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Notes on *Ceriporia* (*Basidiomycota*, *Polyporales*) in China

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Abstract — The 16 species recorded from China in the genus *Ceriporia* were studied. Among them *Ceriporia nanlingensis* is new to science, and *C. davidii*, *C. mellea* and *C. totara* are new to the Chinese fungal flora. These four species are described and illustrated from the Chinese materials, and a key to accepted species of Chinese *Ceriporia* is supplied.

Key words — lignicolous, poroid, fungi, *Phanerochaetaceae*, taxonomy

Introduction

Ceriporia Donk is a polypore genus, characterized by its annual growth habit, resupinate basidiocarps with variable colors of poroid surface, a monomitic hyphal system with simple septa on generative hyphae (clamps present in some species only), hyaline, thin-walled and usually cylindrical to oblong-ellipsoid basidiospores, and causing a white rot (Gilbertson & Ryvarden 1986; Núñez & Ryvarden 2001; Pieri & Rivoire 1997; Ryvarden & Gilbertson 1993). *Ceriporia* species have a wide distribution, and 32 species have been accepted worldwide.

During the last 10 years, Chinese polypores have been examined, with 12 *Ceriporia* species recorded from different provinces of China (Cui et al. 2008; Dai et al. 2002, 2003, 2004, 2007a, b, 2009; Dai & Penttilä 2006; Li et al. 2007, 2008; Wang et al. 2009; Yuan & Dai 2006; Yuan et al. 2008). However, many unidentified specimens were kept in our herbarium, after checking most of the type materials of the genus, one species new to science and three species new to Chinese mycota were found. In this paper we make illustrated descriptions for them. In addition, we provide an identification key to the *Ceriporia* species thus far collected in China.

Materials & methods

The studied specimens were deposited in herbaria as cited below. The microscopic procedure follows Dai (2010). In presenting the variation in the size of the spores, we

exclude 5% of measurements (given in parentheses) from each end of the range. The following abbreviations are used: IKI = Melzer's reagent, IKI– = negative in Melzer's reagent, KOH = 5% potassium hydroxide, CB = Cotton Blue, CB+ = cyanophilous, CB– = acyanophilous, L = mean spore length (arithmetic average of all spores), W = mean spore width (arithmetic average of all spores), Q = variation in the L/W ratios between the specimens studied, n = number of spores measured from given number of specimens. Sections were studied at magnifications up to ×1000 using a Nikon Eclipse E 80i microscope and phase contrast illumination. Drawings were made with the aid of a drawing tube. Special colour terms follow Anonymous (1969) and Petersen (1996).

Taxonomy

Ceriporia nanlingensis B.K. Cui & B.S. Jia, **sp. nov.** Fig. 1

MycoBank MB 561157

Carpophorum annuum, resupinatum; facies pororum nivea, lilacina vel lavendula, pori rotundi vel irregulati, 3–5 per mm. Systema hypharum monomiticum, hyphae generatoriae septatae, efibulatae; hyphae subiculi 3–7.3 µm. Cystidiae hyalinae, tenuitunicatae, clavatae, 25–36 × 3–6 µm. Sporae hyalinae, oblonge-ellipsoideae, IKI–, CB–, 3.6–4 × 1.7–2 µm.

Type. — China. Hunan Province, Yizhang County, Mangshan Nature Reserve, on fallen angiosperm twig, 26.VI.2007, Dai 8173 (**holotype** in BJFC).

Etymology — *nanlingensis* (Lat.): refers to the mountain name of Nanling.

Fruitbody — Basidiocarps annual, resupinate, soft corky when fresh, corky to fragile when dry, up to 9.5 cm long, 2.4 cm wide, and 0.4 mm thick at the center. Pore surface white, lilac to lavender when fresh, flesh-pink, clay-pink, pinkish buff, clay-buff, vinaceous to brownish vinaceous when dry; pores round to irregular, 3–5 per mm; dissepiments thin to thick, entire. Margin distinct, thinning out, up to 5 mm wide, cream to buff, cottony. Subiculum cream to olivaceous buff, soft corky when dry, up to 0.3 mm thick. Tubes concolorous with pore surface, fragile when dry, up to 0.1 mm long.

