
On two remarkable brown-spored agarics from Kerala State, India

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Two brown-spored agarics are described from Kerala State. *Tubaria virescens* is described as new, being distinct on account of the blue-green discoloration when bruised and remarkably large, subcylindrical spores. Based on collections of *Panaeolina rhombisperma* Hongo from Kerala, its taxonomic position is discussed, suggesting that it may well be transferred to the genus *Psathyrella*.

Key words: *Agaricales*, *Basidiomycota*, *Panaeolina rhombisperma*, *Tubaria virescens*

Introduction

The study of agarics in the Asian region has increased in recent years (Antonín and Buyck, 2006, Nuytinck *et al.*, 2006, Tan *et al.*, 2007), including studies from India. The agaric flora of Kerala state, India, seems to be very rich. Recently several studies on a number of genera have been published, for instance, on *Hymenagaricus* Heinem. (Heinemann and Little Flower, 1984), *Micropsalliota* Höhn. (Heinemann and Leelavathy, 1991), *Entoloma* (Fr.) P. Kumm. (Manimohan *et al.*, 1995, 2006), *Psilocybe* (Fr.) P. Kumm. (Thomas *et al.*, 2002), *Agrocybe* Fayod (Thomas and Manimohan, 2003), *Cortinarius* (Pers.) Gray (Peintner *et al.*, 2003), *Gymnopilus* P. Karst. (Thomas *et al.*, 2003), *Lentinus* Fr. (Manimohan *et al.*, 2004), *Hygrocybe* (Fr.) P. Kumm. (Leelavathy *et al.*, 2006), and *Pluteus* Fr. (Pradeep and Vrinda, 2006), revealing numerous species new to science. The current paper describes and discusses two remarkable brown-spored agarics found in the state.

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Materials and methods

The descriptions are based exclusively on material collected from the field. Microscopic characters were studied on the fresh material and studied in a 3% aqueous potassium hydroxide solution. Spore measurements are based on 20 observations. Color names given in inverted commas and colour codes given in brackets refer to Kornerup and Wanscher (1978). All collections studied are deposited in the National Herbarium of the Netherlands (L).

Taxonomic part

Tubaria virescens Noordel. & K. B. Vrinda, **sp. nov.** (Fig. 1, Pl. 1)

MycoBank:511137

Etymology: from the Latin *virescens* = greening, referring to the blue-green discoloration of parts of the fruit body when bruised.

Pileus 8-30 mm latus, convexus demum expansus, infundibuliformis, haud hygrophanus, haud translucido-striatus, brunneus, glabrus vel leviter tomentosus sub lente. *Lamellae* confertae, decurrentes, flavidae demum griseobrunneae. *Stipes* 5-20 × 1-3 mm, cylindraceus, eccentricus, rufobrunneus, fibrillosus. *Odore* fortis, subaromaticis. *Sporae* 8.5-13.5(15) × 3.5-4.5(5) μm, subcylindraceae vel subfusiformiae, flavobrunneae, glabrae, tenuiparietales, inamyloideae, sine poro germinativae. *Basidia* 30-39 × 7.5-9 μm, clavata, tetrasporigera, efibulata. *Acies lamellarum* heterogeneis. *Cheilocystidia* 30-57 × 4.5-10.5 μm, subcylindracea, fusiformia vel lageniformia, leviter capitata. *Pleurocystidia* 60-105 × 10.5-21 μm, fusiformia, apice obtuse vel acuta. *Pileipellis* cutis vel trichoderma e elementis cylindraceis, 4-9 μm latis constituta pigmentis incrustatis. *Caulocystidia* 20-70 × 3-9 μm, cylindracea vel clavata, tenui-vel crassitunicata. Fibulae absentes. *Ad terram* et lignam putridam.

Holotypus: INDIA, Kerala State, Thiruvananthapuram District, Palode, TBGRI Campus: 16 June 2000, K.B. Vrinda, TBGT5061 (L).

