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New records of resupinate, non-poroid agaricomycetous fungi from India

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Nine species of corticioid fungi are newly reported from India. *Amethicium luteoincrustatum*, *Athelidium aurantiacum*, *Dendrothele commixta*, *Erythricium hypnophilum*, *Gloeodontia columbiensis*, *Peniophorella incrustatissima*, *Scytinostroma ahmadii*, *S. corneri* and *Tretomyces lutescens* are described and illustrated, based on collections made from different localities of Punjab and the adjoining area of Chandigarh.

Key words: Basidiomycota, Agaricomycetes, corticioid fungi, wood-rotting fungi, Punjab.

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Na základě sběrů z Paňdžábu a přilehlého území Čandígarh je devět druhů kornatcotvarých hub uvedeno jako nové pro Indii. V práci jsou popsány a ilustrovány *Amethicium luteoincrustatum*, *Athelidium aurantiacum*, *Dendrothele commixta*, *Erythricium hypnophilum*, *Gloeodontia columbiensis*, *Peniophorella incrustatissima*, *Scytinostroma ahmadii*, *S. corneri* a *Tretomyces lutescens*.

INTRODUCTION

The resupinate non-poroid agaricomycetous fungi (commonly called "corticioid fungi" regardless their taxonomic position) are characteristic in having hymenomycetous sporocarps, unilateral, gymnocarpic hymenium, perforate to imperforate parenthesomes and two- to eight-spored basidia. Earlier reports, namely Rattan (1977), Dulat (1992), Dargan & Dulat (1998), Dargan et al. (1999, 2002, 2006), Lalji (2003), Singh (2007), Kaur (2012) and Kaur et al. (2014a, 2014b, 2015a, 2015b, 2016, 2017a, 2017b), described 80 taxa of these fungi from Punjab and the Union Territory of Chandigarh, which is also the capital of the state of Punjab. The vegetation of this area can broadly be categorised into northern dry mixed

deciduous forests, dry deciduous scrub forests, dry bamboo brake forests, khair-sissoo forests and Shiwalik chir pine forests (Champion & Seth 1968).

During fungal forays conducted in the monsoon months of the years 2012–2015 at different localities of the districts Roopnagar and Patiala in the state of Punjab and Union Territory of Chandigarh, nine specimens of corticioid fungi were identified as new species to India based on macroscopic and microscopic characters and verified with literature: *Amethicium luteoincrustatum* Hjortstam & Ryvarden, *Athelidium aurantiacum* (M.P. Christ.) Oberw., Kotir. & Saaren., *Dendrothele commixta* (Höhn. & Litsch.) J. Erikss. & Ryvarden, *Erythricium hypnophilum* (P. Karst.) J. Erikss. & Hjortstam, *Gloeodontia columbiensis* Burt ex Burds. & Lombard, *Peniophorella incrustatissima* (Boidin & Gilles) K.H. Larss., *Scytinostroma ahmadii* Boidin & Lanq., *S. corneri* Boidin & Lanq. and *Tretomyces lutescens* (J. Erikss. & Ryvarden) K.H. Larss., Kotir. & Saaren. The aim of this study is to describe these interesting species with brief remarks on their distinguishing characters and worldwide distribution.

MATERIAL AND METHODS

Collected specimens were spread on blotting paper sheets and dried either in the sun or by using an electric drier. The dried specimens were packed in Zip lock pouches, which were placed into bond paper envelopes together with a herbarium label including essential details. For the preservation of dried specimens, 1,4-dichlorobenzene crystals were put into each packet. Photographs depicting details of the hymenial surface were taken using a Nikon or Canon DSLR camera.

Micromorphological studies were performed by making crush mounts and transverse sections from the basidiocarps in 3%, 5% or 10% potassium hydroxide, 1% phloxine in water, 1% Congo red in water, sulphovanillin (0.5 g vanillin + 4 ml conc. sulphuric acid + 2 ml distilled water), Melzer's reagent (0.5 g iodine + 1.5 g potassium iodide + 20 g chloral hydrate + 20 ml distilled water) and 1% cotton blue in lactophenol. The microscopic attributes pertaining to hyphae, cystidia, basidia and basidiospores were observed under an Olympus compound microscope at magnifications of 100×, 400× and 1000×. The outlines of all the microscopic structures were drawn using a camera lucida at the same magnifications. Photomicrographs of certain structures were also taken with the help of an Olympus CX microscope.

The macro- and micromorphological details were compiled in the form of a description which was compared with the published literature (Eriksson & Ryvarden 1973, 1975, Burdsall & Lombard 1976, Rattan 1974, 1977, Boidin & Lanquetin 1987, Nakasone 2009, Bernicchia & Gorjón 2010, Nakasone & Burdsall 2011, Dhingra 2014, Dhingra et al. 2014 and Kaur et al. 2014a, 2014b, 2016) for

identification. The material of all the species has been deposited at the Herbarium, Department of Botany, Punjabi University, Patiala (PUN).

