

Type studies on *Chamaeota* species described from China

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Abstract—A critical restudy of the holotype of *Chamaeota dextrinoidespora*, and the holotype and paratypes of *Chamaeota sinica* showed that they belong to *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* and should be placed in the genus *Leucoagaricus*. Thus, two new combinations, *Leucoagaricus dextrinoidesporus*, and *L. sinicus*, are made. Both species are redescribed and illustrated in detail.

Key words—*Pluteaceae*, *Basidiomycota*, taxonomy

Introduction

The genus *Chamaeota* (W.G. Sm.) Earle, typified by *C. xanthogramma* (Ces.) Earle, is classified in the family *Pluteaceae* Kotl. & Pouzar because of pink and non-dextrinoid basidiospores without a germ pore, free lamellae, a convergent lamellar trama and presence of annulus (Singer 1986). Recent study showed that *C. mammillata* (Longyear) Murrill is an annulate *Pluteus* Fr., and *Chamaeota* may be rendered obsolete (Minnis et al. 2006). During a study of collections of *Agaricaceae* from China, the author found that it is necessary to restudy the types of *C. dextrinoidespora* and *C. sinica*, and the additional materials cited by the authors (Bi & Li 1988, Ying 1995) because these two species might be lepiotaceous fungi. Reexamination of the collections revealed, surprisingly, that (with one exception) they are representatives of *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae*, and should best be placed in the genus *Leucoagaricus* in accordance with the recent taxonomy of this group of fungi.

Materials and methods

The macroscopical descriptions are based on the original descriptions and notes with the material. In the original descriptions colour notations were used by Ying (1995) but not by (Bi & Li 1988). Revived tissues were mounted in 5% aqueous KOH, Melzer's reagent, 1% aqueous Congo red, 1% aqueous Cresyl Blue or cotton blue for microscopic examination. The abbreviation [*n/m/p*]

shall mean n basidiospores measured from m basidiocarps of p collections. Dimensions of basidiospores excluding the apiculus are given using notation of the form (a) b - c (d). The range b - c contains a minimum of 90% of the measured values. Extreme values a and d are given in parentheses. Q refers to the length/width ratio of basidiospores; \bar{Q} refers to the average Q of all basidiospores \pm sample standard deviation. Herbarium abbreviations follow Holmgren et al. (1990).

Taxonomy

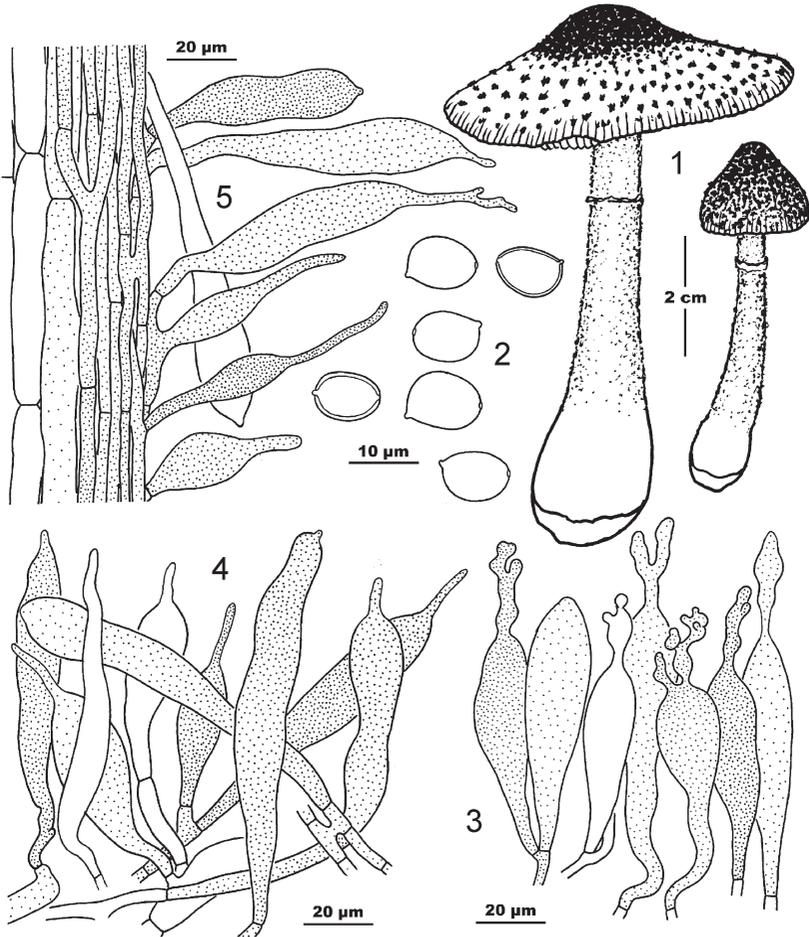
Leucoagaricus dextrinoidesporus (Z.S. Bi) Zhu L. Yang, comb. nov. Figs. 1-5

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Basionym: *Chamaeota dextrinoidespora* Z.S. Bi, Bull. Bot. Res. 8 (1): 98, figs. 1-5 (1988).