Pileus 8-30 mm diam, initially convex, becoming plane or nearly so, often with a shallow depression, with deflexed finally uplifted margin to infundibuliform; surface 'brownish orange' (5C3), 'bronze-brown' (5E5), 'linoleum-brown' (5E7), 'coffee-brown' (5F7), smooth and glabrous to the naked eye, but slightly squamulose under lens, slightly shiny when wet, otherwise dry, often cracking to expose the underlying 'dull yellow' (3B3) context below. *Lamellae* unequal with lamellulae of different lengths, crowded, decurrent, triangular to ventricose, up to 3 mm broad, often forked or reticulately interveined, 'wax yellow' (3B5), 'corn' (4B5), 'amber yellow' (4B6) or 'sun yellow' (2A5), gradually changing to 'greyish brown' (2B6) or 'chartreuse' (2C6) when mature, immediately turning 'peacock green' (27D7) on cutting or bruising, with concolorous edge. *Stipe* 5-20 × 1-3 mm, mostly eccentric, sometimes central, curved, terete or compressed, tapering downwards, initially solid, becoming fistulose to hollow, with a white mycelial mat at the base; surface 'cinnamon-brown' (6D6), 'sunburn' (6D5), or 'cocoa-brown' (6E6), paler

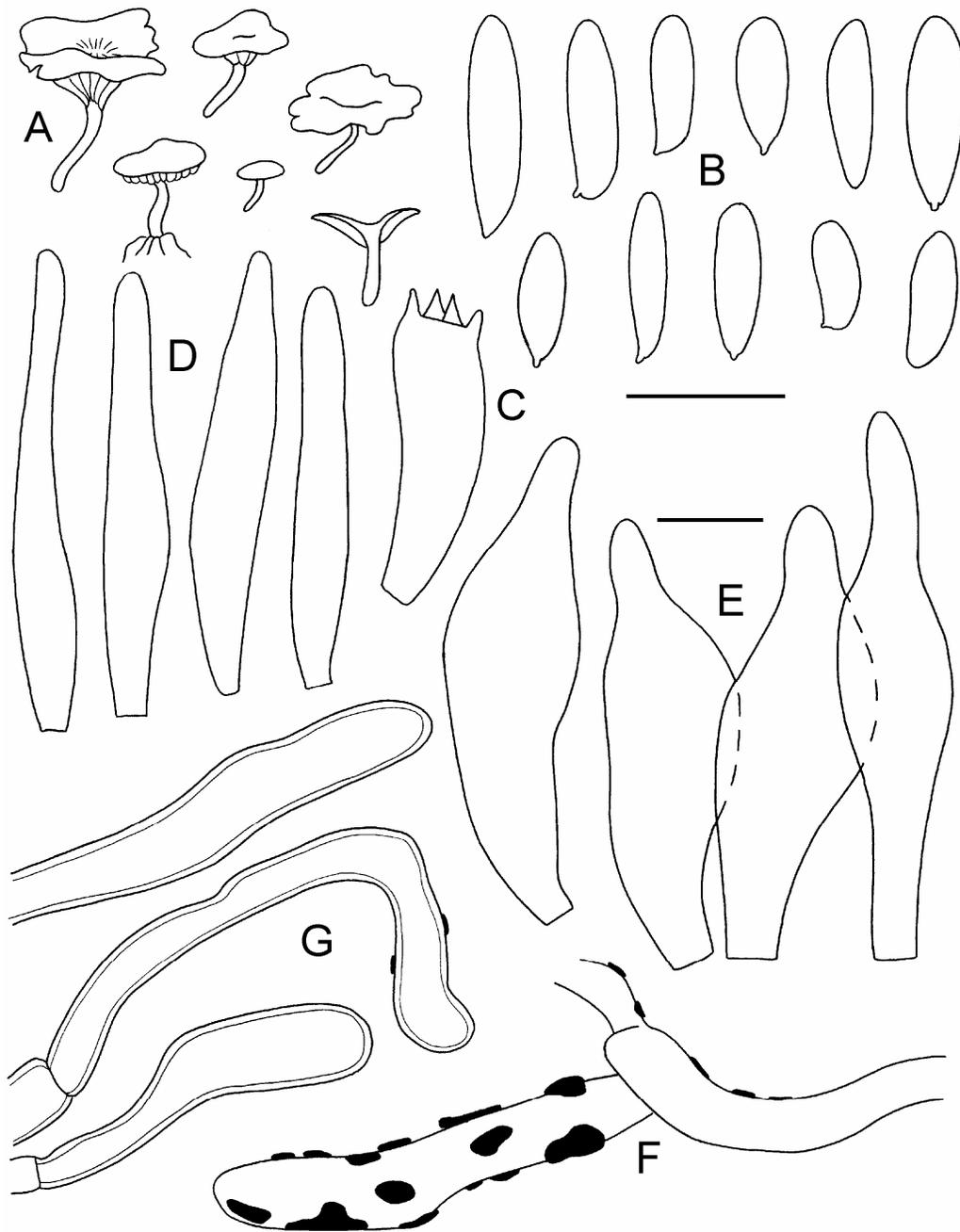


Fig. 1. *Tubaria virescens*. **A.** Habit, **B.** Spores. **C.** Basidium. **D.** Cheilocystidia. **E.** Pleurocystidia. **F.** Elements of pileipellis. Bar = 10 μ m.

