

Seven species of lignicolous agarics (Agaricomycetidae) new to Taiwan

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ABSTRACT

Seven species of lignicolous agarics (Agaricomycetidae) are reported from Taiwan for the first time, viz. *Campanella buettneri*, *Chaetocalathus columellifer*, *Marasmius pellucidus*, *M. tenuissimus*, *Mycena lazulina*, *Tapinella panuoides* and *Xeromphalina brunneola*. Morphological features and ITS (internal transcribed spacers) of rDNA sequences were studied to confirm the species identification. Basidiocarp photos, collection information and notes for these species, are provided.

Key words: Agaricales, Boletales, Marasmiaceae, pleurotoid fungi, taxonomy

Introduction

In Taiwan, lignicolous agarics has not much updated for many years. Most of the recent studies focused mainly on publishing new species (Kirschner et al. 2013, Shih et al. 2014, Chang and Ju 2017, Chang and Chou 2019, Wei and Kirschner 2019, Chang et al. 2020, Wu et al. 2020). In this study, seven species of lignicolous agarics (Agaricomycetidae) collected during 2017–2020 are newly recorded in Taiwan.

Materials and Methods

The specimens of this study are deposited at the herbarium of National Museum of Natural Science, R.O.C. (TNM). Freehand thin sections of basidiomes were made from dry specimens. All descriptions and measurements were prepared under 5% KOH. Melzer's reagent (IKI) was

used to test amyloidity and dextrinoidity of various structures. The molecular methods followed Wei et al. (2020). ITS (internal transcribed spacers) of rDNA sequences generated in this study were used to confirm the species determination. And was submitted to the GenBank (<https://www.ncbi.nlm.nih.gov/GenBank/>).

Taxonomy

Campanella buettneri Henn., Botanische Jahrbücher für Systematik Pflanzengeschichte und Pflanzengeographie 22: 95. 1895. Fig. 1A

Description. See Desjardin et al. (2017).

Specimen examined. TAIWAN. Taichung City, Heping District, Taiwan Endemic Species Research Institute, Low Altitude Experimental Station, 24°16'22.8"N, 120°56'54.4"E, alt. 1000 m, on gymnosperm branch, 7 Aug 2017, Wei, C.L. & Huang, Y.L. WEI 17-513 (TNM F32544),

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GenBank accession no. MW527101.

Habitat. On angiosperm wood (Desjardin et al. 2017) or on gymnosperm branch (this study).

Distribution. Africa—São Tomé and Príncipe and Togo, Oceania—Hawaii (Desjardin et al. 2017), and Taiwan (this study).

Notes. *Campanella buettneri* is the type species of the genus. It is characterized by small (about 1 cm wide) and pleurotoid basidiomes, vein-like hymenophore, gelatinized hyphal structures with fusoid to ventricose cystidia, and inamyloid basidiospores. *Campanella junghuhnii* (Mont.) Singer, a widespread species which distributed in subtropical to tropical Asia (e.g., Japan, Philippines and Indonesia), is separated from *C. buettneri* by having narrower basidiospores, 4.2–5 µm in *C. junghuhnii* (Singer 1945) vs. 6.0–7.2 µm in *C. buettneri* (Desjardin et al. 2017). The Taiwanese specimen fits the description of Desjardin et al. (2017) in all aspects, except for the slightly bigger basidiospores, 10–11 × 6.7–7.5 µm in this study vs. 8.6–10.2 × 6.0–7.2 µm in Desjardin et al. (2017). The ITS sequence derived from *WEI 17-513* (GenBank MW527101) has a 99% similarity with the epitype strain *DED 8276* (GenBank MF075136) (Desjardin et al. 2017) of this species.

Chaetocalathus columellifer (Berk.) Singer, Sydowia 9 (1-6): 398. 1955. Fig. 1B

Descriptions. See Singer (1955) and Singer (1976).

Specimen examined. TAIWAN. Pingtung County, Majia Township, Lidingshan Walking Road No.4, 120°38'24.1"E, 22°39'27.7"N, alt.

300 m, on angiosperm twig, 11 Jun 2018, *Chen, C.C. & Wei, C.L. WEI 18-162* (TNM F33822), GenBank accession no. MW527102.

Habitat. On angiosperm twigs or on palm (Singer 1955, 1976).