Basidiomata (fig. 1) scattered. **Pileus** 2-6 cm diam., convex, umbonate, red-brown, becoming umbrinous over disc, covered with minute, brown squamules; margin of pileus finely striate (0.1-0.2R); context concolorous with pileal surface, 2-3 mm thick. **Lamellae** free, cream when young, purple red when mature, becoming dark brown with olivaceous tinge when dried, moderately crowded. **Stipe** 5-8 \times 0.5-1.5 cm, attenuate upwards, becoming hollow when mature; surface brownish to pale red-brown, covered with squamules; base enlarged. **Annulus** superior, membranous, simple, concolorous with the pileus, persistent. Odor and taste none.

Basidiospores (fig. 2) [46/2/1] (8.0) 8.5-11.5 (12.0) \times (6.0) 6.5-8.5 μm [$Q = (1.25) 1.27$ -1.36 (1.41), $\bar{Q} = 1.32 \pm 0.03$], in side view broadly ellipsoid to ellipsoid, sometimes slightly amygdaliform, without suprahilar depression, in frontal view ellipsoid to broadly ellipsoid, hyaline, colorless or pale greenish yellow in 5% KOH, strongly dextrinoid, thick-walled (wall up to 1 μm thick), with germ pore, not or only slightly truncate, without a cap over the pore, cyanophilous, with pink inner wall and pink plug in germ pore in Cresyl Blue (metachromatic). **Basidia** 21-30 \times 9-12 μm , subclavate, hyaline, thin-walled, 4-spored, not surrounded by pseudoparaphyses; sterigmata 3-4 μm long; basal clamp connections absent. **Pleurocystidia** absent. **Cheilocystidia** (fig. 3) crowded, often forming a sterile band along the lamellar edge, clavate to fusiform (60-120 \times 13-18 μm), occasionally broadly clavate (50-70 \times 11-18 μm), often with a single or a few abrupt, apical, often branched, sinuous to moniliform, appendix up to 30 μm long and 2-8 μm in diam, thin-walled, often with a brownish to brownish yellow intracellular pigment in KOH. **Lamellar trama** difficult to rehydrate, probably trabecular, made up of filamentous hyphae 3-12 μm in diam. **Squamules on pileus** (fig. 4) a disrupted trichodermium composed of loose fascicles of more or less erect, narrowly clavate to subfusiform, sometimes lanceolate, 60-140 \times (8) 13-20 μm , slightly thick-walled (wall up to 0.5 μm thick) terminal elements often with yellowish



Figs. 1-5: *Leucoagaricus dextrinoidesporus* (holotype). 1. Basidiomata (based on dry material); 2. Basidiospores; 3. Cheilocystidia; 4. Squamules on pileus; 5. Caulocystidia and surface of stipe.

to brownish intracellular pigment in KOH, sometimes subhyaline and nearly colorless; terminal elements often with abrupt subcylindrical apical appendix up to 10 (30) µm long and 2-5 µm in diam. **Caulocystidia** (fig. 5) densely covering the surface of the stipe except the apical part, clavate to fusiform (55-140 × 10-20 µm), often with yellowish to brownish, intracellular pigment, slightly thick-walled (wall ≤ 0.5 µm thick), often with abrupt subcylindrical apical appendix up to 20 (45) µm long. **Clamp connections** not observed.

Habit, habitat, distribution and season—Scattered, on soil among grass; so far only known from the type locality in Guangdong Province of China; August.

COLLECTION EXAMINED—China, GUANGDONG PROVINCE, Shixing (“Shizing”) County, Zhangdong, 20.VIII.1985, Z.S. Bi & Y.F. Liu *s.n.* (GDGM 9701, holotype).