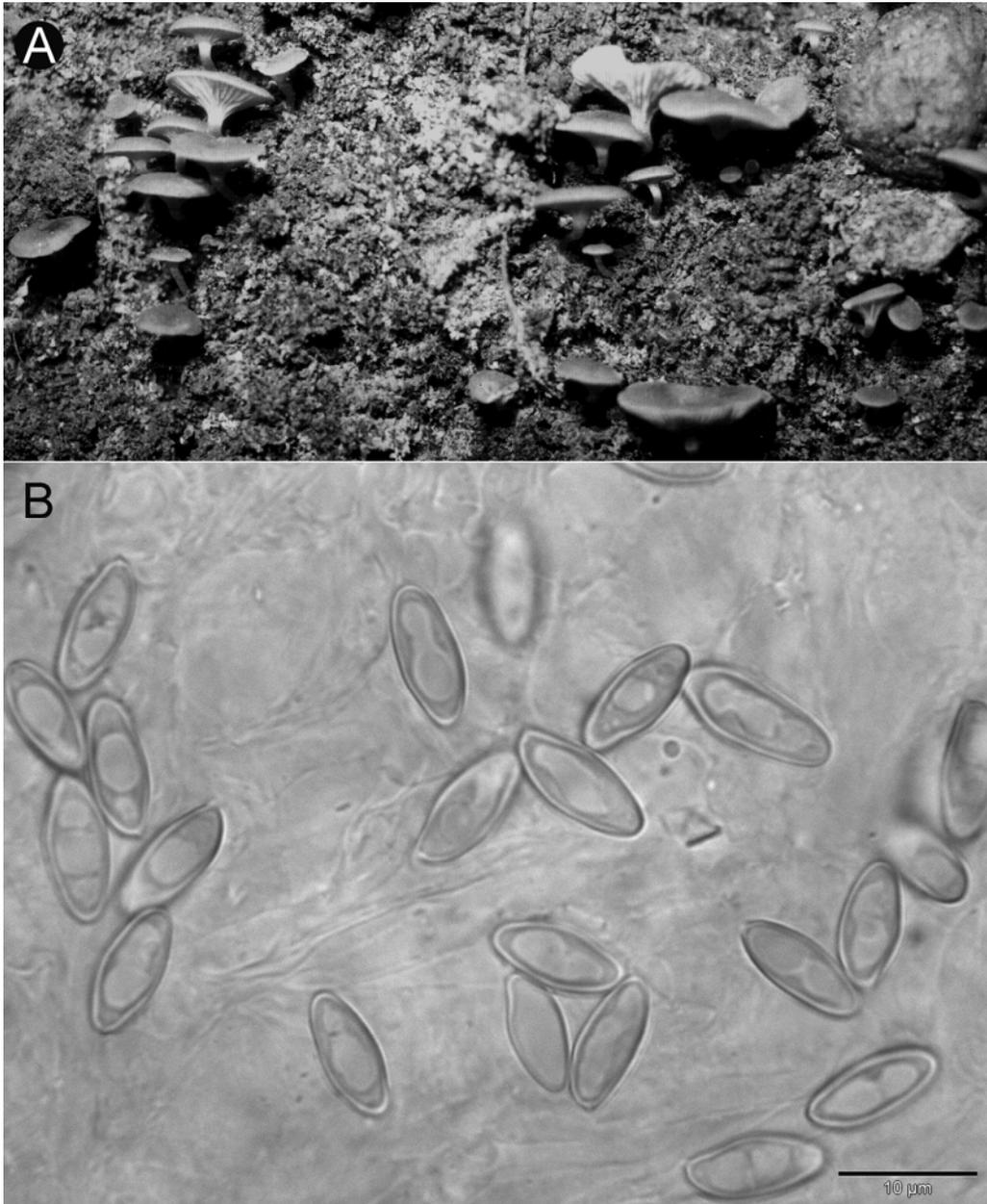


Plate 1. *Tubaria virescens*. **A.** Fruitbodies *in situ*. **B.** spores (bar = 10 μm).

at the upper part, fibrillose-striate, slimy. *Veil* absent. *Context* thin, 'dull yellow' (3B3), turning blue on cutting, up to 2 mm wide, soft. *Odour* strong but pleasant. Spore-print brownish orange (5D3).

Spores 8.5-13.5(15) × 3.5-4.5(5) μm, subcylindrical to subfusiform, yellowish brown, smooth, thin-walled, inamyloid, without germ pore. *Basidia* 30-39 × 7.5-9 μm, clavate, 4-spored. *Lamella-edge* heteromorphous. *Cheilocystidia* 30-57 × 4.5-10.5 μm, subcylindrical, fusiform or, lageniform, thin-walled, hyaline. *Pleurocystidia* scattered both on sides and edges of the lamellae, 60-105 × 10.5-21 μm, broadly fusiform with obtuse to subacute apices, with a thin or slightly thickened wall. *Hymenophoral trama* regular, composed of thin-walled, hyaline 4.5-12 μm wide hyphae, occasionally with incrustated pigment in form of spiral thickenings. *Pileipellis* a transition between a cutis and a trichoderm, made up of brown-encrusted, 4-9 μm wide hyphae, with cylindrical to slightly inflated terminal elements. *Pileitrama* regular, made up of composed 3-15 μm wide, thin-walled, slightly gelatinised hyphae. *Stipitipellis* a cutis of 4-8 μm wide, thick-walled, incrustated hyphae. *Caulocystidia* 20-70 × 3-9 μm, cylindrical to cylindrico-clavate, thin- or slightly thick-walled, in tufts. Clamp connections absent.

Habitat: In groups, on moss-covered soil around exposed living roots of a tree, with a white mycelial mat at the base.

Known distribution Kerala State, India.

Material examined: INDIA, Kerala State, Thiruvananthapuram District, Palode, TBGRI Campus: 16 Jun. 2000, K. B. Vrinda, TBGT5061 (**holotype**); 13 July 2000, K. B. Vrinda, TBGT5117; 1 Jul.2003, K. B. Vrinda, TBGT5878.