RESULTS AND DISCUSSION

Amethicium luteoincrustatum Hjortstam & Ryvarden, Mycotaxon 25(2): 542, 1986 Fig. 1a–f

Description. Basidiocarp resupinate, adnate, effused, up to 850 µm thick in cross section, membranaceous, fairly brittle, with two or more zones above the subiculum; hymenial surface tuberculate, dotted by reddish encrusted cystidia, pale orange through greyish orange and greyish red to reddish brown when fresh, somewhat cracking, orange white through greyish orange, greyish red and brownish orange to light brown on drying; margin thinning, fimbriate, paler than the hymenial surface or indeterminate.

Hyphal system dimitic. Generative hyphae up to 3.8 µm wide, thin-walled, branched, septate, clamped; subiculum of horizontal hyphae encrusted with yellowish resinous matter, separated from the hymenium by two or more brownish sterile zones consisting of residual hyphae and cystidia; subhymenium of thin-walled vertical hyphae with or without encrustation. Microbinding hyphae up to 1.3 µm wide, thin-walled, branched, without clamps. Cystidia 36–96 × 7.5–12.5 µm, subfusiform, somewhat sinuous, thin-walled, with basal clamp, strongly encrusted with yellowish resinous matter in the basal region; immersed in the hymenium. Basidia 22–27 × 3.5–5.8 µm, clavate, somewhat sinuous, thin-walled, tetrasterigmatic, with basal clamp; sterigmata up to 3.8 µm long. Basidiospores 3.5–6.3 × 3–3.5 µm, ellipsoid to broadly ellipsoid, smooth, thin-walled, inamyloid, acyanophilous.

Remarks. This species is characteristic in having a dimitic hyphal system with microbinding hyphae, ellipsoid to broadly ellipsoid basidiospores and cystidia encrusted with yellowish resinous matter in the basal region. It has also been reported from Argentina, Columbia and Taiwan (IMA on-line).

Collection examined: India, Union Territory of Chandigarh, Sector 18–19 dividing road, on sticks of *Ficus infectoria*, 29 September 2013, Gurpreet and Dhingra 8384 (PUN).

Athelidium aurantiacum (M.P. Christ.) Oberw., Sydowia 19(1–6): 63, 1966 Fig. 1g–i

≡ *Xenasma aurantiacum* M.P. Christ., Dansk Botanisk Arkiv 19(2): 107, 1960

Description. Basidiocarp resupinate, adnate, effused, up to 220 µm thick in cross section; hymenial surface smooth (appearing tuberculate due to the pattern of the host surface), cracked, dull red through greyish red to brownish red

when fresh, not changing much on drying; margin thinning, somewhat fibrillose (under lens), paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae up to 3 µm wide, branched, simple-septate, thin-walled; basal hyphae parallel to the substrate; subhymenial hyphae vertical. Cystidia none. Basidia 18–27 × 6.2–8.1 µm, clavate, tetrasterigmatic, without basal clamp; sterigmata up to 8.3 µm long. Basidiospores 7.5–10.3 × 3.5–4.8 µm, ellipsoid to subfusiform, smooth, thin-walled, inamyloid, acyanophilous.

Remarks. Among other species in the genus, this species is peculiar in having ellipsoid to subfusiform inamyloid basidiospores. It has also been reported from Norway, Sweden, Denmark, Belgium, Germany, Poland and Turkey (Bernicchia & Gorjón 2010).

Collection examined: India, Punjab, Patiala town, Punjabi University, Gol market, on sticks of *Thevetia peruviana*, 2 October 2013, Gurpreet 8308 (PUN).

Dendrothele commixta (Höhn. & Litsch.) J. Erikss. & Ryvarden, The *Corticiaceae* of North Europe 3: 35, 1975 Fig. 2f–j

≡ *Corticium commixtum* Höhn. & Litsch., Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften Math.-naturw. Klasse Abt. I 116: 82, 1907

Description. Basidiocarp resupinate, adnate, effused, up to 190 µm thick in cross section; hymenial surface smooth, reddish white through pale red to greyish red when fresh, not changing much on drying; margin thinning, paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae up to 2 µm wide, septate, clamped, thin-walled; basal hyphae parallel to the substrate, not much branched; subhymenial hyphae vertical, branched more, with encrustation dissolving in 5% KOH solution. Dendrohyphidia usually numerous in the hymenium, strongly encrusted. Basidia 19–35 × 6–8.3 µm, generally clavate with a tapering base, somewhat sinuous, 2–4-sterigmatic; sterigmata up to 9 µm long. Basidiospores 7.5–10.8 × 3.5–5.8 µm, ellipsoid, thick-walled, smooth, with oily contents, walls sometimes cyanophilous, inamyloid.

Remarks. This species is typical in having clavate, somewhat sinuous, 2-4-sterigmatic basidia with long sterigmata and thick-walled, ellipsoid basidiospores. It has also been reported from Portugal, Spain, France, Switzerland, Belgium, United Kingdom, Norway, Sweden, Denmark, Germany, Poland, Italy, Slovenia, Croatia, Macedonia, Russia, and the Caucasus region (IMA on-line).

Collection examined: India, Union Territory of Chandigarh, Sector 1, Lake Reserve Forest, on bark of *Acacia arabica*, 15 August 2013, Gurpreet & Dhingra 8319 (PUN).