Comments—In the above description the color and size of the basidiomata are mainly based on the data of Bi & Li (1988) and notes with the holotype. Other data are from personal observations on the dried holotype material. Bi & Li (1988) stated that the basidiospores of the present species were pale purple-red and without a germ pore, and clamp connections were present. This does not seem to be the case. The color changes of the basidioma on bruising or cutting and the reaction of the lamellae and the context to ammonia vapor are unknown, and need to be studied in the future when fresh material becomes available.

Due to the trichodermial elements in the squamules on the pileus and the hyaline, colorless, dextrinoid and metachromatic basidiospores with a germ pore, this taxon is not a species of *Chamaeota* but belongs to the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* (fide Vellinga 2004). It should be placed in *Leucoagaricus* Singer (fide Vellinga 2000, 2001, 2004, Vellinga & Davis 2007), and is very close to *L. americanus* (Peck) Vellinga (= *L. bresadolae* (Schulzer) Bon), *L. holospilotus* (Berk. & Broome) Bon and *L. meleagris* (Sowerby) Singer. However, *L. americanus* usually has larger basidiomata with all parts becoming yellow or saffron and finally red-brown on bruising, and slender, tapering elements in the squamules on the pileus [Smith & Weber 1987 under *Lepiota americana* (Peck) Sacc., Reid 1999, Vellinga 2000, 2001]. *Leucoagaricus holospilotus*, originally described from Sri Lanka, differs from *L. dextrinoidesporus* by its somewhat smaller basidiospores, shorter appendix of cheilocystidia and smaller terminal elements in the squamules on the pileus (Reid 1990 under *Leucocoprinus holospilotus* (Berk. & Broome) D.A. Reid, Pegler 1972, 1986 under *Lepiota holospilota* (Berk. & Broome) Sacc.). *Leucoagaricus meleagris* has a pileus with dark brown to blackish squamules, a context becoming yellow and then red on exposure, cheilocystidia with shorter apical appendix, and clavate fusoid to lanceolate elements in the squamules on the pileus often without an abrupt subcylindrical apical appendix (Reid 1990, Vellinga 2000, 2001). According to Vellinga (2000), the North American species *Lepiota sanguiflua* Murrill is very close to *L. meleagris* and may well be identical. *Leucoagaricus caldariorum* (D.A. Reid) Bon (= *Leucocoprinus caldariorum* D.A. Reid) (nom. inval., Art. 37.5, herbarium mentioned neither by Reid 1990 nor by Bon 1993) originally described from the UK, is also somewhat similar to *L. dextrinoidesporus* but has a stipe becoming red when scratched, a hymeniform lower layer in the squamules on the pileus (Reid 1990).

Bi & Li (1988) stated that the present species is similar to *Chamaeota tropica* Pegler, but differs from the latter by the color of the pileus and the dextrinoid spores. However, *C. tropica* has a much smaller, buff-yellow pileus with a narrowly plicate striate margin, whitish lamellae with a faint pink tinge, a white stipe, smaller subglobose to lacrymoid basidiospores without a germ pore, and pyriform cheilocystidia. Moreover, the pileipellis is an epithelium of isodiametric elements 8-15 μm in diam. (Pegler 1983).

Bi & Li (1988) cited another collection, GDGM 9175, besides the holotype under the name of *Chamaeota dextrinoidespora*. Reexamination revealed that it is *Chlorophyllum hortense* (Murrill) Vellinga (Ge & Yang 2006).

Leucoagaricus sinicus (J.Z. Ying) Zhu L. Yang, **comb. nov.**

Figs. 6-10

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Basionym: *Chamaeota sinica* J.Z. Ying, Mycotaxon 54: 303, figs.1-8, 1995.

Basidiomata (fig. 6) caespitose to gregarious. **Pileus** 2.5-6 cm diam., convex, distinctly umbonate, vinaceous-cinnamon, darker over disc, densely covered with minute, dark brown squamules; margin finely striate (0.1-0.3R) or barely striate; context flesh-colored, vinaceous buff on drying. **Lamellae** free, pinkish, becoming dirty white to brownish when dried, moderately crowded to crowded; lamellulae in 2-3 tiers. **Stipe** 4-9 \times 0.3-0.6 cm, subcylindrical or slightly attenuate upwards, hollow; surface concolorous with the pileus, covered with squamules; basal mycelium white to dirty white when dried. **Annulus** superior, membranous, often persistent.

