



Freshwater Ascomycetes Fungi from Tapi District (Gujarat, India)

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ABSTRACT

taxa are being recorded for the first time from Gujarat state. The data provides information on the range of distribution of these fungi in India. Descriptions and illustrations are provided.

KEYWORDS : Ascomycetes, *Savoryella*, submerged wood, *Zopfiella*

INTRODUCTION

Freshwater Ascomycetes are defined as Ascomycetes fungi which have been recorded in freshwater habitats and which complete part or the whole of their life cycle within freshwater habitats (Shearer, 1993). Lignicolous freshwater Ascomycetes inhabit submerged woody material in lentic and lotic habitats (Wong et al., 1998; Luo et al., 2004) playing an important role in recycling organic matter in the aquatic ecosystem. Shearer (1993) listed 288 species of freshwater Ascomycetes. Freshwater Ascomycetes comprise a diverse taxonomic assemblage of about 595 species (Raja and Shearer, 2011). Shearer et al. (2009) considered freshwater Ascomycetes as only those species that occur on submerged substrates and Ascomycetes on aerial parts of aquatic plants are considered terrestrial.

Previous work on these fungi from India were made by Manoharachary and Ramarao (1972), Manoharachary (1972), Udaiyan (1989), Udaiyan and Hosogaudar (1991), Udaiyan & Manian (1991a, b), Udaiyan et al. (1993), Agarwal et al. (1991), Ramesh (2002), Ramesh and Vijaykumar (2000, 2004, 2005), Borse and Pawara (2007), Sridhar et al. (2010, 2011), Sudheep and Sridhar (2011) Patil and Borse (2011, 2012a, b), Patil (2012), and Upadhyaya et al. (2012).

Details on five species of *Savoryella* and two species of *Zopfiella* previously unreported from Gujarat state (India) are described and illustrated here.

MATERIALS AND METHODS

Samples of submerged woody debris supporting freshwater Ascomycetous fungi were collected randomly during 2011-13 from different lentic and lotic habitats from Tapi district (Gujarat). The samples were placed in plastic bags and sealed well in order to avoid moisture loss. On returning to the laboratory, samples with debris and fouling organisms were washed thoroughly with running tap water. Surface fouling organisms were scrapped off, following rinsing in tap water. The fresh samples were examined using a stereomicroscope for fungal growth. After initial observations, samples were incubated in plastic boxes and kept moist by spraying with distilled water and periodically examined for the presence of fungal growth. Permanent voucher slides of fungi were prepared according to the method 'double cover glass' provided by Volkmann-Kohlmeyer and Kohlmeyer (1996). Identifications of isolated fungal species were confirmed with the help of Jones and Eaton (1969), Jones and Hyde (1992), Hyde (1993, 1994), Ho et al. (1997) and Chang et al. (1998) Reports of fungi studied were confirmed with the help of Bilgrami et al. (1991), Sarbhoj et al. (1996) and Jamaluddin et al. (2004).

TAXONOMIC ACCOUNT

Genus: *Savoryella* E.B.G. Jones & Eaton

Trans. Br. Mycol. Soc., **52**: 162 (1969).

The genus *Savoryella* was established by Jones and Eaton (1969) with *S. lignicola* as the type species. Species of the genus are character-

ized by having, *Ascomata*: solitary to gregarious, immersed, partly immersed to superficial, ostiolate, periphysate, papillate, membranous and brown, *Peridium* of *textura angularis* when viewed from the surface and in section composed of several layers of angular cells. *Paraphyses*: presents in young ascomata, wide and septate. *Asci*: 2 to 8-spored, cylindrical to clavate, short pedunculate, unitunicate, persistent, with a non-amyloid apical thickening containing a pore. *Ascospores*: ellipsoidal, 3-septate, central cells brown, end cells hyaline, with or without polar appendages.

Savoryella aquatica K.D. Hyde (Plate -1, Fig-1 to Fig-3)

Aust. Syst. Bot., **6**: 162 (1993).