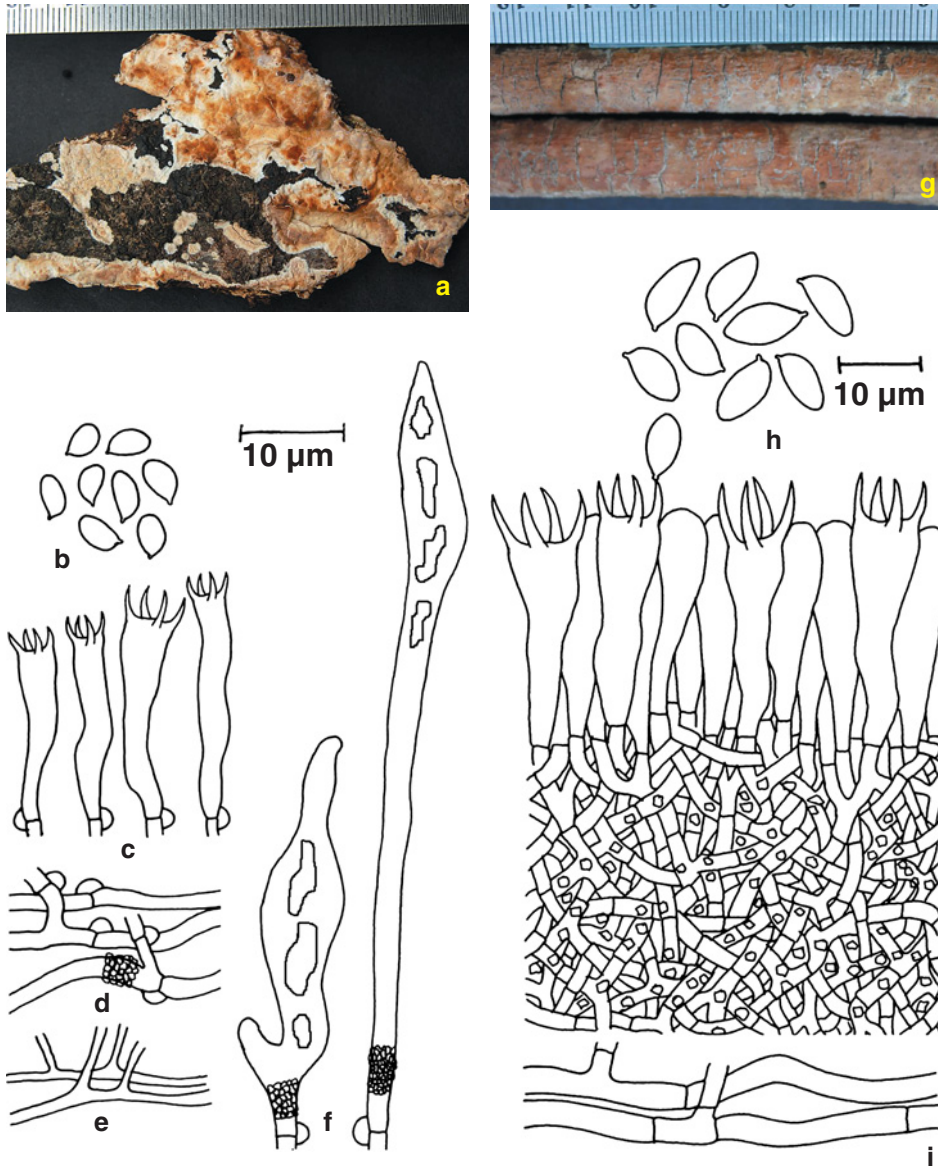


Fig. 1. *Amethicium luteoincrustatum* (8384 PUN): **a** – basidiocarp showing hymenial surface; **b** – basidiospores; **c** – basidia; **d** – generative hyphae; **e** – microbinding hyphae; **f** – cystidia. *Athelidium aurantiacum* (8308 PUN): **g** – basidiocarp showing hymenial surface; **h** – basidiospores; **i** – vertical section through basidiocarp. Scale bars = 10 µm; del. G. Kaur (b–f, h–i). Photos by G.S. Dhingra (a), A.P. Singh (g).