Hyphal structure — Hyphal system monomitic; generative hyphae with simple septa, IKI–, CB+; tissues unchanged in KOH.

Subiculum — Generative hyphae hyaline, thin- to slightly thick-walled, frequently branched, often at right angles, interwoven, covered by hyaline to pale yellowish crystals, 3–7.3 µm in diam.

Tubes — Generative hyphae hyaline, thin- to slightly thick-walled, frequently branched, interwoven, usually covered by hyaline to pale yellowish crystals, 2–6.2 µm in diam; cystidia present, hyaline, clavate, 25–36 × 3–6 µm; basidia clavate with four sterigmata and a simple basal septum, 11–21 × 3.4–4.5 µm; basidioles in shape similar to basidia, but smaller.

Spores — Basidiospores oblong-ellipsoid, hyaline, thin-walled, smooth, mostly bearing one or two guttules, IKI–, CB–, (3.4–)3.7–4.6(–4.7) × (1.6–) 1.7–2 µm, L = 4.08 µm, W = 1.85 µm, Q = 2.18– 2.24 (n = 60/2).

Type of rot — White rot.

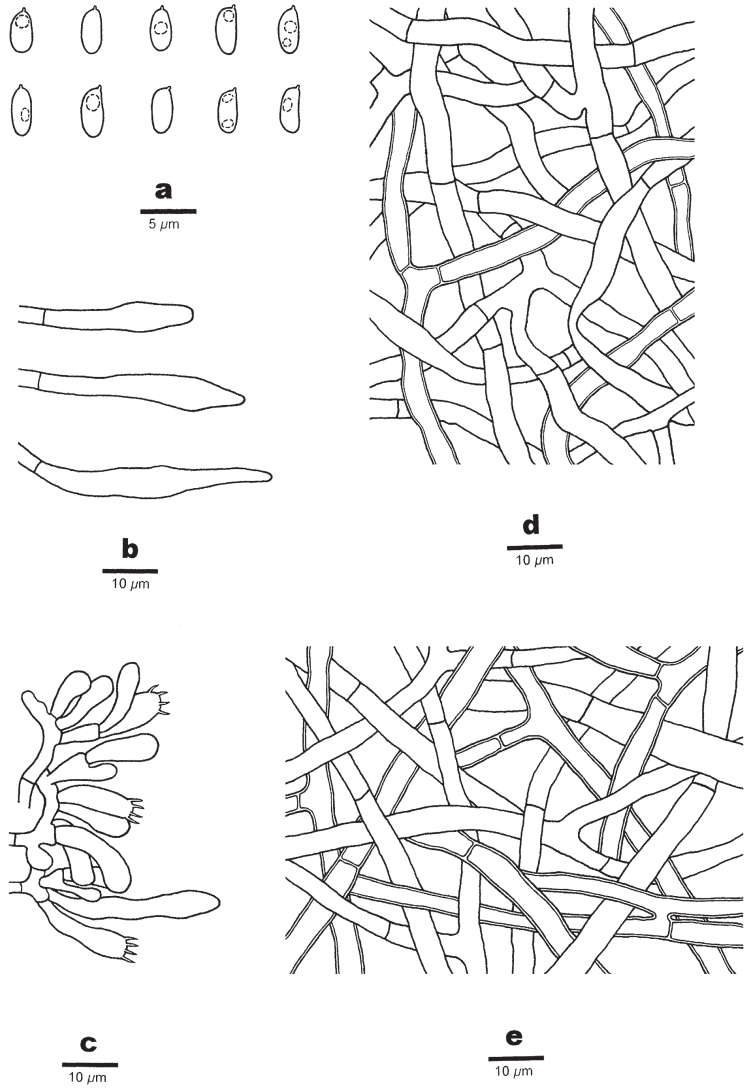

Fig. 1. Microscopic structures of *Ceriporia nanlingensis* (drawn from the holotype).
a: Basidiospores. b: Cystidia. c: A section of hymenium.
d: Hyphae from tube trama. e: Hyphae from subiculum.

