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The genus *Cystolepiota* (*Agaricales, Basidiomycota*) in Kerala State, India

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Abstract — Three species of the genus *Cystolepiota* are documented from Kerala State, India including a new species, *C. furfuracea*. *Cystolepiota fumosifolia* is new to Asia and *C. pulverulenta* is new to India.

Key words — *Agaricaceae*, floristics, lepiotaceous fungi

Introduction

Cystolepiota Singer (*Agaricaceae*, *Agaricales*) is a genus closely allied with section *Echinatae* of *Lepiota* sensu stricto, distinguished from the latter in having mostly inamyloid and uninucleate spores and a pileus covering composed of more or less loosely arranged, inflated, globose, oblong or elongate elements. The pileal covering of members belonging to *Lepiota* section *Echinatae* has hyphae gradually transient into globose or ellipsoid elements (Vellinga 2001), making up the pyramidal squamules whereas such intermediate cells constituting the veil are absent in *Cystolepiota* (Knudsen 1980).

Only one species of *Cystolepiota*, *C. hemisclera* (Berk. & M.A. Curtis) Pegler, has been recorded from India so far (Vrinda et al. 1997). Our investigations on the lepiotaceous agarics of Kerala revealed a new species of *Cystolepiota* and two new records. The new species is fully described and illustrated below along with brief accounts of the two new records.

Materials and methods

Microscopic observations were made on material stained with 1% aqueous solutions of phloxine and Congo red and mounted in 3% KOH. Pigmentation and exudates if any were noted by mounting the material in water. Melzer's reagent, cresyl blue and cotton blue were used to observe whether the spores

were dextrinoid, metachromatic, and cyanophilic respectively. In all cases, spore measurements were taken from twenty randomly selected spores. Colour codes refer to Kornerup & Wanscher (1978). The holotype of the new species and additional and/or representative collections of all taxa documented here are at Kew (K) and these collections are indicated by their Kew (Mycology) accession numbers (e.g., K(M)155998). All other collections examined are in the personal herbarium of the second author.

Taxonomic account

Key to the *Cystolepiota* species of Kerala

1a. Hymenial cystidia and clamp-connections absent; spores 4–6 × 2–3 µm ..... ***C. pulverulenta***

1b. Hymenial cystidia and clamp-connections present 2

2a. Spores dextrinoid, 5.5–7.5 × 2.5–3.5 µm ..... ***C. hemisclera***

[reported from Kerala by Vrinda et al. (1997); not collected during our study]

2b. Spores inamyloid, 4–6 × 2–3.5 µm 3

3a. Cheilocystidia and pleurocystidia with yellowish contents and exudates; pileal covering made of subglobose to globose elements; spores 4–5 × 2–3 µm ..... ***C. fumosifolia***

3b. Cheilocystidia without any exudates; pleurocystidia absent; pileal covering made of inflated cylindrical or ellipsoid cells; spores 4–6 × 2.5–3.5 µm ..... ***C. furfuracea***

Description of new species

Cystolepiota furfuracea T.K.A. Kumar & Manim., **sp. nov.** Figure 1

MycoBank MB511633

Pileus 17.5–20 mm latus, e globose expansus, albus, non striatus, squamis furfuraceis pallide luteolis decoratus. Lamellae liberae, albidae, moderate confertae. Stipes 20–23 × 1–1.5 mm, ad basim inflatus, solidus, albidus, squamulosus. Sporae 4–6 × 2.5–3.5 µm, ellipsoideae, hyalinae, laeves, inamyloideae, azurei cresylici non-metachromaticae. Cheilocystidia cylindrico-clavata, clavata vel utriformia. Pleurocystidia nulla. Cuticula pilei ex hyphis et sphaerocystis composita. Hyphae omnes fibulatae.