Basidiospores (fig. 7) [60/3/3] 9.0-11.5 (13.0) \times 6.5-8.0 (8.5) μm [Q = (1.27) 1.35-1.57 (1.71), Q = 1.45 \pm 0.08], in side view ellipsoid, occasionally slightly amygdaliform, without suprahilar depression, in frontal view ellipsoid to subovoid, hyaline, colorless or pale greenish yellow in 5% KOH, rarely with yellow-brown pigment, thick-walled (wall up to 1 μm thick), with germ pore, not or only slightly truncate, without a cap over the pore, strongly dextrinoid, cyanophilous, with pink inner wall and pink plug in germ pore in Cresyl Blue (metachromatic). **Basidia** 23-35 \times 9-11 μm , subclavate, hyaline, thin-walled, 4-spored, rarely intermixed with 2- or 3-spored basidia, not surrounded by pseudoparaphyses; sterigmata 3-4 μm long; basal clamp connections absent. **Pleurocystidia** absent. **Cheilocystidia** (fig. 8) scattered to crowded, often in fascicles, irregularly cylindrical and sinuous [50-120 (150) \times 3-10 (13) μm], occasionally clavate (40-60 \times 10-13 μm), sometimes with apical part slightly enlarged and irregularly branched, colorless, hyaline or with yellow-brown to ochreous intracellular pigment in KOH, thin-walled, occasionally slightly thick-walled (wall \leq 0.5 μm thick). **Lamellar trama** difficult to rehydrate, probably trabecular, made up of filamentous hyphae 3-10 μm in diam.,

branching, interwoven, sometimes anastomosing. **Squamules on pileus** (fig. 9) a disrupted trichodermium composed of loose fascicles of long, more or less erect, subcylindrical, occasionally narrowly fusiform or lanceolate elements, $70\text{--}170 \times 7\text{--}10$ (14) μm , thin to slightly thick-walled (wall $<0.5\mu\text{m}$ thick), often with a dark brown to dark yellowish brown intracellular pigment. **Caulocystidia** (fig. 10) densely covering the whole surface of the stipe except the apical part, subcylindrical to lanceolate [$50\text{--}150$ (200) \times $5\text{--}16$ (20) μm], sometimes broadly clavate ($30\text{--}70 \times 10\text{--}15$ μm), colorless, hyaline or with a yellow-brown, intracellular pigment, thin- to slightly thick-walled (wall $\leq 0.5\mu\text{m}$ thick). **Clamp connections** not observed.

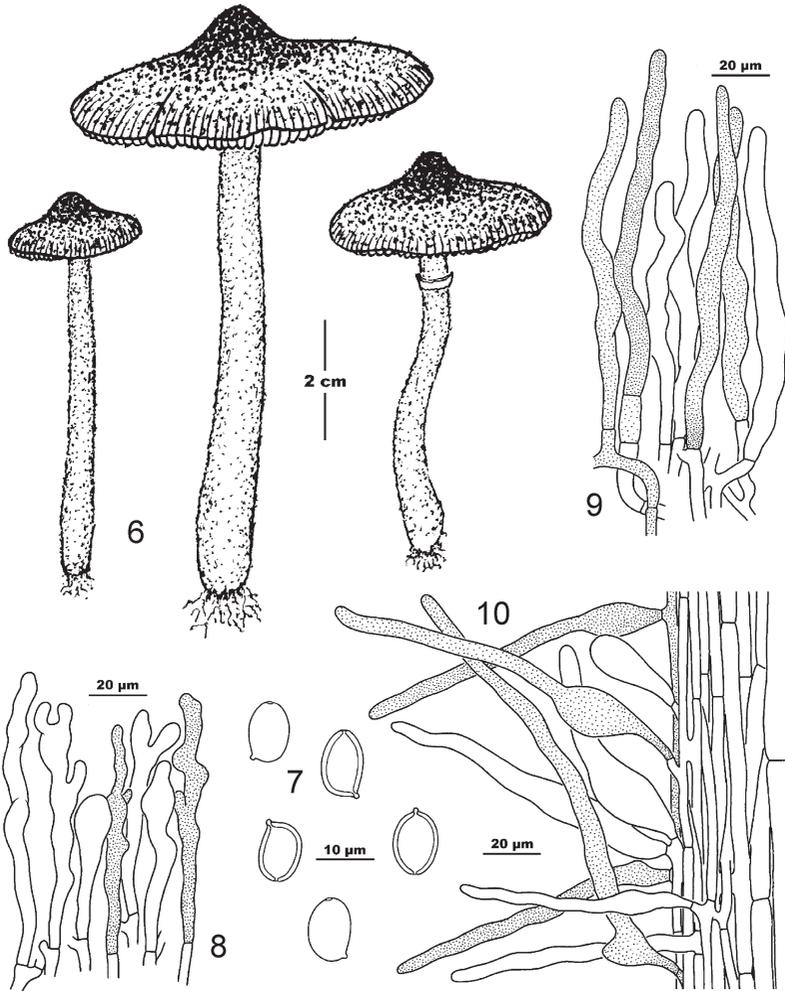
Habit, habitat, distribution and season — Caespitose to gregarious, on soil under bushes of *Rhododendron*; so far only known from the type locality in Zhejiang Province of China; May.