Additional specimens examined — **China. Hunan Province**, Yizhang County, Mangshan Nature Reserve, on fallen angiosperm trunk, 23.VI.2007 Dai 8107 (BJFC); on rotten angiosperm wood, 24.VI.2007 Li 1670 (BJFC); on dead angiosperm tree,

24.VI.2007 Li 1673 (BJFC). **Hubei Province**, Tongshan County, Jiugongshan Nat. Res., on fallen angiosperm twig, 6.IX.2006 Li 1568 (BJFC).

Remarks — *Ceriporia nanlingensis* is characterized by its white to lilac colored pore surface, oblong-ellipsoid basidiospores, and presence of cystidia.

In the forest, *C. nanlingensis* resembles *C. viridans* (Berk. & Broome) Donk, which has allantoid spores and lacks cystidia. Dried specimens of *C. nanlingensis* are similar to those of *C. aurantiocarnescens* (Henn.) M. Pieri & B. Rivoire, which, however, has smaller pores (5–7 per mm), parallel tramal hyphae, allantoid basidiospores, and lacks cystidia (Pieri & Rivoire 1997). *Ceriporia crassitunicata* Y.C. Dai & Sheng H. Wu and *C. nanlingensis* share the same kind of spores, but *C. crassitunicata* has a cream pore surface, distinct thick-walled tramal hyphae, and lacks cystidia (Dai et al. 2002). *Ceriporia nanlingensis* and *C. cystidiata* Ryvarden & Iturr. have similar cystidia, but *C. cystidiata* has allantoid and longer spores, (3.6–)3.7–4.6(–4.8) × (1.4–)1.5–1.8(–1.9) μm , L = 4.1 μm, W =1.66 μm, Q = 2.47 (measured from type material).

Ceriporia davidii (D.A. Reid) M. Pieri & B. Rivoire, Bulletin de la Société Mycologique de France, 113: 212, 1997 Fig. 2
≡ *Riopa davidii* D.A. Reid, Revue de Mycologie. 33: 247, 1969

Fruitbody — Basidiocarps annual, resupinate, fragile when dry, up to 4 cm long, 2 cm wide, and 6 mm thick at the center. Pore surface cream when fresh, grayish cream, clay-buff to orange-brown when dry; pores angular to irregular, 3–5 per mm; dissepiments thin, lacerate. Margin very thin, narrow, usually pores extend to the very edge, cream, arachnoid. Subiculum cream to buff, soft corky, up to 4 mm thick. Tubes concolorous with pore surface, fragile when dry, up to 2 mm long.

Hyphal structure — Hyphal system monomitic; generative hyphae with simple septa, IKI–, CB+; tissues unchanged in KOH.

Subiculum — Generative hyphae hyaline, thin- to slightly thick-walled, frequently branched, often at right angles, usually restricted at septa, interwoven, covered by abundant hyaline to pale yellowish, tiny crystals, 4–7.5 μm in diam.

Tubes — Generative hyphae hyaline, thin-walled, rarely branched, subparallel along he tubes, coarsely encrusted with pale yellowish crystals, 2.5–4.5 μm in diam; cystidia absent; basidia clavate to barrel-shaped with four sterigmata and a simple basal septum, 12.8–18 × 4.8–5.9 μm; basidioles in shape similar to basidia, but smaller.

Spores — Basidiospores oblong-ellipsoid, slightly curved, hyaline, thin-walled, smooth, IKI–, CB–, (4–)4.3–5.2(–5.7) × 2–2.4(–2.6) μm, L = 4.84 μm, W = 2.15 μm, Q = 2.25 (n = 30/1).

Type of rot — White rot.