Ascomata: 200-250 µm long, 90-125 µm diam., immersed, semi-immersed or superficial, coriaceous, pyriform, brown or black, ostiolate, papillate, periphysate, solitary or gregarious. *Necks*: short, up to 60 µm diam., hyaline, bending up towards the light. *Peridium*: thin, of *textura angularis* in surface view and brown. *Paraphyses*: few, with round cells. *Asci*: 110-130 x 28-35 µm, 8-spored, clavate, thin-walled, with a short peduncle, apically thickened with a ring and pore/plug, mature successively. *Ascospores*: 30-35 x 14-17 µm, ellipsoidal, biserial, hyaline to olive-green when immature, central cells dark brown when mature, end cells hyaline, constricted weakly at the septa, central septa appearing as a band and highly guttulate.

Habitat: On submerged wood, Tapi River, 28 January 13; Leg., V.S. Patil

Distribution in India:- Maharashtra (Borse and Pawara, 2007);

Savoryella fusiformis W.H. Ho, K.D. (Plate -1, Fig-4 to Fig-6)

Hyde & Hodgkiss

Mycol. Res., **101**: 804 (1997).

Ascomata: 140-180 µm long, 75-90 µm diam., immersed or superficial, coriaceous, pyriform, dark-brown, ostiolate, papillate, axis horizontal to the host surface, solitary or gregarious. *Necks*: 75-110 µm long, 35-45 µm diam., cylindrical, slightly tapers towards the apex, brown, periphysate, mostly pointing upwards with a hyaline apex. *Peridium*: thin, brown, of *textura epidermoidea* when viewed from the surface. *Paraphyses*: septate. *Asci*: 85-115 x 10-15 µm, 8-spored, cylindrical or clavate, unitunicate, thin-walled, short pedicellate, persistent, with non-amyloid apical ring. *Ascospores*: 25-35 x 6-10 µm, fusiform, biserial, 3-septate, slightly constricted at the septa, smooth, thin-walled; central cells brown, apical cells hyaline.

Habitat: On submerged wood, , Ukai Dam, 27 January 13 ; Leg., V.S. Patil

Distribution:- Maharashtra (Patil and Borse, 2011);

Savoryella grandispora K.D. Hyde (Plate -1, Fig-7 to Fig-9)

Mycoscience, **35**: 59-61 (1994).

Ascomata: 200-250 µm long, 95-125 µm diam., immersed, semi-immersed or superficial, coriaceous, pyriform, brown or black, ostiolate, papillate, periphysate, solitary or gregarious. **Necks**: short, up to 60 µm diam., hyaline, bending up towards the light. **Peridium**: thin, of *textura angularis* in surface view and brown. **Paraphyses**: few, with round cells. **Asci**: 110-135 x 28-35 µm, 8-spored, clavate, thin-walled, with a short peduncle, apically thickened with a ring and pore/plug, mature successively. **Ascospores**: 50-58 x 14-16 µm, ellipsoidal, biseri-ate, light brown, central cells dark brown when mature, end cells hyaline, constricted weakly at the septa.

Habitat: On submerged wood, Ukai Dam, 27 January 13; Leg., V.S. Patil

Distribution:- Maharashtra (Patil and Borse, 2011);

Savoryella lignicola E.B.G. Jones & R.A. Eaton (Plate -2, Fig-10 to Fig-12)

Trans. Br. Mycol. Soc., **52**: 162 (1969).

Ascomata: 210-340 µm high, 125-170 µm in diam., globose, subglobose or ellipsoidal, immersed, partly immersed or superficial, ostio- late, papillate, membranous and pale to dark brown. **Necks**: 85-160 µm long and up to 70 µm in diam., brown with periphyses. **Peridium**: brown, a *textura angularis* when viewed from the surface, while in section composed of several layers of thick-walled angular cells. **Paraphyses**: present but sparse. **Asci**: 130-170 x 17-22 µm, 8-spored, cylindrical or clavate, short- stalked, unitunicate, persistent, with an apical truncate non-amyloid apical thickening containing a pore. **Ascospores**: 25-35 x 9-13 µm, uni or biseri-ate, ellipsoidal, 3-septate, not markedly constricted at the septa; central cells brown, apical cells smaller and hyaline.