Distribution. Central and South America—Bolivia and Panama, Southeast Asia—Borneo and Indonesia (Singer 1976), and Taiwan (this study).

Notes. *Chaetocalathus columellifer* is characterized by having a small (less than 1 cm wide) and dorsally attached pileus, lamellae radiating from a centrally rudimentary stipe, setulose cheilocystidia, and ellipsoid basidiospores. This species was reported from tropical areas of Southern Hemisphere [e.g., Borneo (Berkeley 1849), Panama (Singer 1955) and Bolivia (Singer 1976)]. The Taiwanese specimen was collected in tropical southern Taiwan (Pingtung County) which is located in Northern Hemisphere. *Chaetocalathus fragilis* (Pat.) Singer and *C. galeatus* (Berk. & M.A. Curtis) Singer were described from the Philippines (Patouillard 1915) and Japan (Berkeley and Curtis 1860), respectively. They are separated from *C. columellifer* by having cheilocystidia with obtuse apices and subglobose to shortly ovoid-ellipsoid basidiospores in the former (Takahashi 2011) and having cheilocystidia with coralloid apex and bisporic basidia (tetrasporic in *C. columellifer*) in the later (Redhead and Bo 1982). The Taiwanese collection fits the descriptions of Singer (1955, 1976) in all aspects. The ITS sequence derived from *WEI 18-162* (GenBank MW527102) has a 98% similarity with the strain *JFK72* (GenBank FJ167665) (Kerekes and Desjardin 2009) of this species.



Fig. 1. Basidiomes and lamellae magnification. A. *Campanella buettneri* (WEI 17-513). B. *Chaetocalathus columellifer* (WEI 18-162). C–D. *Marasmius pellucidus* (WEI 18-377). E–F. *Marasmius tenuissimus* (WEI 17-238, dry specimens). G–H. *Mycena lazulina* (WEI 18-367). I. *Tapinella panuoides* (WEI 20-140). J. *Xeromphalina brunneola* (WEI 19-348). Bars in A, B, C, E, G, I, J = 10 mm; D, F, H, = 5 mm.

Marasmius pellucidus Berk. & Broome, Journal of the Linnaean Society. Botany 14: 35. 1875.

Fig. 1C–D

Descriptions. See Deng and Li (2014), Wannathes et al. (2004, 2009).

Specimen examined. TAIWAN. Taichung City, Xinshe District, Dakeng Walking Road No. 4, 120°48'01.8"E, 24°10'37.9"N, alt. 780 m, on rotten angiosperm wood, 10 Jun 2018, Wei, C.L. & Huang, C.P. WEI 18-377 (TNM F34204), GenBank accession no. MW527103.

Habitat. On angiosperm wood or on leaf mulch, sometimes on bamboo leaves (Wannathes et al. 2004).

Distribution. South and Southeast Asia—Indonesia, China, Malaysia, Singapore, Sri Lanka, Thailand (Wannathes et al. 2009, Deng and Li, 2014), and Taiwan (this study).

Notes. *Marasmius pellucidus* is widespread in South Asia. The features of this species are caespitose growth habit, medium to large sized pileus (about 2–5 cm wide), fairly thin context (less than 1 mm), and reddish brown stipe with white mycelia at base. Microscopically, it has *Globulares*-type of pileipellis, dextrinoid trama tissue and subfusoid to ellipsoid basidiospores. *Marasmius fissuratus* Chun Y. Deng, Antonín & T.H. Li and *M. nivicola* Har. Takah. from China and Japan, respectively, are highly similar species. The former differs in having a smaller pileus (1–2.5 cm wide) and the pileal surface with a grayish orange areola (Deng et al. 2015); the latter is distinct in having a white stipe with furfuraceous to pruinose ornamentations (Takahashi 2000). The

Taiwanese collection fits the description of Wannathes et al. (2004) in all aspects, except that the pileipellis is intermixed with a few lageniform cells. The ITS sequence derived from WEI 18-377 (GenBank MW527103) has a 98% similarity with the strain NW321 (GenBank EU935508) of this species (Wannathes et al. 2009).

Marasmius tenuissimus (Sacc.) Singer, Flora Neotropica 17: 258. 1976. Fig. 1E–F

Descriptions. See Singer (1976), Tan et al. (2009), and Wannathes et al. (2009).