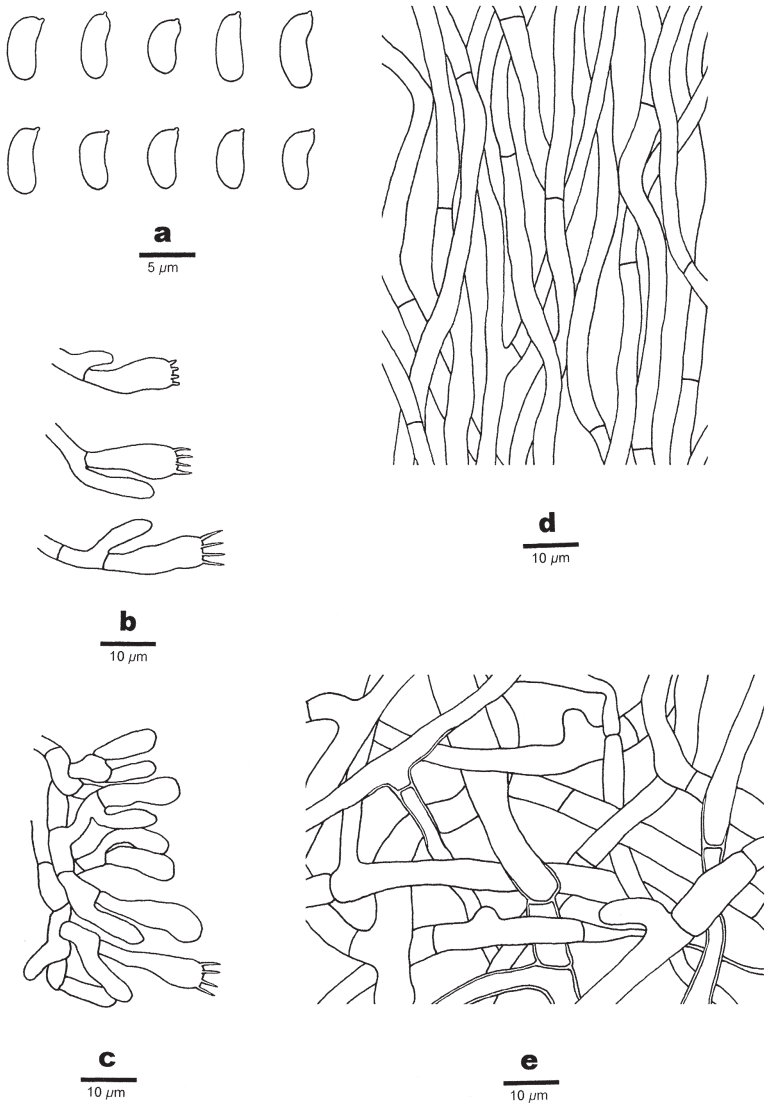

Fig. 2. Microscopic structures of *Ceriporia davidii* (drawn from Yuan 655).
a: Basidiospores. b: Basidia and basidioles. c: A section of hymenium.
d: Hyphae from tube trama. e: Hyphae from subiculum.

Specimens examined — **CHINA**. **Heilongjiang Province**, Ning'an County, Underground Forest Park, on fallen trunk of *Pinus*, 14.IX.2004 Yuan 655 (BJFC). **Hubei Province**, Fang County, Shennongjia Nature Reserve, on rotten angiosperm wood, 2.VIII.2006 Li 1387 (BJFC).

Remarks — Although Pieri & Rivoire (1997) mentioned that in the European material of *Ceriporia davidii* the tramal hyphae were frequently branched, they are rarely branched in our studied specimens. Because the Chinese specimens fit all other characters of the species, we treat our specimens as *C. davidii*.