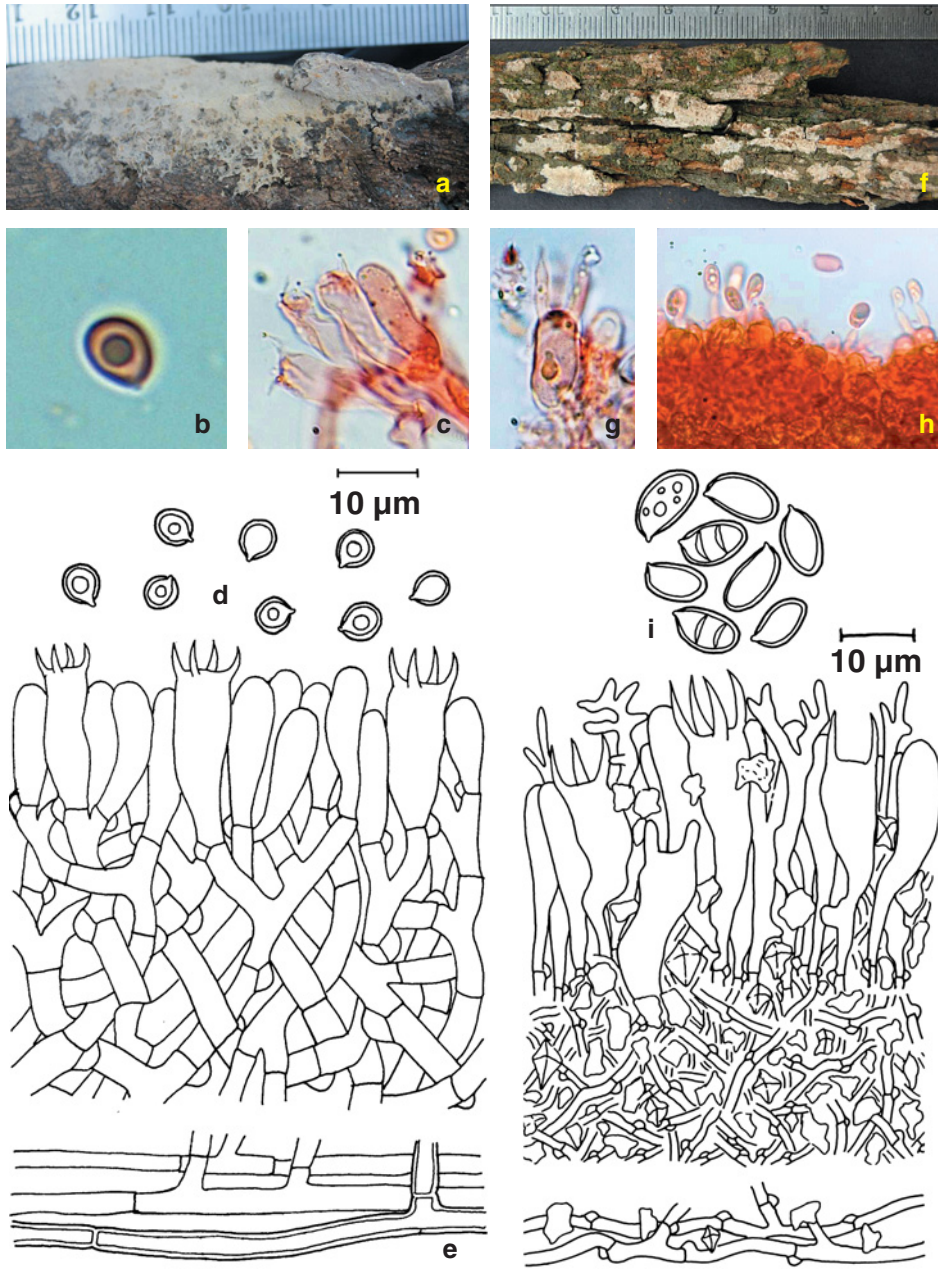


Fig. 2. *Tretomyces lutescens* (8314 PUN): **a** – basidiocarp showing hymenial surface; **b** – basidiospore; **c** – basidia; **d** – basidiospores; **e** – vertical section through basidiocarp. *Dendrothele commixta* (8319 PUN): **f** – basidiocarp showing hymenial surface; **g** – basidia; **h** – basidia and basidiospores; **i** – basidiospores; **j** – vertical section through basidiocarp. Scale bars = 10 µm; del. G. Kaur (d–e, i–j). Photos by A.P. Singh (a), G.S. Dhingra (f), P. Kaur (b–c, g–h).

Erythricium hypnophilum (P. Karst.) J. Erikss. & Hjortstam, Svensk Botanisk Tidskrift 64(2): 168, 1970 Fig. 3a–e

≡ *Corticium hypnophilum* P. Karst., Revue Mycologique Toulouse 12: 126, 1890

Description. Basidiocarp resupinate, adnate, effused, up to 110 µm thick in cross section; hymenial surface smooth (appearing uneven due to substrate), reddish white through pale red to dull red when fresh, dull red to reddish brown on drying; margin thinning, fibrillose, paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae septate, without clamps; basal hyphae up to 5.8 µm wide, parallel to the substrate, distantly septate, thick-walled, not much branched; subhymenial hyphae up to 3.5 µm wide, vertical, short-celled, thin-walled, branched more. Cystidia absent. Basidia 31–43 × 6.5–7.5 µm, narrowly clavate, sinuous, tetrasterigmatic, without basal clamp; sterigmata up to 6.5 µm long. Basidiospores 6.5–11 × 4.5–6.5 µm, ellipsoid to broadly ellipsoid, thick-walled, smooth, cyanophilous, inamyloid.

Remarks. This species is characteristic in having clavate, 4-spored basidia in combination with ellipsoid to broadly ellipsoid, thick-walled, cyanophilous basidiospores. It has been reported from coniferous forests usually in association with an underlayer of mosses, twigs or small debris in Sweden, Finland, United Kingdom, Belgium, the Netherlands, Germany, Poland and Austria (Bernicchia & Gorjón 2010, IMA on-line). This is the first report of *E. hypnophilum* in association with *Morus alba*.

