Pak. J. Bot., 38(1): 161-167, 2006.

TAXONOMIC STUDIES ON *CYMBELLA* (BACILLARIOPHYTA) FROM PUNJAB AND AZAD KASHMIR

SYED TARIQ-ALI[1], A. ZARINA[1], MASUD-UL-HASAN[2] AND MUSTAFA SHAMEEL[3]

[1]Department of Botany, Federal Urdu University of Arts, Science & Technology, Gulshan-e-Iqbal Campus, Karachi-75300
[2]Haleema Sheikh Street No. 12, Shahgoharabad, P.O. Baghbanpura, Lahore-54920
[3]Department of Botany, University of Karachi, Karachi-75270, Pakistan

Abstract

Ten species of the diatom genus *Cymbella* C. A. Agardh (Cymbellaceae, Bacillariales, Bacillariophyceae) were collected from various freshwater habitats at Kasur, Lahore and Sialkot districts of the Punjab (Pakistan), Chenari and Neelum Valley of Azad Kashmir during April 2003 to December 2004. They were taxonomically determined and are described for the first time from these areas.

Introduction

West & West (1902) described for the first time 59 freshwater diatoms from the region now included in Pakistan. Carter (1926) added 49 new species. Abdul-Majeed (1935) gave an account of 62 diatoms of the undivided Punjab. A detailed investigation on the taxonomy of 102 species belonging to 25 genera of freshwater diatoms of Peshawar Valley (N. W. F. P.) of Pakistan was carried out by Salim & Khan (1960). Several attempts were made to describe the marine diatoms from the coastal waters of Karachi (Salim, 1954, 1964; Salim & Iqbal, 1964; Saifullah & Moazzam, 1978). A few species of freshwater diatoms were also reported from Punjab, Azad Kashmir (Masud-ul-Hasan & Zeb-un-Nisa, 1986; Masud-ul-Hasan & Batool, 1987; Masud-ul-Hasan & Yunus, 1989; Leghari MK *et al.,* 2003, 2004) and Sindh (Jahangir *et al.,* 2000, 2001; Leghari SM *et al.,* 2001, 2002, 2004, 2005a, b). But no composite study was carried out on the Bacillariophyta from any area of the country. A research program was, therefore, started in March 2003 (Tariq-Ali *et al*., 2005), and a large collection of diatoms was made from freshwater habitats of various districts of the Punjab, certain areas of N. W. F. P. and Azad Kashmir. During this collection several species of the genus *Cymbella* C. A. Agardh were obtained and their taxonomic descriptions are presented herein.

Materials and Methods

Collections were made from various freshwater habitats at Kasur, Lahore and Sialkot districts of the Punjab Province of Pakistan and Chenari & Neelum Valley of Azad Kashmir during April 2003 to December 2004. The collected material was taxonomically investigated as described earlier (Tariq-Ali *et al*., 2005). Specimens were identified with the help of authentic literature (Østrup, 1908; Salim & Khan, 1960; Starmach, 1964; Nizamuddin, 1984). The voucher specimens are kept in the Phycology & Phycochemistry Lab, MAH Qadri Biological Centre, University of Karachi, where the research work was carried out.

Results and Discussion

Ten species of the diatom genus *Cymbella* (Cymbellaceae, Bacillariales, Bacillariophyceae; *fide* Shameel, 2001) were identified. They have been taxonomically described for the first time from their area of collection. Their taxonomic enumerations are given below:

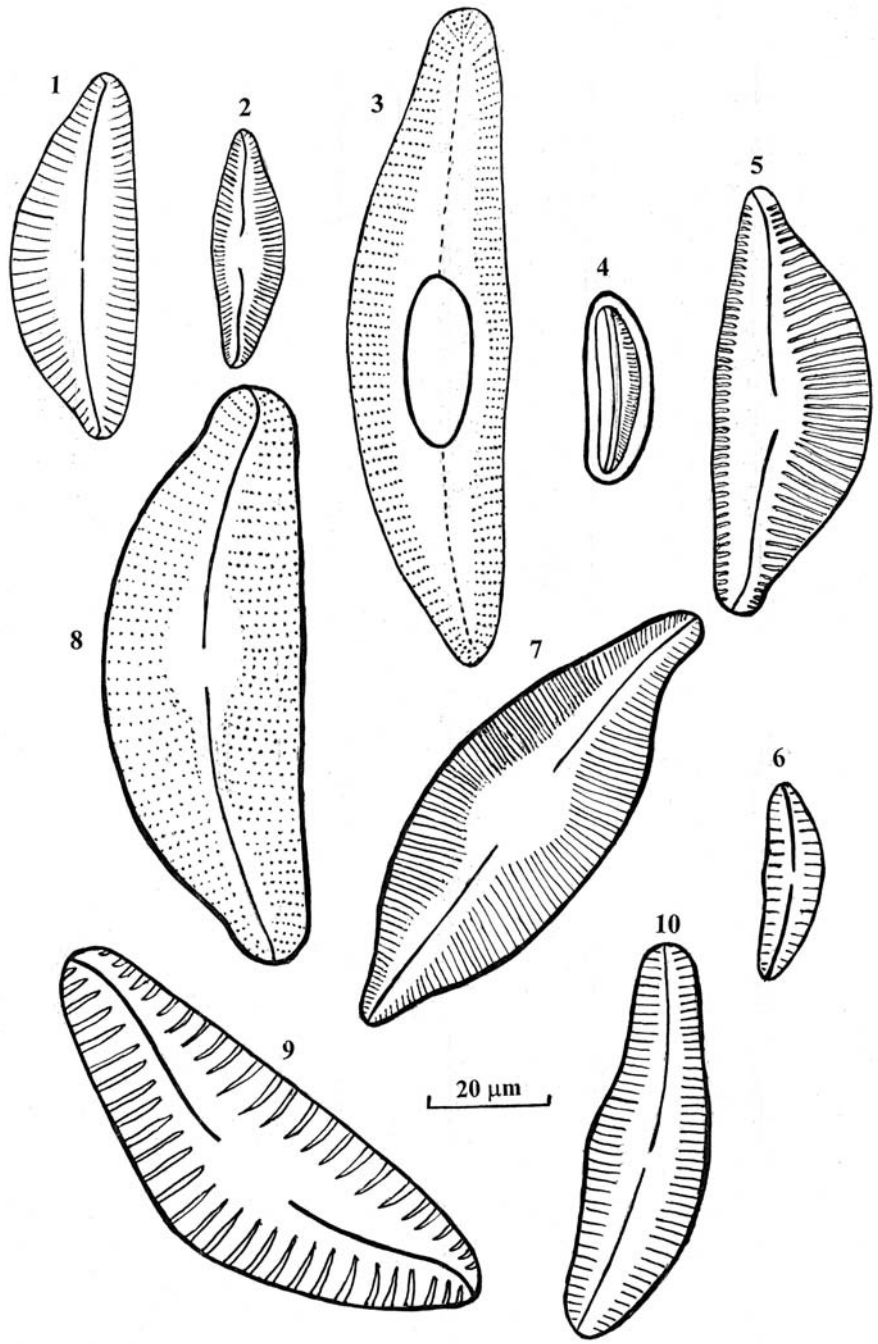
***Cymbella* C. A. Agardh 1830: 1**

Frustules asymmetrical, solitary or in colonies, free floating or epiphytic, sessile or stalked, or enclosed in gelatinous tube; girdle straight or sub-rectangular; valve attenuated from the middle towards the obtuse ends; striae punctate, radiate or coarse; raphe arched, eccentric with central and polar nodules; axial area narrow or straight or curved towards the dorsal margin; chromatophores one or more, plate like. Following species were collected which may be distinguished as follows:

1. Cells less than 36 µm long 2
   Cells more than 36 µm long 3
2. Cells up to 13 µm broad ..... *C. ventricosa* (10)
   Cells less than 13 µm broad 4
3. Cells up to 11 µm broad 5
   Cells more than 11 µm broad 6
4. Cells up to 20 µm long ..... *C. austriaca* (2)
   Cells more than 20 µm long ..... *C. gracilis* (5)
5. Valve boat shaped ..... *C. helvetica* (6)
   Valve semielliptic ..... *C. affinis* (1)
6. Cells up to 85 µm long ..... *C. tumida* (9)
   Cells less than 85 µm long 7
7. Cells up to 40 µm long ..... *C. naviculiformis* (7)
   Cells more than 40 µm long 8
8. Valve boat shaped ..... *C. cymbiformis* (3)
   Valve otherwise 9
9. Raphae straight ..... *C. ehrenbergii* (4)
   Raphae arcuate ..... *C. stuxbergii* (8)