Ceriporia davidii is similar to *C. alba* M. Pieri & B. Rivoire, which differs in basidiospores that are allantoid and longer [(5.1–)5.2–6.3 × 2–2.8 μm, L = 5.84, W = 2.35, Q = 2.49; measured from the type specimen]. *Ceriporia camaresiana* (Bourdot & Galzin) Bondartsev & Singer and *C. davidii* have similarly shaped basidiospores, but spores are larger in the former species, (5–)5.5–6(–7) × 2.3–2.8(–3) μm (Pieri & Rivoire 1997). In addition, pores are also larger (1–3 per mm) in *C. camaresiana* (Bondartsev & Singer 1941). *Ceriporia otakou* (G. Cunn.) P.K. Buchanan & Ryvarden, which also resembles *C. davidii*, produces spores that obviously taper and interwoven tramal hyphae (from the type specimen) (Buchanan & Ryvarden 1988).

Ceriporia mellea (Berk. & Broome) Ryvarden, Bulletin du Jardin Botanique National de Belgique 48: 98, 1978 Fig. 3

≡ *Polyporus melleus* Berk. & Broome, Journal of the Linnean Society, Botany 14: 53, 1873

Fruitbody — Basidiocarps annual, resupinate, fragile when dry, up to 16 cm long, 5 cm wide, and 0.5 mm thick at center. Pore surface white to cream, buff, straw-yellow or honey-yellow when fresh, buff to lemon-yellow, cinnamon-buff or pinkish buff when dry; pores angular to irregular, 1–2(–3) per mm; dissepiments thin, lacerate. Margin very thin, narrow to almost absent, cream, arachnoid. Subiculum cream to buff-yellow, fragile when dry, up to 0.1 mm thick. Tubes concolorous with pore surface, fragile when dry, up to 0.4 mm long.

Hyphal structure — Hyphal system monomitic; generative hyphae usually with simple septa, but clamp connections occasionally present on subicular hyphae; hyphae IKI–, CB+, become slightly swollen in KOH.

Subiculum — Generative hyphae hyaline, thin- to thick-walled, moderately branched, interwoven, covered by pale-yellow, rhombic to polygonal crystals, 3.6–7 μm in diam.

Tubes — Generative hyphae hyaline, thin- to slightly thick-walled, frequently branched, interwoven, covered by abundant hyaline to pale yellowish and tiny crystals, 3–4.5 μm in diam; cystidia present at the bottom of tubes, clavate, hyaline, thin-walled, 49.2–70 × 4–7 μm; basidia clavate with four sterigmata and a simple basal septum, 16.6–30 × 4–7 μm; basidioles in shape similar to basidia, but obviously smaller.