Collection examined: India, Punjab, Patiala town, Punjabi University, Horticulture Dept., on bark of *Morus alba* tree, 10 September 2012, Gurpreet 8322 (PUN).

Gloeodontia columbiensis Burt ex Burds. & Lombard, Memoirs of the New York Botanical Garden 28(1): 17, 1976 Fig. 3f–j

Description. Basidiocarp resupinate, effused, loosely adnate, up to 830 µm thick in cross section (including length of aculei); hymenial surface odontioid, orange white through pale orange to greyish orange when fresh, greyish orange to brownish orange on drying; aculei dense, generally conical with blunt tips, up to 680 µm long; margins thinning, fibrillose, paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae up to 3.3 µm wide, branched, septate, clamped; basal hyphae parallel to the substrate, not much branched, thick-walled; subhymenial hyphae vertical, richly branched, thin-walled; tramal hyphae thin- to thick-walled. Cystidia of two types: (1) pseudocystidia 69–97 × 3.8–8.5 µm, subcylindrical, thick-walled, strongly encrusted, with basal clamp; (2) gloeocystidia 54–78 × 5–9.3 µm, clavate with long hyphoid base, with oily con-

tents positive to sulphovanillin. Basidia 17–40 × 3.8–4.8 µm, narrowly clavate to clavate, somewhat sinuous, tetrasterigmatic, with basal clamp; sterigmata up to 3.3 µm long. Basidiospores 3.8–5.3 × 2.5–3.8 µm, ellipsoid to broadly ellipsoid, asperulate, thick-walled, amyloid, acyanophilous.

Remarks. This species is distinguished by its odontioid hymenophore, generally conical aculei with blunt tips, monomitic hyphal system, presence of two types of cystidia and asperulate, amyloid basidiospores. The present collection differs from earlier reports in having comparatively smaller basidiospores (3.8–5.3 × 2.5–3.8 µm as compared to 5.5–6.5 × 3.5–4 µm), which can be due to its tropical habitat. According to MycoBank (IMA on-line), the species has been reported from North America and west Asian/European countries (Canada, Spain, France, Switzerland, Italy, Turkey and the Caucasus region). In addition to these, it has also been reported from Libya (Rattan & El-Buni 1981).

Collection examined: India, Punjab, Roopnagar town, Boat Club, on a branch of *Nerium oleander*, 5 September 2012, Gurpreet & Avneet 8471 (PUN).

Peniophorella incrustatissima (Boidin & Gilles) K.H. Larss., Mycological Research 111(2): 192, 2007 Fig. 4a–c

≡ *Hyphoderma incrustatissimum* Boidin & Gilles, Cryptogamie Mycologie 12 (2): 111, 1991

Description. Basidiocarp resupinate, adnate, effused, up to 325 µm thick in cross section; hymenial surface smooth to tuberculate under lens, orange white through pale orange to greyish orange when fresh, not changing much on drying; margin thinning, pruinose to somewhat fibrillose, paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae up to 4.5 µm wide, branched, septate, clamped; basal hyphae parallel to the substrate, thick-walled; subhymenial hyphae vertical, denser, thin-walled. Sterile elements of three types: (1) gloeocystidia 42–104 × 10.8–13.5 µm, subfusiform, thin-walled, with oily contents negative to sulphovanillin, with basal clamp; (2) leptocystidia 28–50 × 6–11.3 µm, subfusiform, thin-walled, encrusted in the upper half, with basal clamp; (3) stephanocystidia 11.5–14.5 × 8.5–9.5 µm, bladder-shaped, surrounded by a whorl of small teeth, with basal clamp. Basidia 18–24 × 5–7.3 µm, clavate, somewhat sinuous, thin-walled, tetrasterigmatic, with basal clamp; sterigmata up to 5 µm long. Basidiospores 6–7.8 × 3.5–5 µm, ellipsoid to broadly ellipsoid, smooth, thin-walled, inamyloid, acyanophilous, with oily contents.

Remarks. This species is characteristic in having encrusted cystidia in addition to two other kinds of sterile elements. It had been only reported from its type locality in Réunion Island (Boidin & Gilles 1991).

Collection examined: India, Punjab, Roopnagar town, Boat club, on bark of *Nerium indicum*, 4 October 2012, Gurpreet & Avneet 8324 (PUN).

Scytinostroma ahmadii Boidin & Lanq., Bibliotheca Mycologica 114: 26, 1987
Fig. 5a–c

Description. Basidiocarp resupinate, adnate, effused, up to 1.3 mm thick in cross section; hymenial surface tuberculate, coriaceous, reddish grey when fresh, greyish orange to brownish orange on drying; margin thinning, somewhat fibrillose, paler than the hymenial surface or indeterminate.

Hyphal system dimitic. Generative hyphae up to 2.5 µm wide, branched, simple-septate, thin-walled, horizontal in the subiculum, vertical in the context and subhymenium. Skeleto-binding hyphae up to 3.3 µm wide, dichotomously to irregularly branched with obtuse apex, non-septate, thick-walled, cyanophilous, masking all other structures in the subiculum, subhymenium and hymenium. Gloeocystidia 61–101 × 5.5–8.3 µm, subfusiform to subcylindrical, sinuous, smooth, thin- to thick-walled, with oily contents positive to sulphovanillin, without basal clamp. Basidia 36–49 × 4.3–5.8 µm, clavate, sinuous, tetrasterigmatic, with oily contents, without basal clamp; sterigmata up to 5 µm long. Basidiospores 5.5–6.5 × 5–6.8 µm in diameter, subglobose to globose, thin-walled, smooth, amyloid, acyanophilous.