Specimen examined. TAIWAN. New Taipei City, Sanxia District, near Wuliao Primary School, 24°51'32.1"N, 121°21'35.7"E, alt. 170 m, on angiosperm twigs, 11 Jun 2017, Wei, C.L., Wei, C.T. & Huang, M.Y. WEI 17-238 (TNM F31949), GenBank accession no. MW527104.

Habitat. On angiosperm twigs and leaves, or on liana stem, also found on bamboo leaves (Tan et al. 2009).

Distribution. South America—Bolivia and Brazil (Singer 1976), Southeast Asia—Indonesia, Malaysia and Thailand (Tan et al. 2009), and Taiwan (this study).

Notes. *Marasmius tenuissimus* is among the few species within the genus where the pileus is pleurotoid. It is characterized by having a small pileus (about 1 cm wide), distant lamellae (5–9 series), an eccentric, short, dark brown stipe. Microscopically, it has *Siccus*-type of pileipellis and ellipsoid basidiospores. *Marasmius koeae* Desjardin & Hemmes described from Hawaii is distinguished by lacking a stipe and having longer basidiospores, i.e., 12–14.5(–15.3) × 4–

4.8 μm in *M. koeae* (Desjardin and Hemmes 2011) vs. (7–)9–10(–12) \times 4–6(–7) μm in *M. tenuissimus* (Wannathes et al. 2009). The Taiwanese specimen fits description of Singer (1976), Tan et al. (2009) and Wannathes et al. (2009) in all aspects. The ITS sequence derived from *WEI 17-238* (GenBank MW527104) has a 99% similarity with the strain *NW192* (GenBank EU935568) (Wannathes et al. 2009).

Mycena lazulina Har. Takah., Taneyama, Terashima & Oba, The Agaric flora in Southwestern Japan 1: 209. 2016. Fig. 1G–H

Description. See Terashima et al. (2016).

Specimen examined. TAIWAN. New Taipei City, Gongliao District, Datieliao, 25°03'31.8"N, 121°54'19.4"E, alt. 25 m, on rotten bamboo, 16 Jun 2018, *Wei, C.L. WEI 18-367* (TNM F34151), GenBank accession no. MW540882.

Habitat. On bamboo and palm (Terashima et al. 2016).

Distribution. Japan (Terashima et al. 2016) and Taiwan (this study).

Notes. *Mycena lazulina* is characterized by having a tiny (1–2 mm wide) pileus, collariate lamellae, a blue stipe base and bioluminescent basidiomes. The Japanese specimens were collected from Ishigaki Island, Iriomote Island and Yonaguni Island, geographically close to Taiwan. Japanese collections of *M. lazulina* occur from June to November and gregariously on dead bamboo and palm (Terashima et al. 2016), as does our collection. The Taiwanese specimen fits the description of Terashima et al. (2016) in all aspects. However, the available ITS sequence of

M. lazulina from holotype (GenBank AB971703) is questionable, being highly similar to *Bourdotigloea* (Atractiellales, Atractiellomycetes). Our ITS (GenBank MW540882) and 28S (GenBank MW540883) sequences derived from *WEI 18-367* share high similarities with those of *Mycena* spp.

Tapinella panuoides (Fr.) E.-J. Gilbert, Les Livres du Mycologue Tome I-IV, Tom. III: Les Bolets: 68. 1931. Fig. 1I

Description. See Gilbertson and Hemmes (1997).

Specimens examined. TAIWAN. Taoyuan City, Fuxing District, Jiaobanshan Park, 24°48'49.4"N, 121°21'00.7"E, alt. 430 m, on rotten wood, 12 Nov 2017, *Wei, C.L., Wei, C.T. & Huang, M.Y. WEI 17-756* (TNM F32747), GenBank accession no. MW527105; Taichung City, Heping District, Mt. Tangmadan Trail, 120°57'26.4"E, 24°09'53.0"N, alt. 670 m, on decorticated angiosperm trunk, 20 Aug 2020, *Wei, C.L. WEI 20-140* (TNM F34446).

Habitat. On angiosperm (*Metrosideros*) and gymnosperm (*Pinus*) wood (Gilbertson and Hemmes 1997).

Distribution. Hawaii (Gilbertson and Hemmes 1997) and Taiwan (this study).