Habitat: On submerged wood, Ukai Dam, 27 January 13 ; Leg., V.S. Patil

Distribution:- Tamil Nadu: (Udaiyan, 1989); Karnataka: (Ramesh and Vijaykumar, 2000); Maharashtra: (Borse and Pawara, 2007);

Savoryella limnetica H.S. Chang & S.Y. Hsieh (Plate-2, Fig-13 to Fig-15)

Mycol. Res., **102**: 715 (1998).

Ascomata: 260-290 x 165-190 µm, partly to fully immersed in wood, oblique to horizontal, dark brown to black, globose to subglobose, ostiolate, periphysate. solitary or gregarious. **Necks**: 190-320 µm long, 60-80 µm diam., lateral and periphysate. **Peridium**: *textura angularis*, with brown, septate, unbranched hyphae on the surface and neck. **Paraphyses**: broad up to 8 µm, deliquescing early, hyaline, rarely branched. **Asci**: 145-150 x 10-12 µm, unitunicate, long-cylindrical with a short foot, apices truncate, with a non-amyloid apical thickening containing a pore, 8-spored, pedicellate with an annulus. **Ascospores**: 20-26 x 7-9 µm, ellipsoidal, 3-septate, not constricted, smooth, thin-walled, central cells brown, end cells smaller and hyaline to sub-hyaline.

Habitat: On submerged wood, Ambica River, 29 January 13 ; Leg., V.S. Patil

Distribution:- Maharashtra: (Patil and Borse, 2011);

Genus: *Zopfiella* Winter

Kryptogamenflora, **1**: 56 (1884).

The genus *Zopfiella* was erected by Winter in 1884 with *Zopfiella tabulata* Winter as the type species. Species of the genus are characterized by having, **Ascomata**: solitary or gregarious, globose to subglobose, superficial or rarely immersed, nonostiolate, thin-walled, irregularly dehiscing, and covered with hairs. **Peridium**: pseudoparen-

chymatous, membranaceous, cephalothecoid in some species, cells forming a *textura angularis*. **Paraphyses**: early deliquescing, indistinct or absent. **Asci**: 4 to 8-spored, clavate to cylindrical or rarely subglobose, pedunculate, unitunicate, deliquescing, in some species with an apical ring, fasciculate or irregularly arranged. **Ascospores**: uni-, bi-, or triseriate, at first 1-celled, hyaline, becoming 1-septate, hyaline in the lower third, forming a large ellipsoidal, dark upper cell and a small, mostly cylindrical, hyaline, often collapsing basal cell; the upper cell may become divided by a horizontal septum in some species; with an apical or subapical germ pore.

Zopfiella karachiensis (S.L. Ahmed & Asad) Guarro (Plate-2, Fig-16 to Fig-18)

Trans. Br. Mycol. Soc., **91**: 589 (1988).

≡ *Strattonia karachiensis* Ahmed & Asad, *Sydowia*, **21**: 282 (1968).

≡ *Podospora faurelii* Mouchacca, *Rev. Mycol.*, **38**: 109 (1973).

≡ *Triangularia karachiensis* (Ahmed & Asad) Udagawa, *Trans. Mycol. Soc. Japan*, **20**: 362-365 (1979).

Ascomata: 300-365 x 240-275 µm., clothed densely with hyphal-like hairs, globose to subglobose, superficial, ostiolate, coriaceous, dark brown. **Necks**: 80-140 µm long, conical. **Peridium**: thin, membranaceous, outer layer composed of brown angular cells. **Asci**: clavate, with a short stipe, 8-spored, 110-130 x 18-24 µm. **Ascospores**: biseri-ate, ellipsoidal, at first 1-celled, latter becoming 2-celled, 35-40 x 12-20 µm; upper cell dark olivaceous brown to dark brown, ellipsoid, inequilateral, smooth, with a single germ pore at the apex, 24-29 x 12-20 µm; lower cell conical, hyaline often collapsed at maturity, 7-10 x 7-9 µm.