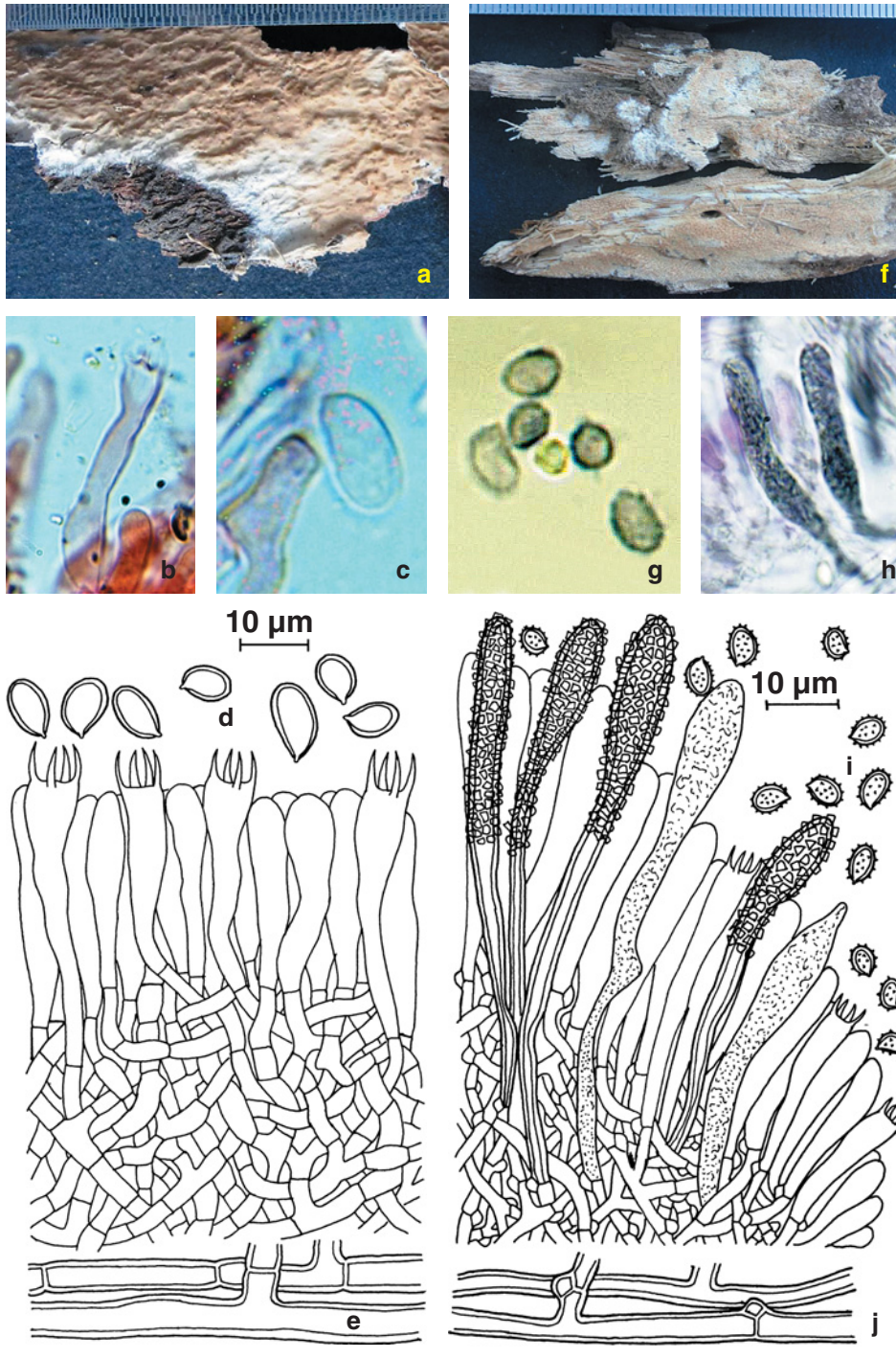
Remarks. This species is characterized by thick, coriaceous basidiocarp. It is closely related to *S. hemidichophyticum* Pouz. but differs by comparatively larger and broader, subfusifrom to subcylindrical gloeocystidia and dichohyphidia with obtuse ultimate ramifications. Earlier, it has been reported from Pakistan (Boidin & Lanquetin 1987, IMA on-line).

Collection examined: India, Union Territory of Chandigarh, Industrial Area Phase – I, on bark of tree of *Mangifera indica*, 28 September 2013, Gurpreet and Dhingra 8453 (PUN).

Scytinostroma corneri Boidin & Lanq., Bibliotheca Mycologica 114: 40, 1987
Fig. 5d–f

Description. Basidiocarp resupinate, adnate, effused, up to 350 µm thick in section; hymenial surface smooth, reddish white to pale red to greyish red to reddish grey when fresh, not changing much on drying; margins thinning, somewhat fibrillose, whitish to paler than the colour of the hymenial surface, or indeterminate.

