylindrical, chlorophyll is present. Cell size maximums 6-8µ in diameter and 5-7µ long.

*Microspora loefgrenii* (Figure 5, Plate-20)

The cell is cylindrical, thallus is small and green. Cell size maximums 7-8µ in diameter and 5-7µ long.

*Oocystis crassa* (Figure 5, Plate-21)

It is a freshwater alga found in cold running water, It is soft thick and chains like Floridian starch are present. Cell size maximums 10-17µ in diameter and 11-16µ long.
Figure 5. It includes the species 15) *Chlamydomonas glohosa* 16) *Cladopora fracta* 17) *Cladopora glomerata* 18) *Microspora crassior* 19) *Microspora floccose* 20) *Microspora loefgrenii* 21) *Oocystis crassa*

**Oocystis elliptica** (Figure 6, Plate-22)
*Oocystis elliptica* is a freshwater green algae species. The cell is slightly swollen and almost spherical; size is 6.8-16.5 µm wide and 11-25 µm long, oval to sub-cylindrical apices broadly rounded and without polar wall thickenings. The chloroplast is a large 10-20 per cell, without pyrenoids, auto-spore 4-8 per sporangium, each have several chloroplasts.

**Stigeoclonium flagelliferum** (Figure 6, Plate-23)
Has erected which is densely branched at the base while a branch of the upper portion is irregular. Cell size maximums 6-7µ in diameter and 4-7µ long.

**Stigeoclonium lubricum** (Figure 6, Plate-24)
The thallus is elongated, having branch also on the apex. Cell size maximums 2-7µ in diameter and 4-9µ long.

**Ulothrix equalis** (Figure 6, Plate-25)
It may be solitary, fusiform in shape, the tips is sharply pointed and sometimes twisted in opposite directions. Cell size maximums 4-5µ in diameter and 5-30µ long.

**Ulothrix cylindricum** (Figure 6, Plate-26)
This is filamentous algae, having flagella. They form colonies which are surrounded by a sheath. Cell size maximums 12-17µ in diameter and 14-16µ long.

**Ulothrix zonata** (Figure 6, Plate-27)
Filamentous algae, having flagella, Cell is surrounded by a sheath. Cell size maximums 12-17µ in diameter and 14-16µ long.

**Volvox aureus** (Figure 6, Plate-28)
Green filamentous algae, having flagella, they form colonies which are surrounded by sheath. Cell size maximums 12-17µ in diameter and 14-16µ long.

**Volvox globator** (Figure 6, Plate-29)
The thallus is green and forms a large ball like structure. Cell size maximums 14-17µ in diameter and 12-16µ long.
Figure 6. It includes the species 22) Oocystis elliptica 23) Stigeoclonium flagelliferum 24) Stigeoclonium luhricum 25) Ulothrix aequalis 26) Ulothrix cylindricum 27) Ulothrix zonata 28) Volvox aureus 29) Volvox globator

*Nitella flexilis* (Figure 7, Plate-30)
It is Smooth stonewort in fresh water. It grows in a meter long and 1mm wide. Cell size of this species maximums 12-18 µ in diameter and 11-17 µ in long.

*Nitella tenuissima* (Figure 7, Plate-31)
This is algae having filaments; they form colonies which are surrounded by a sheath. Cell size maximums 13-17µ in diameter and 10-16µ long.

*Spirogyra aequinoctialis* (Figure 7, Plate-32)
This species has a cylindrical cell, chloroplast sometime many sometimes in the group which makes 5-6 turn. The cell wall of this species is scrobiculate, spindle shape having a diameter of 3-7m in diameter.

*Spirogyra scrobiculata* (Figure 7, Plate-33)
The thallus of this is cylindrical, many chloroplasts are present which make 15-17 turn. The cell wall of this species is scrobiculate, spindle shape having diameter of 3-4m in diameter.

*Spirogyra weberi* (Figure 7, Plate-34)
This specie sometime present in groups and sometime in groups, Thallus is elongated have 2-4 m in diameter. Pyrenoids are located at their sides.

*Zygogonium ericetorum* (Figure 7, Plate-35)
The cell of this algae is elongated, it form sometime group. The cell is 3-6 µ in diameter and 15-41 µ long.
Conclusion
District Dir lower has river, lakes, streams and other fresh water bodies where algae are in abundance and district Dir lower is the most ignored area of aquatic botany. The current investigations is done is river Panjkora different sites and found 35 species belong to 5 phylum, 9 classes, 12 order, 15 families and 16 genera. The area is rich of algal flora and further study is needed under this record.

Authors’ contributions
Conceived and designed the experiments: M Shuaib, Performed the Fields work and experiments: M Shuaib & K Ali, Analyzed the data: U Zeb, S Ahmed & S Ali, Contributed reagents/ materials/ analysis tools: S Ali, I Khan & F Hussain, Wrote the paper: M Shuaib & F Hussain.

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