Holotype: **INDIA, Kerala State, Thiruvananthapuram District,** PALODE: 18 July 2005, Arun Kumar AK355 (K(M)155998, **HOLOTYPE***).*

Etymology: *furfuracea* (L), scurfy

Basidiomata small; pileus 17.5–20 mm diam., globose when very young, expanding to become convex and finally applanate on maturity; surface whitish with yellowish white (4A2) to pale yellowish (4A3) furfuraceous squamules that are almost spiny towards the centre, non-striate; margin initially incurved, becoming straight, entire; lamellae free, whitish, moderately crowded, up to 2 mm wide, with lamellulae in 3–4 tiers; edge finely fimbriate under a lens,

concolorous with the sides; STIPE 20–23 × 1–1.5 mm, central, terete, almost equal, with a subbulbous base, solid; surface whitish, turning brownish orange (7C4) on bruising, with detersile, cottony squamules; base connected to white mycelial cords; ANNULUS not observed; CONTEXT up to 1 mm thick, whitish, turning brownish orange (7C4) on exposure; ODOUR not distinctive; SPORE-PRINT not obtained.

SPORES 4–6 × 2.5–3.5 (5 ± 0.44 × 3 ± 0.22) µm, Q = 1.3–2, Qm = 1.7, ellipsoid to oblong or subcylindrical, hyaline, with refractive guttules, slightly thick-walled, smooth, inamyloid, non-dextrinoid, non-metachromatic in cresyl blue, cyanophilic in cotton blue; BASIDIA 13–22 × 6–8 µm, clavate, with guttulate contents, hyaline, 4-spored, with sterigmata up to 3 µm long; lamella-edge sterile; CHEILOCYSTIDIA crowded, 15–55 × 5–17 µm, cylindrico-clavate, clavate, or utriform, thin-walled, hyaline, guttulate, with basal clamp-connections; PLEUROCYSTIDIA absent; LAMELLAR TRAMA subregular; hyphae 2–17 µm wide, slightly inflated, hyaline, thin-walled, inamyloid; SUBHYMENIUM cellular; PILEAL TRAMA interwoven; composed of inflated, septate, 3–17 µm wide, hyaline, thin-walled, inamyloid hyphae; PILEAL COVERING a highly disrupted cutis composed of both ascending or erect, inflated, 2–15 µm wide hyphae and loosely arranged detersile chains of cylindrical or ellipsoid, 17–42 × 4–13 µm large elements; hyphae thin-walled and with pale yellowish to brown plasmatic pigments; STIPE COVERING a disrupted cutis of loosely arranged cylindrical or ellipsoid elements similar to those of the pileal covering. All hyphae with clamp-connections.

HABITAT: On soil among decaying leaf litter, solitary.

ADDITIONAL COLLECTION EXAMINED — **INDIA, KERALA STATE, Thiruvananthapuram District,** PALODE: 20 July 2005, Arun Kumar AK370 (K(M)157120).

DISCUSSION: The outstanding characteristics of this small-sized species are the yellowish, furfuraceous squamules that become somewhat spiny towards the centre of the pileus; ellipsoid spores that are inamyloid and non-metachromatic in cresyl blue; cylindrico-clavate, clavate or utriform cheilocystidia; and a pileal covering with loosely attached chains of cylindrical or ellipsoid elements. Gross morphology of this species is reminiscent of *Lepiota cystophoroides* Joss. & Riousset, *L. scaberula* Vellinga, and *Cystolepiota cystophora* (Malençon) Bon. However, dissimilarities, especially with regard to the microscopical characteristics, exist that make *C. furfuracea* unique.

Lepiota cystophoroides [see Bon (1996) and Candusso & Lanzoni (1990) for species descriptions] differs from *Cystolepiota furfuracea* in having somewhat larger basidiomata that usually develop a vinaceous-purple tint on bruising. Although *C. furfuracea* basidiomata also change colour turning brownish orange on bruising, vinaceous-purple tinges are not observed. The spores of