COLLECTIONS EXAMINED—China, ZHEJIANG PROVINCE, HANGZHOU CITY, Jiulison (30°.16' N, 120°.10' E), 14.V.1990, J.F. Wen 904 (HMAS 59909, paratype); the same location, 15.V.1990, J.F. Wen 905 (HMAS 60647, holotype); the same location, 16.V.1990, J.F. Wen 906 (HMAS 62975, paratype).

Comments—In the above description the color and size of the basidiomata are mainly based on the data of Ying (1995) and notes with the materials. Other data are from personal observations on the dried material cited above. In the protologue, the spore mass, and mycelium at the base of the stipe were described as between Buff-Pink and Japan Rose, and Pale Vinaceous respectively (Ying 1995), which, together with the color changes on bruising or cutting and the reaction of the lamellae and the context to ammonia vapor, need to be studied in the future when fresh material becomes available. Ying (1995) described that the basidia were 2-spored, rarely 4-spored, and cheilocystidia were composed of long, septate cells. The present observations on the specimens cited above differ from those in Ying's report.

Due to the trichodermial elements composing the squamules on the pileus and the hyaline, colorless, dextrinoid and metachromatic basidiospores with a germ pore, this species is not a member of *Chamaeota* but belongs to the *Leucoagaricus/Leucocoprinus* clade in the *Agaricaceae* (fide Vellinga 2004). It should be placed in *Leucoagaricus* (fide Vellinga 2000, 2001, 2004, Vellinga & Davis 2007). This species is well characterized by its subcylindrical stipe, irregularly cylindrical to sinuous cheilocystidia with apical part slightly enlarged and irregularly branched, and subcylindrical to narrowly fusiform trichodermial elements in the squamules on the pileus.

Leucoagaricus sinicus is similar to *L. americanus*, and *L. meleagris*. However, *L. sinicus* differs from the latter two by its subcylindrical stipe, the more or less irregularly cylindrical cheilocystidia often with apical branches, and the



Figs. 6-10: *Leucoagaricus sinicus* (holotype). 6. Basidiomata (based on dry material); 7. Basidiospores; 8. Cheilocystidia; 9. Squamules on pileus; 10. Caulocystidia and surface of stipe.

subcylindrical to narrowly fusiform or lanceolate elements without a tapering apex in the squamules on the pileus. Moreover, *L. americanus* usually has larger basidiomata and *L. meleagris* has fibrillose squamules on the pileus and an inconspicuous germ pore on the spore wall (Vellinga 2001). According to Ying (1995), the pileus context of *L. sinicus* is flesh-colored, while that of *L. americanus* and *L. meleagris* is usually white to whitish but changes to yellow, and

then reddish to red after cutting (Vellinga 2000, 2001). Molecular phylogenetic analysis based on ITS and nLSU-rDNA nucleotide sequences of the holotype of *L. sinicus* and other members of the *Leucoagaricus/ Leucocoprinus* clade also showed that *L. sinicus* clustered with the *L. americanus* group, but differs from *L. americanus* and *L. meleagris* (unpublished data of Z.W. Ge).

Leucoagaricus sinicus is also somewhat similar to *L. holospilotus* and *L. caldariorum*. However, *L. holospilotus* has smaller basidiospores, clavate to lanceolate cheilocystidia often with an appendix and much wider trichodermial elements in the squamules on the pileus. *Leucoagaricus caldariorum* has broadly amygdaliform, somewhat smaller basidiospores, ovate, clavate to lanceolate cheilocystidia often with a short apical appendix and much wider clavate to lanceolate elements in the squamules on the pileus with a hymeniform lower layer (Reid 1990).

With regard to the more or less cylindrical stipe and elements in the squamules on the pileus, *L. sinicus* is similar to *Leucocoprinus lacrymans* T.K.A. Kumar & Manim. However, the latter differs from *L. sinicus* by its white to whitish pileus and stipe beaded with golden yellow to reddish brown watery exudates, the white to pale orange context, and the somewhat narrower cheilocystidia and caulocystidia (Kumar & Manimohan 2004).

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