1. *C. affinis* Kützing 1844: 80
(Fig. 1)

References: Østrup, 1908: 266; Starmach, 1964: 448; Nizamuddin, 1984: 44; Masud-ul-Hasan & Zeb-un-Nisa, 1986: 244; Masud-ul-Hasan & Yunus, 1989: 122.
General characters: Valve broadly semielliptic, dorsal side strongly convex; ends obtuse or subrostrate; raphe slightly arcuate, eccentric; axial area narrow. Cell length 34-37 µm and breadth 10.0-10.8 µm; chromatophores one to several, plate like.
Locality: Azad Kashmir: Chenari (28-4-2003).
Geographical distribution: Afghanistan, Libya, Poland, Faeröes (Denmark).
Remarks: The specimens were collected from a stagnant pool from Chenari (Azad Kashmir) during summer. Reproduction was not observed and the material was obtained in vegetative form only.



Figs. 1-10. Species of *Cymbella* from Pakistan: 1. *C. affinis,* 2. *C. austriaca,* 3. *C. cymbiformis,* 4. *C. ehrenbergii,* 5. *C. gracilis,* 6. *C. helvetica,* 7. *C. naviculiformis,* 8. *C. stuxbergii,* 9. *C. tumida,* 10. *C. ventricosa.*

2. *C. austriaca* Grunow 1876
(Fig. 2)

References: Østrup, 1908**:** 265; Starmach, 1964: 439.
General characters: Valve 17-20 µm in length and 4.2-5.8 µm in breadth, chromatophore one, plate like.
Locality: Kasur District: Village Kamal Chishti (22-12-2004).
Geographical distribution: Europe: Kunduz, Maimana River, west side of Heart Pass, Poland, Faeröes (Denmark)
Remarks: The material was obtained from the village Kamal Chishti of Kasur District during winter. The specimens were collected in vegetative form and reproduction was not observed.

3. *C. cymbiformis* C. A. Agardh 1830: 10
(Fig. 3)

References: Østrup, 1908: 266; Salim & Khan, 1960: 49; Starmach, 1964: 448; Nizamuddin, 1984: 44; Jahangir *et al.,* 2000: 1967.
General characters: Valve boat shaped, with dorsal side convex and ventral gibbous centrally; ends obtuse; raphe arcuate; axial area narrow; slightly dilated in the centre, isolated; punctum indistinctly present; striae radiate, punctate or lineate; length cell 63-65 µm and breadth 14-16 µm; striae 8-9 within 10 µm; chromatophores plate like.
Localities: Lahore District: Badshahi Masjid, Jallow More (24-4-2003); Sialkot District: Head Marala (28-4-2003).
Geographical distribution: Pakistan: Khewra, Peshawar; Libya, Poland, Faeröes (Denmark).
Remarks: The specimens were collected from fountain of Badshahi Mosque of Lahore and from stagnant water channel at Head Marala of Sialkot District during summer. Reproduction was not observed and the material was obtained in vegetative form only.

4. *C. ehrenbergii* Kützing
(Fig. 4)

Reference: Starmach, 1964: 440.
General characters: Valve elliptic, lanceolate; ends produced, obtuse; striae radiate, coarsely puncatate; raphe straight, slightly eccentric; axial area distinct, widened in the middle; cell length 68-69 µm and breadth 22-24 µm; chromatophores plate like.
Locality: Lahore District: between Mureedke and Narang Mundi (19-9-2003).
Geographical distribution: Poland.
Remarks: The material was obtained from paddy fields between Mureedke and Narang Mundi during autumn. The specimens were collected in vegetative form and reproduction could not be observed in them.

5. *C. gracilis* (Rabenhorst) Cleve
(Fig.5)

References: Starmach, 1964: 445; Jahangir *et al.,* 2000: 1967.
General characters: Valve 33-36 µm in length and 9-12 µm in breadth; chromatophores plate like.

Locality: Kasur District: Pandoki Village (24-12-2004).
Geographical distribution: Afghanistan: Nuristan Eschtaway, Kabul Swamp; Poland
Remarks: The specimens were collected from road-side puddles between Kasur and the village Pandoki during winter. Reproduction was not observed. The material was obtained in the vegetative form only.