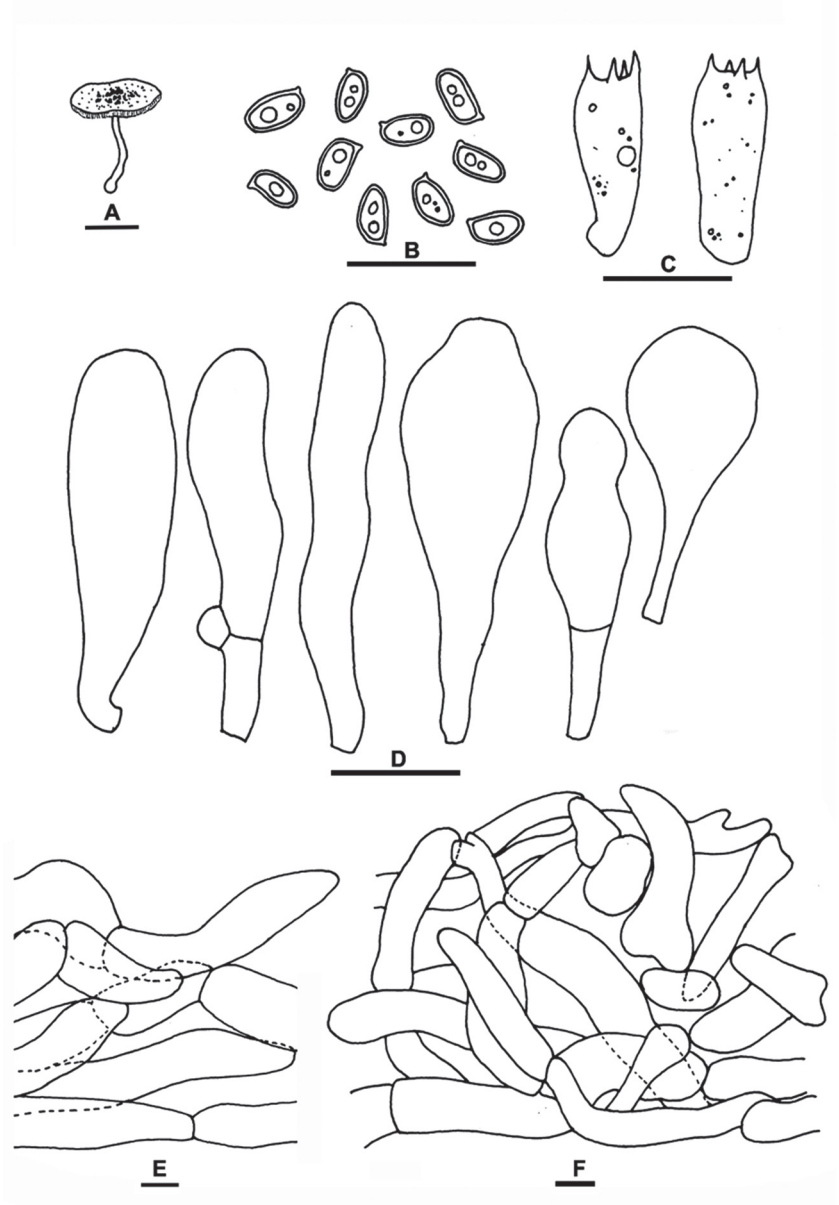

Figure 1. *Cystolepiota furfuracea*. A, habit, scale bar = 10 mm.
B, basidiospores; C, basidia; D, cheilocystidia; E, stipe covering; F, pileus covering.
Scale bars (B–F) = 10 μm.

L. cystophoroides are larger (6–8 × 3–4.5 µm) and somewhat dextrinoid. Spores of *C. furfuracea* are unmistakably non-dextrinoid. The squamulose pileal surface of *L. cystophoroides* is made up of erect, compactly arranged clavate elements bearing (sub)globose terminal elements. Remarkably, *C. furfuracea* lacks such a compact palisade-like arrangement with clavate elements and has a furfuraceous pileal covering composed of highly disrupted and loosely arranged chains of cylindrical or ellipsoid terminal elements, borne on inflated cylindrical hyphae. This contrasting nature of the pileal covering is the most important distinction between *L. cystophoroides* and *C. furfuracea.*

Lepiota scaberula, a species closely related to *L. cystophoroides,* could be distinguished from *Cystolepiota furfuracea* in having little scurfy scales, a distinctly glabrous patch at the centre of the pileus, a large stipe that is pale reddish towards base, larger spores (5–7 × 3–4 µm) with an inner wall pink in cresyl blue, and by the clavate terminal elements of pileal covering.