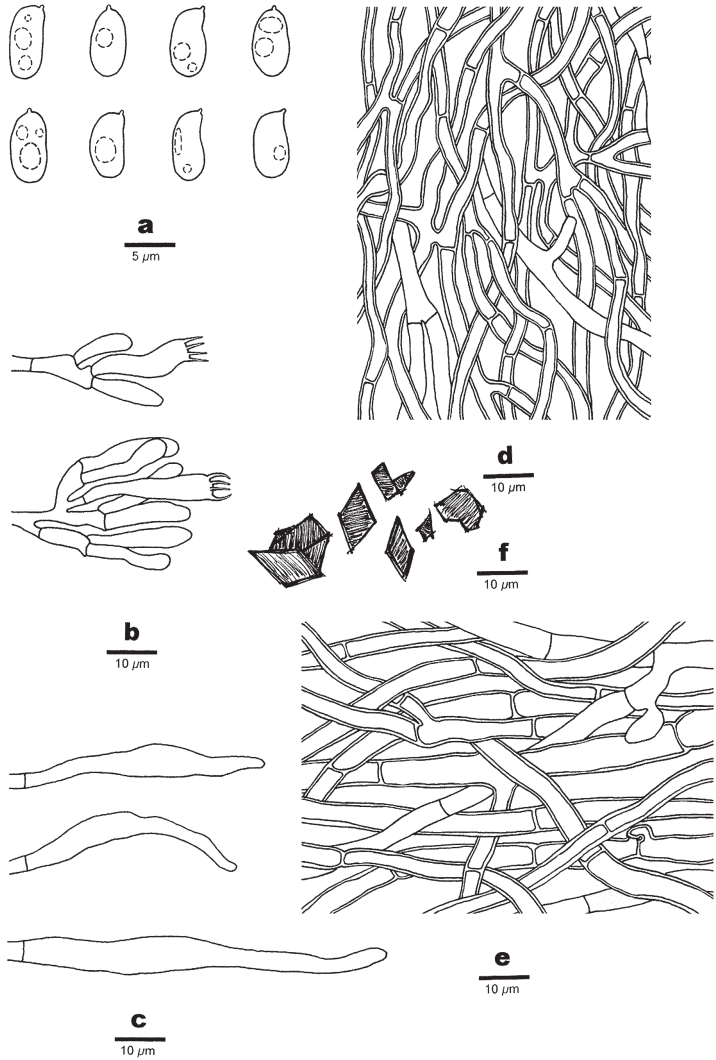

Fig. 3. Microscopic structures of *Ceriporia mellea* (drawn from Dai 9453).
a: Basidiospores. b: A section of hymenium. c: Cystidia. d: Hyphae from tube trama.
e: Hyphae from subiculum. f: Crystals.

Spores — Basidiospores cylindrical to oblong-ellipsoid, hyaline, thin-walled, smooth, some bearing one to three guttules, IKI–, CB–, 6–7.5(–8) × 2.9–3.5(–3.7) μm, L = 6.76 μm, W = 3.11 μm, Q = 2.16–2.19 (n = 60/2).

Type of rot — White rot.

Specimens examined — **China. Hainan Province**, Haikou, on fallen angiosperm trunk, 23.V.2008 Dai 9453 (BJFC); Wuzhishan County, Wuzhishan Nature Reserve, on rotten angiosperm wood, 26.V.2008 Dai 9667 (BJFC). **Yunnan Province**, Menglun County, Xishuangbanna Nature Reserve, on rotten angiosperm wood, 5.VIII.2005 Dai 6768 (BJFC).

Remarks — *Ceriporia mellea* is characterized by its frequently branched tramal hyphae, presence of cystidia, and large basidiospores. Cystidia, which Ryvarden (1978) did not report for the type material, are rare and found at the bottom of tubes only.

Ceriporia mellea is similar to *C. reticulata* (Hoffm.) Domański which, however, has longer basidiospores [(6–)7–10 × 2.5–3.5(–4) μm] and lacks cystidia (Pieri & Rivoire 1997).

Ceriporia totara (G. Cunn.) P.K. Buchanan & Ryvarden, Mycotaxon 31: 33, 1988 Fig. 4

≡ *Poria totara* G. Cunn., Bulletin of the New Zealand Department of Industrial Research 164: 261, 1965

Fruitbody — Basidiocarps annual, resupinate, soft and fragile when dry, up to 20 cm long, 8 cm wide, and 1 mm thick at center. Pore surface cream, buff to cinnamon-buff, vinaceous when fresh, cinnamon to clay-buff when dry; pores highly variable in appearance, angular to labyrinthine, irregular, 3–5 per mm; dissepiments thin, slightly lacerate to dentate. Margin thin, narrow to almost lacking, cream, cottony. Subiculum cream, corky, up to 0.2 mm thick. Tubes concolorous with pore surface, soft and fragile when dry, up to 0.8 mm long.

Hyphal structure — Hyphal system dimitic; generative hyphae with simple septa; all hyphae IKI–, CB+; tissues unchanged in KOH.

Subiculum — Generative hyphae hyaline, thin- to thick-walled, frequently branched, often at right angles, 3–4.2 μm in diam; skeletal hyphae subsolid, interwoven, covered by abundant hyaline to pale yellowish, tiny crystals, 3.8–5 μm in diam.

Tubes — Generative hyphae hyaline, thin- to thick-walled, frequently branched, 2.4–3.5 μm in diam; skeletal hyphae subsolid, interwoven, covered by abundant hyaline to pale yellowish and tiny crystals, 3–4 μm in diam; cystidia present in the hymenium, clavate, hyaline, thin-walled, 18–47 × 3.8–5 μm; subhymenium cell inflated; basidia barrel-shaped with four sterigmata and a simple basal septum, 8–13 × 4–5 μm; basidioles in shape similar to basidia, but smaller.