Notes. *Tapinella panuoides*, a brown rot mushroom, belongs to the order Boletales. This species is characterized by pileate and sessile basidiomes, lack of cystidia, and dextrinoid basidiospores. *Pseudomerulius curtisii* (Berk.) Redhead & Ginns is similar in macromorphology. However, according to Gilbertson and Hemmes

(1997), *P. curtisii* has narrowly ellipsoid to sub-cylindrical basidiospores, which have a negative reaction in Melzer's reagent. Basidiospores of *T. panuoides* are ellipsoid and have a dextrinoid reaction. The Taiwanese collections fit the description of Gilbertson and Hemmes (1997) in all aspects except for having slightly bigger basidiospores, i.e., $4.8\text{--}5.5 \times 3.5\text{--}3.8 \mu\text{m}$ in this study vs. $4\text{--}5 \times 2.5\text{--}3.5 \mu\text{m}$ in Gilbertson and Hemmes (1997). The ITS sequence derived from *WEI 17-756* (GenBank MW534092) has a 99% similarity with that from the strain *REG318* (GenBank DQ534574) in Binder and Hibbett (2006). The 28S sequence derived from *WEI 17-756* (GenBank MW527105) has a 100% similarity with that from the strain *RLG-23232* (GenBank GU187605) in Binder et al. (2010).

Xeromphalina brunneola O.K. Mill., Mycologia 60: 167. 1968. Fig. 1J

Descriptions. See Miller (1968) and Antonín (2000).

Specimen examined. TAIWAN. Chiayi County, Alishan Township, Tashan Trail, $120^{\circ}48'54''\text{E}$, $23^{\circ}31'39''\text{N}$, alt. 2320 m, on rotten gymnosperm trunk, 26 Aug 2019, *Chen, C.C. WEI 19-348* (TNM F34445), GenBank accession no. MW527139.

Habitat. On gymnosperm wood, especially of *Picea* (Miller 1968; Antonín 2000).

Distribution. Europe—Austria, Finland, Italy, Norway, Poland, Sweden (Antonín 2000), North America—America and Canada (Miller 1968, Redhead 1988), Asia—Japan (Redhead 1988), and Taiwan (this study).

Notes. *Xeromphalina brunneola* is characterized by a gregarious growth habit, a small pileus (about 1 cm wide), decurrent lamellae, and ochraceous pubescence at stipe base. Microscopically, it has cheilocystidia and amyloid basidiospores. The Taiwanese collection fits the description of Miller (1968) except for having slightly narrower basidiospores, $5.2\text{--}7 \times 2.2\text{--}2.5 \mu\text{m}$ in this study and $5.5\text{--}6.6 \times 2.5\text{--}3 \mu\text{m}$ in Miller (1968). *Xeromphalina campanella* (Batsch) Kühner & Maire and *X. kauffmanii* A.H. Sm. are highly similar species. According to Miller (1968), *X. campanella* has wider basidiospores, $3\text{--}4 \mu\text{m}$ wide, and *X. kauffmanii* occurs on hardwoods (*X. brunneola* occurs on conifers) and has shorter basidiospores, $4.2\text{--}5 \mu\text{m}$ long. The ITS sequence derived from *WEI 19-348* (GenBank MW527140) has a 98% similarity with that of the strain *MICH 5849* (GenBank MK169375; unpublished). The 28S sequence derived from *WEI 19-348* (GenBank MW527139) has a 99% similarity with that of the strain *TENN1179* (GenBank AF261468) (Moncalvo et al. 2002).

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臺灣木生型菇類 (傘菌亞綱) 七種新紀錄

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摘 要

本研究報導臺灣產七種木生型菇類 (傘菌亞綱) 新紀錄種，亦即：布特納脈褶菌 (*Campanella buettneri*)、殘柄毛筐菌 (*Chaetocalathus columellifer*)、蒼白小皮傘 (*Marasmius pellucidus*)、薄小皮傘 (*M. tenuissimus*)、暗藍小菇 (*Mycena lazulina*)、耳狀網褶菌 (*Tapinella panuoides*)、褐干臍菇 (*Xeromphalina brunneola*)。經由形態特徵及核糖體核酸 (rDNA) 內轉錄間隔區 (internal transcribed spacers, ITS) 序列的研究，確認它們的種類鑑定。本研究並提供這七種的照片，標本採集背景資料，以及評論。

關鍵詞：傘菌目，牛肝菌目，小皮傘科，側耳類真菌，分類學