Notes: The genus *Tubaria* (W.G. Sm.) Gillet is characterized by small, mostly omphalinoid basidiocarps with brownish colours, decurrent lamellae, medium brown, thin- to slightly thick-walled, smooth spores without germ pore, presence of cheilocystidia, and a differentiated pileipellis in the form of a cutis or a transition between a cutis and trichoderm (Singer, 1986). As such it is classified in either the *Cortinariaceae* R. Heim ex Pouzar or *Crepidotaceae* Singer. Although *Tubaria* species occur wide-spread, and probably are cosmopolitan, our knowledge in this group is still limited, and, even in Europe, where the genus is relatively well-known (Kühner and Romagnesi, 1953; Moser, 1984; Horak, 2005), identification is offering difficulties, since most taxa are very similar in macroscopic and microscopic characters. Only a few records of *Tubaria* species are known from the Indian subcontinent. Hennings (1901) described four species (*Tubaria asperata* Henn., *T. conspersa* (Pers.) Fayod, *T. furfuracea* (Pers.) Gillet and *T. saharanpurensis* Henn.) including two new species. Later Watling and Gregory (1980) recorded another species [*T. autochthona* (Berk. & Broome) Sacc.] and Natarajan and Raman (1983) recorded two more species [*T. dispersa* (L.) Singer and *T. pentstemonis* Singer].

While studying the current material, it became obvious that it must belong to the genus *Tubaria* on account of the characteristics given above, and considering the fact that at least four striking characters differentiate our species from the known taxa, viz. the blue-green staining of the fruit bodies, presence of pleurocystidia, clamp-less hyphae, and the relatively large, ellipsoid to subcylindrical spores, it was decided to describe it as a new species. All the above-mentioned species recorded from India differ, according to the original descriptions, by having much smaller, differently shaped spores, and the lack of a green-blue discoloration. The blue-green staining reminds of some species of *Psilocybe* (Guzmán, 1983; Noordeloos, 1999), which differ, however, by having darker coloured spores with a distinct germ pore. We could not verify whether psilocybine or related compounds are present in our species. However, a blue-green staining can also be caused by oxidation processes when the fruit bodies are damaged, like for example in the genus *Leccinum* (Bakker and Noordeloos, 2005).

Panaeolina rhombisperma Hongo, Mem. Shiga Univ. 23: 38. 1973.

(Fig. 2, pl.2)

Basidiomata small. *Pileus* 4-13 mm diam, hemispherical, conico-complanate or convex, sometimes with a small umbo; with incurved then decurved, entire, sometimes fissile margin, strongly hygrophanous, finely translucently striate at margin, uniformly dark brown (8F8), becoming brown (7E7) on drying, finely pubescent to almost smooth, dull. *Veil* absent. *Lamellae* unequal with three lengths of lamellulae, crowded to moderately distant, adnexed to almost free, up to 3 mm broad, brown (6E4, 6E5), turning dark brown (7F4, 7F5, 8F4) with age, slightly mottled, with white, finely fimbriate edge. *Stipe* 1.5-4.3 × 0.5-2.5 mm, central, terete, equal, hollow; orange white (6A2), rarely 'flesh' (6B3), entirely pubescent, turning reddish brown on bruising. *Context* up to 1.5 mm thick, whitish. *Odour* none. *Spore-print* not obtained.

Spores 10-12.5 × 8-11.5 µm, rhomboid to nodulose-subangular, dark-brown, partially discoloured by concentrated H₂SO₄, thick-walled, with a small, but distinct germ-pore. *Basidia* 17-30 × 8-10 µm, cylindrico-clavate to clavate, mostly with a median constriction, 4-spored; sterigmata up to 3.5 µm long. *Lamella-edge* sterile. *Cheilocystidia* 20-58 × 5.5-8.5 µm, in dense clusters, flexuose to moniliform, often with a swollen base and a subcapitate apex, thin-walled, hyaline. *Pleurocystidia* none. *Hymenophoral trama* subregular, made up of 2-19 µm wide, inflated, thin-walled hyphae with pale yellowish brown wall. *Pileipellis* an epithelium of subglobose to globose elements, 18-43 × 14.5-29 µm with hyaline to pale yellow wall, with scattered to clustered