Spores — Basidiospores oval to subglobose, hyaline, thin-walled, smooth, some bearing a distinct guttule, IKI–, CB–, (2.4–)2.6–3 × 2–2.2(–2.3) μm, L = 2.86 μm, W = 2.08 μm, Q = 1.38 (n = 30/1).

Type of rot — White rot.

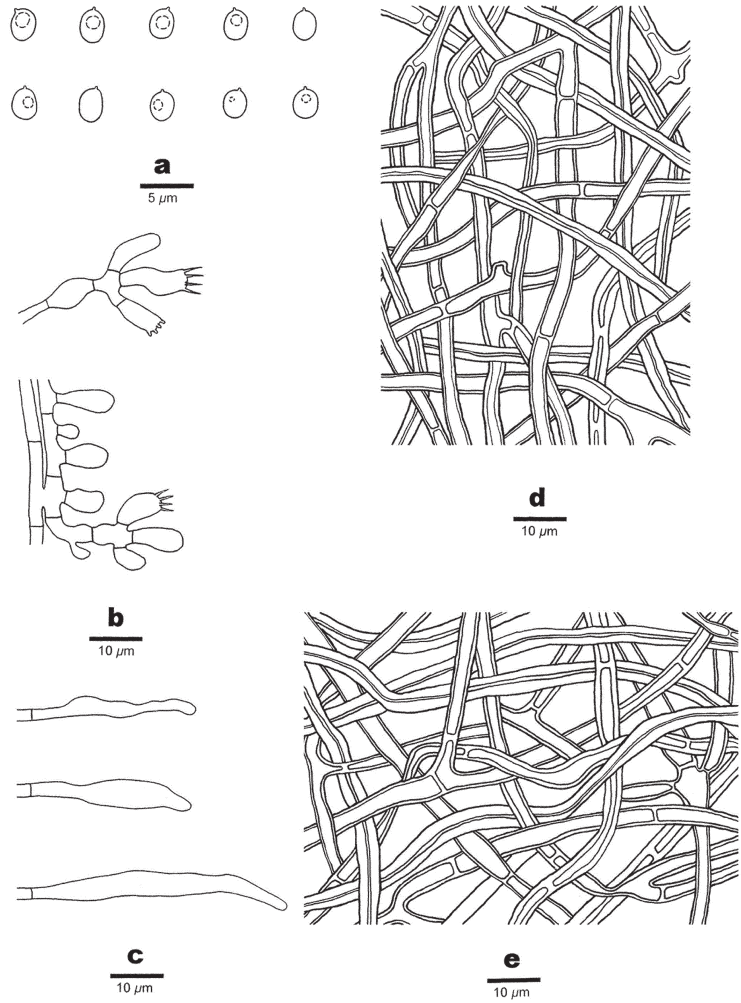

Fig. 4. Microscopic structures of *Ceriporia totara* (drawn from Cui 6577).
a: Basidiospores. b: A section of hymenium. c: Cystidia.
d: Hyphae from tube trama. e: Hyphae from subiculum.

Specimens examined — **CHINA**. **Hainan Province**, Changjiang County, Bawangling Nature Reserve, on rotten angiosperm wood, 8.V.2009 Dai 10755 (BJFC); Ledong County, Jianfengling Nature Reserve, on rotten angiosperm wood, 11.V.2009 Cui 6577 & 6579 (BJFC); Lingshui County, Diaoluoshan Nature Reserve, on rotten angiosperm wood, 24.XI.2002 Dai 4510 (BJFC).

Remarks — *Ceriporia totara* is characterized by its dimitic hyphal system, variable colors of pores, highly variable pore shapes, presence of cystidia, and small, oval to globose basidiospores.