6. *C. helvetica* Kützing
(Fig. 6)

References: Østrup, 1908**:** 266; Starmach, 1964: 452; Jahangir *et al.,* 2000: 1967.
General characters: Valve boat shaped, dorsal side arcuate, ventral side gently swollen at the centre; raphe almost straight; axial area very narrow with straight terminal fissures; isolated puncta below the central nodule; striae radiate fine; cell length 42.0 µm and width 10.5 µm; chromatophores plate like.
Localities: Lahore District: Hadiara, Baowala Village (01-08-2004) and Mahmood-Booti (2-8-2004).
Geographical distribution: Poland, Faeröes (Denmark).
Remarks: The material was obtained from Baowalla Village (Hadiara) and from a pond at Mahmood-Booti during late summer. The specimens were collected in vegetative form and reproduction was not observed.

7. *C. naviculiformis (*Auerswald) Cleve 1894
(Fig. 7)

References: Østrup, 1908**:** 265; Salim & Khan, 1960: 48; Starmach 1964: 441; Nizamuddin, 1984: 45.
General characters: Valves 39-40µm in length and 10-13 µm in width; chromatophores; plate like.
Locality: Kasur District; Al-Feroz Town (9-12-2004).
Geographical distribution: Pakistan: Peshawar; Afghanistan: Nuristan, Pushuki, Kabul River, Maimana; Asia Minor, Libya, Europe: Poland, Faeröes (Denmark).
Remarks: The specimens were collected from a stagnant water pond at Al-Feroz Town during winter. Reproduction could not be observed and the material was obtained in vegetative form only.

8. *C. stuxbergii* Cleve 1880
(Fig. 8)

Reference: Masud-ul-Hasan & Zeb-un-Nisa, 1986: 244.
General characters: Valve broadly semielliptic, dorsal side convex; ends obtuse and prolonged; raphe arcuate; cell length 52-62 µm and width 19-21 µm; striae 8-10 within 10 µm.
Locality: Azad Kashmir: Chenari (28-4-2003).
Geographical distribution: Afghanistan, Europe.
Remarks: The material was obtained from stagnant pools at Chenari (Azad Kashmir) during summer. The specimens were collected in the vegetative form and reproduction was not observed.

9. *C. tumida* (Brébisson) van Heurck 1880 (Fig. 9)

References: Salim & Khan, 1960: 89; Starmach, 1964: 453; Jahangir *et al.,* 2000: 1967; Leghari *et al.,* 2003: 711, 2004: 13.
General characters: Valve cymbiform with gibbous ventral margin and abruptly rostrate ends; median line arcuate; axial area narrow; central area large orbicular; below the central nodule is a punctum; striae punctate; cell length 85 µm; chromatophores plate like.
Locality: Lahore District: Shalimar Garden (7-3-2004).
Geographical distribution: U. S. A., Poland, Pakistan: Peshawar.
Remarks: The specimens were collected from fountain of Shalimar Garden at Lahore during early summer. Reproduction was not observed. The material was obtained in vegetative form only.

10. *C. ventricosa* C. A. Agardh 1830 (Fig. 10)

References: Østrup, 1908**:** 265; Salim & Khan, 1960: 50; Starmach, 1964: 444; Jahangir *et al.,* 2000: 1967, 2001: 637; Leghari *et al.,* 2002: 130, 2004: 13.
General characters: Valve lunate, with dorsal side convex and ventral slightly gibbous in the middle, ends obtuse; striae punctate, radiate; raphe straight; axial area indistinct, narrow; cell length 30-35 µm and width 11-13 µm; striae 10-12 within 10 µm; chromatophores plate like.
Localities: Azad Kashmir: Neelum Valley (28-4-2004), Kasur District: Al-Feroz Town (9-12-2004).
Geographical distribution: Pakistan: Peshawar; Afghanistan: Nuristan, Pushuki, Kabul River, Maimana; Poland, Faeröes (Denmark).
Remarks: The material was obtained from Neelum Valley during summer and Al-Feroz Town during winter. The specimens were collected in vegetative form and reproduction was not observed in them. Slight differences in size were observed in the two collected specimens.

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(Received for publication 2 January 2006)