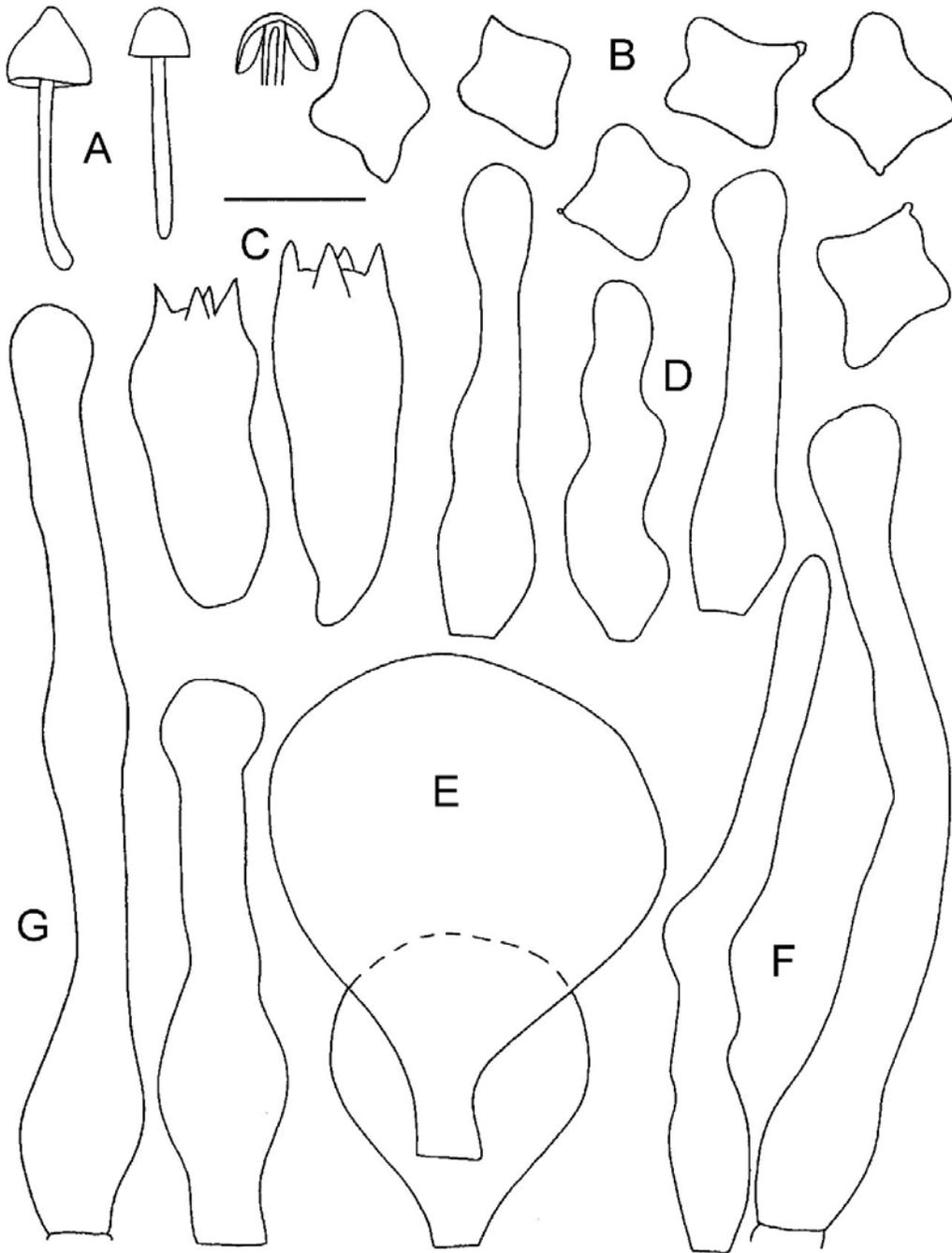


Fig. 2. *Panaolina rhombisperma*. **A.** Habit. **B.** Spores. **C.** Basidium. **D.** Cheilocystidia. **E.** Elements of pileipellis. **F.** Caulocystidia. **G.** Pileocystidia (Bar = 10 μ m.).