Cystolepiota cystophora has larger basidiomata with a relatively broader pileus (usually 20–40 mm) and stout stipe (usually 30–60 × 3–4 mm). A distinct rosy or pinkish brown colouration is seen towards the stipe base that is absent in *C. furfuracea*. *Cystolepiota cystophora* possess larger spores (6–8 × 4–5 µm), and the pileal covering is composed of clavate or pyriform elements with distinct sphaerocysts (Bon 1996, Candusso & Lanzoni 1990). Clavate or pyriform elements and typical sphaerocysts are absent in *C. furfuracea.*

Another species with similar size and shape of spores and a comparable pileal structure is *C. pulverulenta* that could be easily differentiated based on its dextrinoid spores (reaction usually slow and weak) and the absence of cystidia and clamp connections.

Although *Cystolepiota furfuracea* shows similarities with members of *Lepiota* section *Lilaceae* macroscopically and in a few microscopic characteristics, the non-hymenidermal pileal covering in *C. furfuracea* prevents the species from being classified there. Moreover, the unique character combinations observed in *C. furfuracea* does not seem to favour a satisfactory placement in the genus *Lepiota*. Rather, the very small basidiomata, furfuraceous covering of pileus and stipe that are easily removed on handling, and small spores that are non-dextrinoid, are suggestive of species belonging to the genus *Cystolepiota.* In addition, the arrangement of the pileal covering, with inflated and loosely attached velar elements suggests placement in *Cystolepiota.*

The original concept of *Cystolepiota* considered only species with a pileal covering composed of globose cells. However, Vellinga (1992) widened the concept by including *Lepiota pulverulenta* Huijsman, allowing room for species with inflated, non-globose velar elements in *Cystolepiota*. Accordingly, *C. furfuracea* with inflated, cylindrical or ellipsoid pileal elements also seems

relatively well-placed in the genus. In view of the above considerations, we find it more appropriate to treat *C. furfuracea* within the genus *Cystolepiota* than considering it as a *Lepiota*.

Documentation of new records

Cystolepiota fumosifolia (Murrill) Vellinga, Mycotaxon 98: 226 (2006)

Selected descriptions and figures: Vellinga (2001: 155–156, as *C. cystidiosa*), Vellinga & Huijser (1998: 518–521, as *C. cystidiosa*), Vellinga (2006: 226–228).

Pileus 7–22 mm diam.; surface yellowish white (2A2, 3A2), densely covered with detersile, granular to floccose, greyish orange (5B3) to light brown (6D7) or brown (7E5) squamules; lamellae free, yellowish white (3A2) to pastel yellow (3A4) turning dark brown (6E8) on bruising or on drying, moderately crowded to crowded, up to 4 mm wide, with lamellulae in 3–4 tiers; edge finely fimbriate under a lens, concolorous with the sides; stipe 25–43 x 1–3 mm, central, terete, almost equal or slightly tapering towards apex, fistulose; surface yellowish white (2A2), turning brown (7E5) to dark brown (6E8) on bruising, covered with grayish orange (5B3) to light brown (6D7), floccose scales below the annulus that are easily removed on handling; base arising from a white mycelium; annulus present as a thin fibrillose ring, superior, ascending, evanescent; context up to 2 mm thick, whitish; odour not distinctive; spore-print yellowish white (1A2).

