

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

**SYED TARIQ-ALI¹, A. ZARINA¹, MASUD-UL-HASAN²
AND MUSTAFA SHAMEEL³**

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)

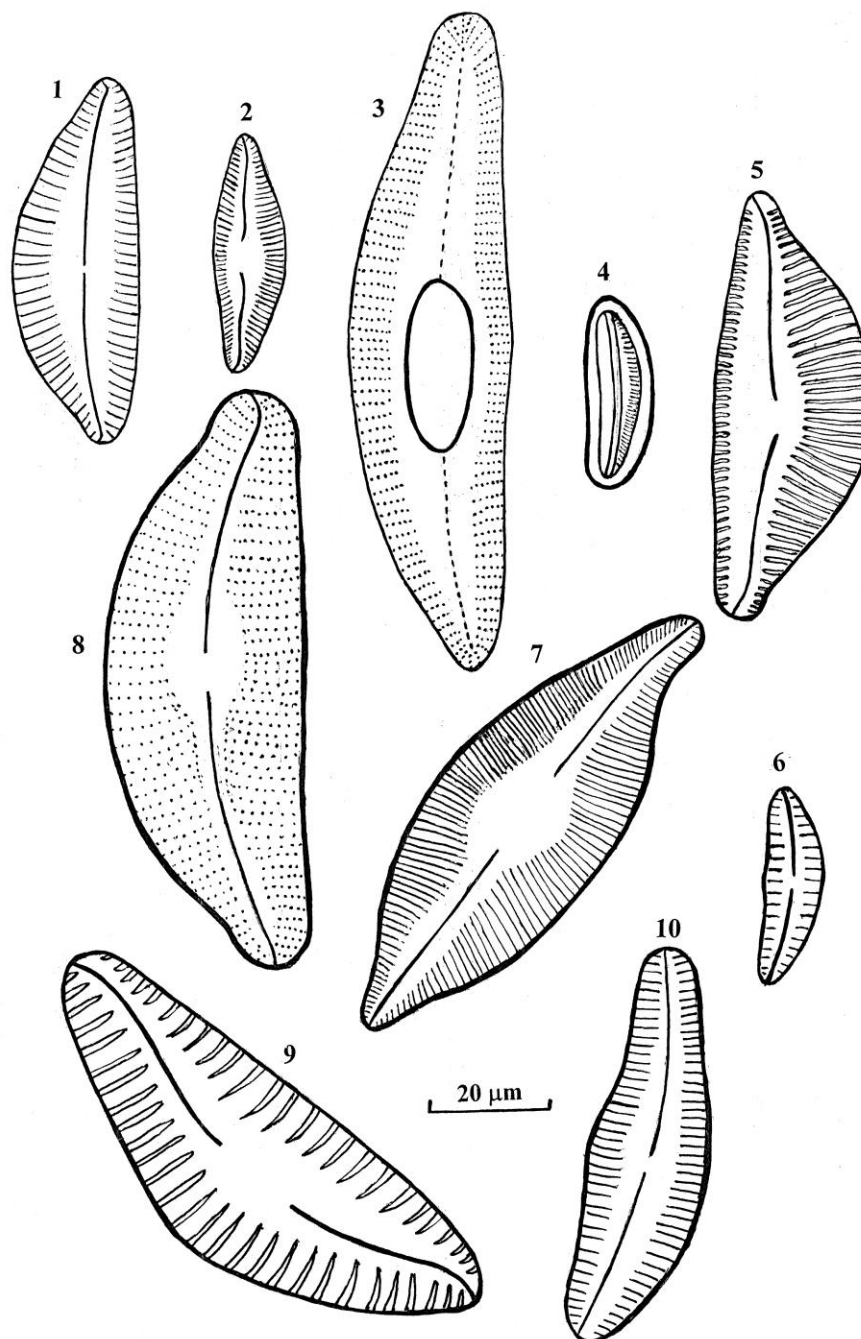
References: Østrup, 1908: 266; Starmach, 1964: 448; Nizamuddin, 1984: 44; Masud-ul-Hasan & Zeb-un-Nisa, 1986: 244; Masud-ul-Hasan & Yunus, 1989: 122.

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, Faerøes (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, Faerøes (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 punctate; 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.