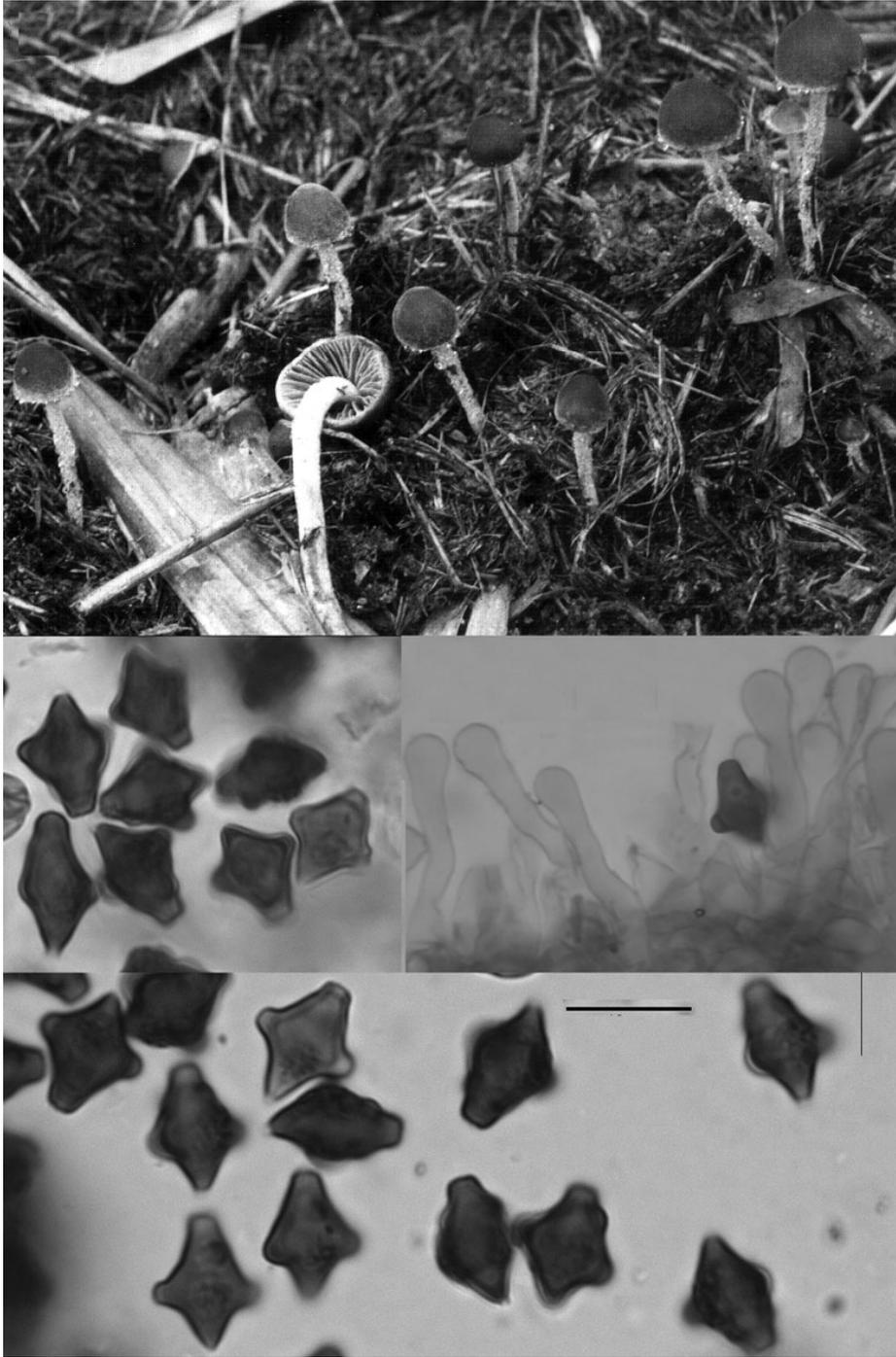


Plate 2. *Panaeolina rhombisperma*. Fruitbodies in situ, spores, and cheilocystidia. Bar = 10 μm .