Spores 4–5 x 2–3 (4 ± 0.31 × 2.3 ± 0.44) µm, Q = 1.3–2.25, Qm = 1.9, ellipsoid to subcylindric, hyaline, with oil guttules, smooth, thin- to slightly thick-walled, inamyloid, non-dextrinoid, non-metachromatic in cresyl blue, cyanophilic in cotton blue; basidia 12–20 × 5–7 µm, cylindrico-clavate to clavate, sometimes slightly flexuose, with minute guttulate contents and yellowish exudates, bearing 4 sterigmata up to 4 µm long; cheilocystidia abundant, 20–45 x 6–15 µm, versiform: fusiform, clavate, ventricose-rostrate, obovoid, or utriform; many with subcapitate or slightly protruding apices, hyaline to pale yellow, thin- to slightly thick-walled (up to 0.5 µm), sometimes with yellowish exudates on the surface, strongly dextrinoid; pleurocystidia 35–53 x 8–18 µm, abundant, evenly dispersed on the sides of lamellae, fusiform, broadly fusiform, ventricose-rostrate, or obclavate, hyaline to pale yellow, thin-walled, dextrinoid, with yellowish exudates on the surface; pileal covering composed of subglobose to globose cells (sphaerocysts), 17–80 µm in diameter, interspersed with 2–7 µm wide, thin- to slightly thick-walled hyphae with pale yellowish to light brown plasmatic and membrane pigments. All hyphae with clamp-connections.

Habitat: On soil and decaying leaf litter, solitary or gregarious.

Collections examined — **INDIA, Kerala State, Thiruvananthapuram District,** PALODE: 2 August 2006, Arun Kumar AK421; 3 August 2006, Arun Kumar AK421a;

4 August 2006, Arun Kumar AK435 (K(M)157121); KALLAR: 4 August 2006, Arun Kumar AK428.

Discussion: Characteristics of the examined specimens agree very well with those of *Cystolepiota fumosifolia* from the Netherlands described by Vellinga & Huijser (1998) and Vellinga (2001). The Kerala collections, however, lack the pinkish tinge on fruit bodies at maturity and on bruising. A closely related species, *C. hetieri* (Boud.) Singer, differs by the absence of yellowish contents in its cystidia. This is the first record of this species from Asia.

Cystolepiota pulverulenta (Huijsman) Vellinga, Persoonia 14: 407 (1992)

Selected description and figures: Vellinga (1992: 407–410)

Pileus 7–8 mm diam., subglobose when young, becoming broadly convex and finally applanate with an indistinct obtuse umbo; surface whitish with a pale brown tinge towards the disc, granular, downy-wooly, or floccose; margin incurved, becoming straight, appendiculate; lamellae free, white, moderately crowded, less than 2 mm wide, with lamellulae in 2–3 tiers; edge finely fimbriate under a lens, concolorous with the sides; stipe 15–32 × 1–2 mm; context less than 1 mm thick, white; odour not distinctive; spore print not obtained.

Spores 4–6 × 2–3 (4.85 ± 0.52 × 2.7 ± 0.3) µm, Q = 1.5-2, Qm = 1.66, subcylindric to cylindric, hyaline, with refractive guttules, thin-walled, smooth, vaguely dextrinoid, metachromatic in cresyl blue, cyanophilic in cotton blue; basidia 10–20 × 6–7 µm, clavate, with guttulate contents, bearing 4 sterigmata up to 3 µm long; cheilocystidia absent; pleurocystidia absent; pileal covering a trichodermium formed of irregular chains of inflated, ellipsoid, fusoid or cylindrical elements, 10–59 × 4–15 µm, arising from repent, 2–13 µm wide, thin-walled, filamentous hyphae. All hyphae lack clamp-connections.

Habitat: On soil and among decaying leaf litter, solitary or scattered in groups.

Collections examined — **INDIA, Kerala State, Malappuram District,** CALICUT UNIVERSITY CAMPUS: 9 November 2004, Arun Kumar AK182; 26 September 2006, Arun Kumar AK444; 27 September 2006, Arun Kumar AK444a; 29 September 2006, Arun Kumar AK450 (K(M)157122).

Discussion: The metachromatic reaction of the spores in cresyl blue, the shape of pileal elements, and the absence of clamp-connections suggest placement of this species in the genus *Leucoagaricus*, but Vellinga (1992) justified its position in *Cystolepiota* owing to the flocculose covering of pileus and stipe, shape and size of spores resembling those of *Cystolepiota* species, spores that are not dextrinoid, and the absence of cheilocystidia. In view of her arguments (Vellinga 1992), and on the basis of molecular evidences (Vellinga 2003, 2004), this species is currently considered under the genus *Cystolepiota*. This is the first record of this species from India.

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