Hyphal system dimitic. Generative hyphae up to 3.3 µm wide, branched, simple-septate, thin-walled, horizontal in the subiculum, vertical in the context and subhymenium. Skeleto-binding hyphae up to 3.5 µm wide, dichotomously to irregularly branched, with ultimate ramifications having conic, straight tips,


a
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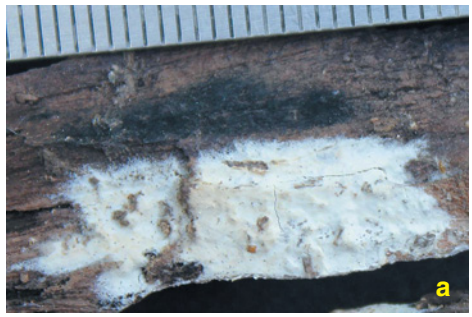
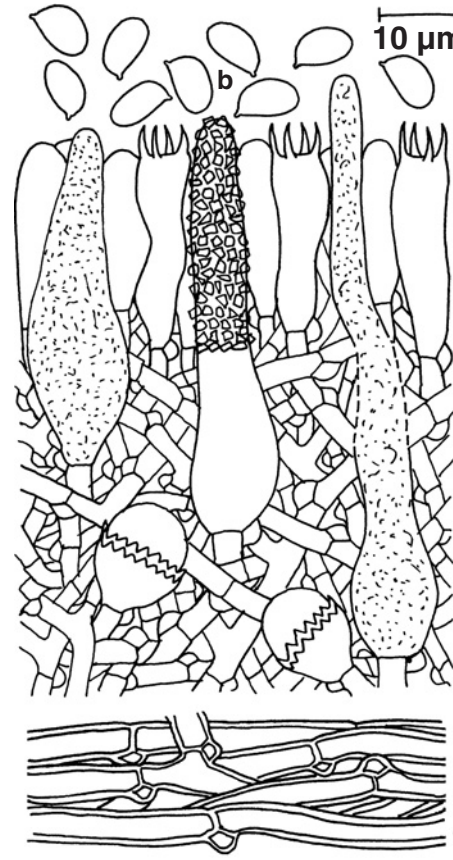


Fig. 4. *Peniophorella incrustatissima* (8324 PUN): **a** – basidiocarp showing hymenial surface; **b** – basidiospores; **c** – vertical section through basidiocarp. Scale bar = 10 µm; del. G. Kaur (b–c). Photo by A.P. Singh (a).



◀ **Fig. 3.** *Erythricium hypnophilum* (8322 PUN): **a** – basidiocarp showing hymenial surface; **b** – basidium; **c** – basidiospore; **d** – basidiospores; **e** – vertical section through basidiocarp. *Gloeodontia columbiensis* (8471 PUN): **f** – basidiocarp showing hymenial surface; **g** – basidiospores; **h** – gloeocystidia; **i** – basidiospores; **j** – vertical section through basidiocarp. Scale bars = 10 µm; del. G. Kaur (d–e, i–j). Photos by A.P. Singh (a, f), P. Kaur (b–c, g–h).

non-septate, thick-walled, cyanophilous, dextrinoid, masking all other structures in the subiculum, subhymenium and hymenium. Gloeocystidia 45–50 × 5.5–7.3 µm, subfusiform, sinuous, smooth, thin-walled, with oily contents positive to sulphovanillin, without basal clamp. Basidia 28–47 × 6–8.3 µm, clavate, sinuous, tetrasterigmatic, with oily contents, without basal clamp; sterigmata up to 4.3 µm long. Basidiospores 5–7.5 × 4.5–7.3 µm in diameter, subglobose to globose, thin-walled, smooth, amyloid, acyanophilous.

Remarks. This species was described by Boidin & Lanquetin (1987) from Singapore. It belongs to the *S. hemidichophyticum* – *S. aluta* complex. It is distinguished by dichotomously branched skeleto-binding hyphae (similar to the genus *Vararia*) and by larger basidiospores.

Collection examined: India, Union Territory of Chandigarh, Lake Reserve Forest, on bark of *Leucaena leucocephala* tree, 15 August 2015, Gurpreet and Dhingra 8455 (PUN).