Ceriporia sulphuricolor Bernicchia & Niemelä and *C. mellea,* which also have cystidia, have a distinctly monomitic hyphal system (Bernicchia & Niemelä 1998; Pieri & Rivoire 1997).

Ceriporia totara is a very distinct species in the genus because of its dimitic hyphal system. Buchanan & Ryvarden (1988), who discussed the taxonomy of the species, retained it in *Ceriporia*. The molecular study should be carried out in the future to investigate its phylogeny.

Other specimens examined — ***Ceriporia alba***. **FRANCE. Jura**, Vernai, Forêt de la Joux, in arboretis, ad lignum angiospermarum, 26.V.1995 Rivoire 1078 (LY, France).

Ceriporia cystidiata. **VENEZUELA**. **Bolívar State**, Municipio Sifontes, Tumeremo, carretera Tumeremo-Bochinche, 17.XI.1994 Ryvarden 35169 (holotype, VEN; isotype, O).

Ceriporia otakou. **NEW ZEALAND. Otago**, Kinloch, head of Lake Wakatipu, on bark of fallen branch of *Nothofagus fusca*, I.1942 (Holotype, PDD 4182).

Key to species of *Ceriporia* in China

1. Hyphal system dimitic ..... ***C. totara***
1. Hyphal system monomitic 2
2. Cystidia present 3
2. Cystidia absent 5
3. Pores 1–2 per mm; cystidia occasionally present at bottom of tubes, spores >2 μm wide ..... ***C. mellea***
3. Pores 3–5 per mm; cystidia frequently present at all hymenia, spores <2 μm wide 4
4. Pores pinkish buff when dry; spores oblong-ellipsoid, <5 μm long ... ***C. nanlingensis***
4. Pores dark brown when dry; spores allantoid, >5 μm long ***C. purpurea*** (Fr.) Donk
5. Spores >8 μm long ..... ***C. reticulata***
5. Spores <8 μm long 6
6. Spores >2.5 μm wide 7
6. Spores <2.5 μm wide 8
7. Spores ellipsoid to broadly ellipsoid, tramal hyphae parallel ..... ***C. lacerata*** N. Maek. et al.
7. Spores cylindrical to allantoid, tramal hyphae interwoven ..... ***C. camaresiana***
8. Spores allantoid 9
8. Spores ellipsoid to cylindrical, or cylindrical, a little curved 11
9. Spores narrowly allantoid, not tapering ..... ***C. spissa*** (Schwein. ex Fr.) Rajchenb.
9. Spores allantoid, tapering towards apiculus 10
10. Pores cream, cinnamon, orange, green, 3–6 per mm; spores mostly >4 μm long ..... ***C. viridans***

10. Pores salmon, clay-pink to brownish vinaceous, 5–8 per mm; spores mostly <4 μm long ..... ***C. aurantiocarnescens***
11. Spores cylindrical, a little curved, mostly >4 μm long.....12
11. Spores ellipsoid to cylindrical, mostly not curved, mostly <4 μm long.....13
12. Pores rose-pink when fresh; tramal hyphae fairly thick-walled, frequently branched ..... ***C. tarda*** (Berk.) Ginns
12. Pores cream when fresh; tramal hyphae thin-walled, rarely branched .... ***C. davidii***
13. Pores sulphur; spores ellipsoid ..... ***C. sulphuricolor***
13. Pores cream, orange or purple; spores cylindrical to oblong-ellipsoid 14
14. Pores orange or purple when fresh; 2–3 per mm; subicular hyphae mostly >6 μm in diam ..... ***C. excelsa*** S. Lundell ex Parmasto
14. Pores cream when fresh; 3–6 per mm; subicular hyphae <6 μm in diam.....15
15. Pores 3–4 per mm; tramal hyphae distinctly thick-walled, interwoven ..... ***C. crassitunicata***
15. Pores 4–6 per mm; tramal hyphae thin- to fairly thick-walled, parallel ..... ***C. alachuana*** (Murrill) Hallenb.

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