Habitat: On submerged wood, Ambica River, 29 January 13 ; Leg., V.S. Patil

Distribution:- Tamil Nadu: (as *Triangularia karachiensis*, Udaiyan 1989);

Zopfiella latipes (N. Lundquist) Malloch & Cain (Plate-2, Fig-19 to Fig-21)

Can. J. Bot., **49**: 876 (1971).

Ascomata: 120-700 µm in diam., globose to subglobose, superficial or immersed, nonostiolate, coriaceous, irregularly dehiscing, dark brown, covered with hyaline to grayish- or yellowish-brown, septate, branched hairs, 2-4 µm in diam.; solitary. **Peridium**: 40-50 µm thick, semitransparent, composed of 3 or 4 layers of irregular or angular, thin-walled cells of 5-12 µm in diam., forming a *textura angularis*. **Paraphyses**: up to 12 µm in diam., composed of vesicular cells, early deliquescing. **Asci**: 85-120 x 12-18 µm, 8-spored, clavate, broadest in the middle, short pedunculate, apically truncate, unitunicate, deliquescing, with a simple apical ring, 2.1 µm wide; fasciculate. **Ascospores**: biseri-ate, ellipsoidal, becoming 1-septate in the lower third; slightly constricted at the septum; larger upper cell 16-24 x 10-14 µm, ellipsoidal, apex conical or abonate, base truncate, olivaceous to brown, thin-walled, smooth, with a apical germ pore, 1 µm in diam.; smaller lower cell 4-8 µm long, 4-7 µm in diam., broadly cylindrical, apex truncate, base broadly rounded, hyaline, at maturity without cytoplasm; the base and one side of the lower cell thin-walled, collapsing, and giving it a cuplike shape; collapsed lower cell appearing triangular in lateral view.

Habitat: On submerged wood, Ambica River, 29 January 13; Leg., V.S. Patil

Distribution:- Tamil Nadu: (Udaiyan, 1989); Karnataka: (Ramesh and Vijaykumar, 2000); Maharashtra: (Patil, 2012); Gujarat: (Present studies).

Photoplate-1



Fig.1

Fig.2



Fig.3



Fig.4



Fig.5



Fig.6



Fig.7



Fig.8



Fig.9

cus,

Fig.3 *Savoryella aquatica*- Ascospore, Fig.4 *Savoryella fusiformis* - Ascomata,

Fig.5 *Savoryella fusiformis* -Ascus, Fig.6 *Savoryella fusiformis* - Ascospore,

Fig.7 *Savoryella grandispora* - Ascomata, Fig.8 *Savoryella grandispora* - Ascus,

Fig.9 *Savoryella grandispora* - Ascospore,

Photoplate-2



Fig.10



Fig.11



Fig.12



Fig.13



Fig.14



Fig.15



Fig.16



Fig.17



Fig.18



Fig.19

Fig.1 *Savoryella aquatica*- Ascomata, Fig.2 *Savoryella aquatica*- As-

Fig.10 *Savoryella lignicola* - Ascomata,

Fig.11 *Savoryella lignicola* - Ascus, Fig.12 *Savoryella lignicola* - Ascospore

Fig.13 *Savoryella limnetica* - Ascomata, Fig.14 *Savoryella limnetica* - Ascus,

Fig.15 *Savoryella limnetica* - Ascospore, Fig.16 *Zopfiella karachiensis* - Ascomata,

Fig.17 *Zopfiella karachiensis* -Ascus, Fig.18 *Zopfiella karachiensis* - Ascospore,

Fig.19 *Zopfiella latipes* - Ascomata, Fig.20 *Zopfiella latipes* - Ascus,

Fig.21 *Zopfiella latipes* – Ascospore

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