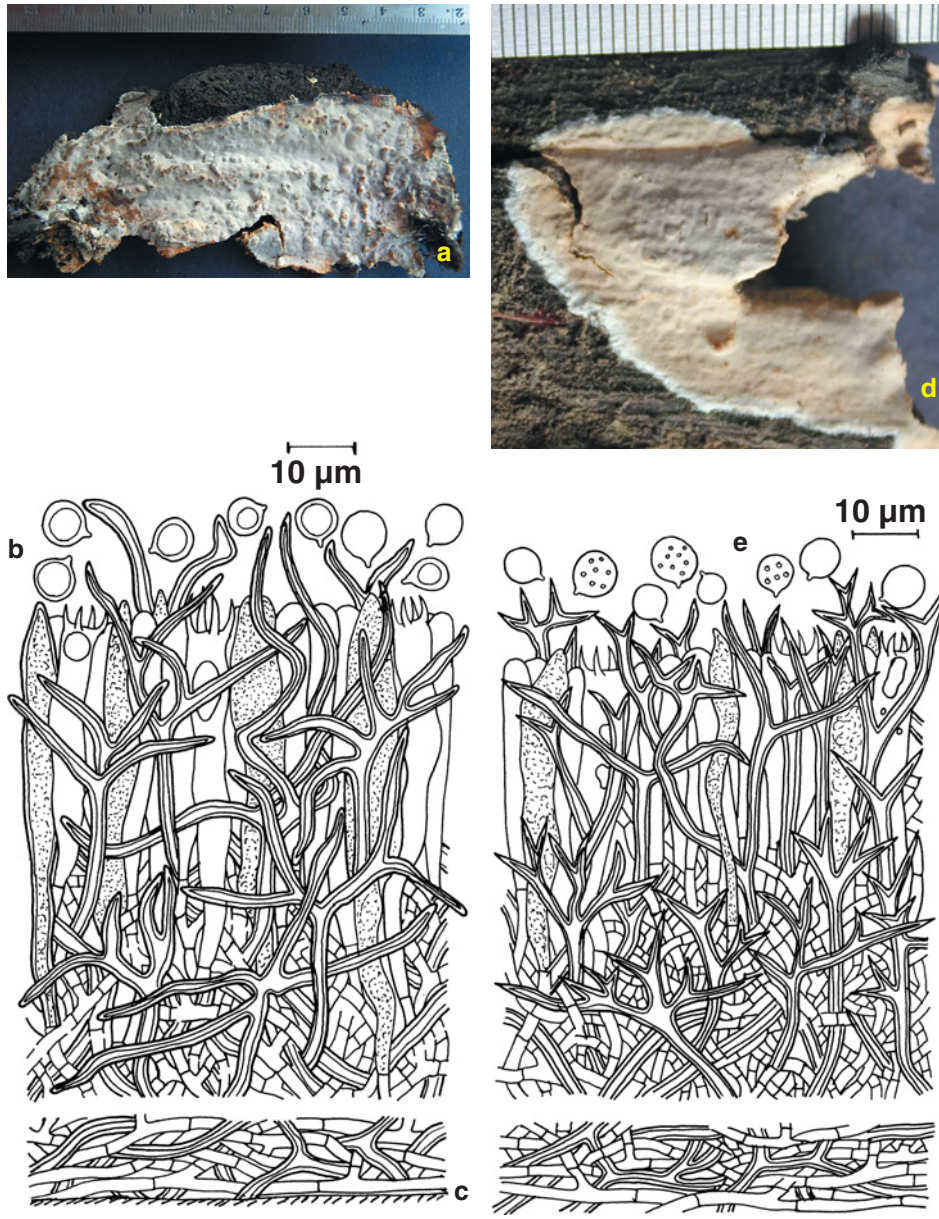


Fig. 5. *Scytinostroma ahmadii* (8453 PUN): **a** – basidiocarp showing hymenial surface; **b** – basidiospores; **c** – vertical section through basidiocarp. *Scytinostroma corneri* (8455 PUN): **d** – basidiocarp showing hymenial surface; **e** – basidiospores; **f** – vertical section through basidiocarp. Scale bars = 10 µm; del. G. Kaur (b–c, e–f). Photos by G.S. Dhingra (a, d).

Tretomyces lutescens (J. Erikss. & Ryvarden) K.H. Larss., Kotir. & Saaren. in Kotiranta, Larsson, Saarenoksa & Kulju, Ann. Bot. Fenn. 48(1): 42, 2011

Fig. 2a–e

≡ *Byssocorticium lutescens* J. Erikss. & Ryvarden, The *Corticiaceae* of North Europe 2: 185, 1973

Description. Basidiocarp resupinate, loosely adnate, effused, up to 210 µm thick in cross section, hymenial surface hypochnoid, orange white to pale orange when fresh, greyish orange to greyish red on drying; subiculum thick, rhizomorphs present; margin thinning, fibrous, paler than the hymenial surface or indeterminate.

Hyphal system monomitic. Generative hyphae branched, septate, with or without clamps; basal hyphae up to 2.3 µm wide, parallel to substrate, not much branched, thin- to somewhat thick-walled, constituting a prominent subicular zone; subhymenial hyphae up to 4 µm wide, vertical, branched more, thin-walled, forming a narrow zone. Cystidia absent. Basidia 14–27 × 5–8.5 µm, clavate, somewhat sinuous, stalked, tetrasterigmatic, with basal clamp; sterigmata up to 5.3 µm long. Basidiospores 3.8–5.3 × 3.5–4.8 µm, subglobose to globose, apiculate, smooth, thick-walled, cyanophilous, inamyloid, generally uniguttulate.

Remarks. This species is different from the species of the genus *Byssocorticium* on the basis of narrower basal hyphae and smaller, cyanophilous basidiospores. It has also been reported from Russia, Sweden, Norway, Denmark and Spain (IMA on-line).

Collection examined: India, Punjab, Roopnagar town, Forest Rest House, on angiospermous log, 5 September 2012, Gurpreet 8314 (PUN).

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