References

- Abdul-Majeed, M. 1935. Freshwater algae of the Punjab. I. Bacillariophyta (Diatomeae). Punj. Univ. Publ., Lahore, 45 pp.
- Carter, N. 1926. Freshwater algae from India. *Rec. Bot. Surv. Ind.*, 9: 263-302.
- Jahangir, T.M., M.Y. Khuhawar, S.M. Leghari, W.A. Balouch, A.A. Leghari and A. Leghari. 2000. Some studies on water quality and biological life at Kinjhar and Haleji Lakes of district Thatta, Sindh, Pakistan. *Pak. J. Biol. Sci.*, 3: 1965-1972.
- Jahangir, T.M., M.Y. Khuhawar, S.M. Leghari and A. Leghari. 2001. Physico-chemical and biological study of Mangho Pir eutermal springs Karachi, Sindh, Pakistan. *Online J. Biol. Sci.*, 1: 636-639.
- Leghari, M.K., M.Y. Leghari, M. Shah and S.N. Arbani. 2003. Ecological study of algal flora of Wah Garden, district Attock, Pakistan. *Pak. J. Bot.*, 35: 705-716.
- Leghari, M.K., M.Y. Leghari, M. Shah and S.N. Arbani. 2004. Water chemistry and its relation with algae of Rawal Dam, Islamabad and Wah Garden, district Attock. *Sindh Univ. Res. J. (Sci. Ser.)*, 36: 29-48.

- Leghari, S.M., T.M. Jahangir, M.Y. Khuhawar and A. Leghari. 2001. Physico-chemical and biological study of Dhabeji springs, Malir, Karachi, Sindh, Pakistan. *Online J. Biol. Sci.*, 1: 623-627.
- Leghari, S.M., T.M. Jahangir, M.Y. Khuhawar and A. Leghari. 2002. Study on the natural springs at Clifton, Karachi, Sindh, Pakistan. *Proc. Pak. Cong. Zool.*, 22: 125-131.
- Leghari, S. M., T. M. Jahangir, M. Y. Khuhawar and A. Leghari. 2004. Some studies on Nang spring and torrents of Khar Centre, Khirthar National Park, Gudap area, Malir, Karachi, Sindh, Pakistan. *Sindh Univ. Res. J. (Sci. Ser.)*, 36: 25-30.
- Leghari, S. M., M. Y. Khuhawar, T. M. Jahangir and A. Abdullah. 2005a. Limnological study of natural springs at Gharo Creek, district Thatta, Sindh, Pakistan. *Int. J. Phycol. Phycochem.*, 1: 37-42.
- Leghari, S. M., M. Y. Khuhawar, T. M. Jahangir and A. Abdullah. 2005b. Limnological study of Pir Bukhari (Karsaz) and Manghopir warm springs, Karachi, Sindh, Pakistan. *Int. J. Phycol. Phycochem.*, 1: 151-158.
- Masud-ul-Hasan and I. Batool. 1987. A taxonomic study of some freshwater algae from Attock and Sargodha districts. *Biologia*, 33: 345-366.
- Masud-ul-Hasan and A. Yunus. 1989. An addition to the algal flora of Lahore. *Biologia*, 35: 99-131.
- Masud-ul-Hasan and Zeb-un-Nisa. 1986. Taxonomic studies of some freshwater algae from Azad Jammu and Kashmir. *Biologia*, 32: 229-256.
- Nizamuddin, M. 1984. *Diatoms of Libya*. Dept. of Botany, Univ. of Al-Fateh, Tripoli, 144 pp.
- Østrup, E. 1908. Freshwater diatoms. In: *Botany of the Faeröes Based Upon Danish Investigations*. (Ed.): E. Warming. Gyldendalske Boghandel, Nordisk Forlag, Copenhagen, p. 260-290.
- Salim, K. M. 1954. Some plankton diatoms from the Karachi coast. *Pak. J. Soc.*, 6.
- Salim, K. M. 1963. A systematic account of some marine diatoms from the Karachi coast. *Pesh. Univ. J.*, 8: 19-52.
- Salim, K. M. and M. M. Iqbal. 1964. Distribution of diatoms in the intertidal zone, rocky ledge of Manora. *Pak. J. Soc.*, 16.
- Salim, K. M. and M. H. Khan. 1960. *The Diatomales: The Freshwater Diatoms of Peshawar Valley*. Dept. of Botany, Peshawar Univ., Peshawar, 66 pp. + 11 pls.
- Saifullah, S. M. and M. Moazzam. 1988. Species composition and seasonal occurrence of centric diatoms in a polluted marine environment. *Pak. J. Bot.*, 10: 53-64.
- Shameel, M. 2001. An approach to the classification of algae in the new millennium. *Pak. J. Mar. Biol.*, 7: 233-250.
- Starmach, K. 1964. *Flora Słodkowodna Polski. 6. Chrysophyta II. Bacillariophyceae - Okrzemki*. Państwowe Wydawnictwo Naukowe, 610 pp.
- Tariq-Ali, S., Masud-ul-Hasan and M. Shameel. 2005. Taxonomic study of the genus *Phacus* (Euglenophyta) from Lahore and Sialkot districts of Pakistan. *Int. J. Phycol. Phycochem.*, 1: 173-176.
- West, G. S. and W. West. 1902. A contribution to the freshwater algae of Ceylon. *Trans. Linn. Soc. Bot.*, ser. 2, 6: 123-215.

(Received for publication 2 January 2006)