pileocystidia, $23-68 \times 6.5-11 \mu\text{m}$, similar to cheilocystidia; subpellis a compact layer of narrow, light yellowish brown hyphae having occasional granular encrustations, well separated from trama. *Pileitrama* regular, made up of short, inflated elements $4-28 \mu\text{m}$ wide, with thin, hyaline to pale yellow, sometimes finely encrusted walls. *Stipitipellis* a cutis of $2-8 \mu\text{m}$ wide, thin-walled, pale yellowish brown hyphae, with occasional granular encrustations. *Caulocystidia* $17-103 \times 5.5-9.5 \mu\text{m}$ either scattered or in large bundles throughout the stipe surface, similar to cheilocystidia, thin-walled, hyaline. *Stipititrama* made up of parallel, $2.5-22 \mu\text{m}$ wide, thin-walled, pale yellowish brown hyphae, occasionally with granular encrustations. Clamp connections present in all parts.

Habitat: On elephant dung, scattered.

Material examined: INDIA, Kerala State, Wayanad district, Ponkuzhy: 17 October 1999, K.A. Thomas, T338a; 18 October 1999, K.A. Thomas T338 b; 28 October 1999, K.A. Thomas T338c; 31 October 1999, K.A. Thomas T 338d.

Notes: These collections are strikingly similar to the original description of *Panaeolina rhombisperma* from Japan in almost all characters, and they form the first record of this enigmatic species from the Indian subcontinent. However, the description given by Hongo (1973) is scanty and no mention is made about the solubility of the spore pigment, the presence of a germ-pore, and the occurrence of pileo- and caulocystidia. Unfortunately, Hongo's material could not be obtained on loan.

This is the second record of this species, although some unpublished notes and sketches by Van Overeem in the herbarium of Bogor, suggest that it might have been found in Indonesia (Horak, 1980). In the original publication, Hongo (1973) indicated that the special cruciform-rhomboid spore-shape was similar to those found in *Pterospora atrocyanea* Métrod or *Crucispora naucorioides* E. Horak. However, he decided to place it provisionally in the genus *Panaeolina* Maire. Later, Horak (1980) recombined *Panaeolina rhombisperma* in *Crucispora* E. Horak. Despite this, the present authors do not think that both species are congeneric. Although superficially the spores resemble those of *C. naucorioides* E. Horak from New Zealand, those of the latter lack a germ-pore, and the other macroscopic and microscopic characters are very different, in particular the presence of veil and the rugose-veined pileal surface with hymenidermal structure, which suggest that Horak's species may well be a member of the *Agaricaceae* Chevall., whereas the characters of *Panaeolina rhombisperma* suggest affinity with the *Coprinaceae* Overeem & Weese. The authors tested the reaction of the spores in concentrated H_2SO_4 and found that they fade distinctly. Spores of typical *Panaeolina* species, however, do not fade in H_2SO_4 , a character used by Singer (1986) to separate the genus *Panaeolina* from *Coprinus* Pers. and *Psathyrella* (Fr.) Quél. According to

Singer (1986), some species in section *Lacrymaria* Pat. may have a slightly rhomboid or subangular appearance, and rhomboid spores are also known to occur in other *Coprinaceae*. Currently the taxonomy of *Coprinaceae* is under revision, and we feel that recombining the epithet *rhombisperma* in *Psathyrella* cannot be made without additional molecular studies.

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