Six new species of *Phanerochaete* from Taiwan

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(Received April 12, 1999; Accepted August 6, 1999)

**Abstract.** Six new species in the genus *Phanerochaete* are reported from Taiwan: *P. angustocystidiata*, *P. canulenta*, *P. ginsit*, *P. laxa*, *P. odontoida*, and *P. subodontoida*. The specimens were collected from 1991 to 1996. Morphological descriptions, microscopic line drawings, and cultural studies are provided for the six new species.

**Keywords:** Corticiaceae; New species; *Phanerochaete*; Taiwan; Taxonomy.

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**Introduction**

*Phanerochaete* Wallr. has been treated by most mycologists under the Corticiaceae Herter for several decades. Although Jülich (1981) established the order Phanerochaetales Jülich and the family Phanerochaetaceae Jülich to accommodate *Phanerochaete* and some related taxa, Parmasto (1986) reduced the Phanerochaetaceae to the subfamily level, the Phanerochaetoidae Parmasto, under the Corticiaceae.

Basidiomata of *Phanerochaete* are resupinate. Hymenial surfaces are usually smooth, but tuberculate. Granidioid or odontidioid surfaces occur in some species. *Phanerochaete* is microscopically characterized by the mononitic hyphal system, generative hyphae with mostly simple septa, clavate basidia, and normally thin-walled nonamyloid and acyanophilic basidiospores. Cystidia, principally lepto- or lamprocyistids, are present in many species. *Phanerochaete* species possess holocentric nuclear behavior, i.e. a pluri- or multi-nucleate condition occurs in the primary and secondary mycelia (Boidin and Lanquetin, 1984). *Phanerochaete* species are lignicolous, saprobic, and cause a uniform white rot in wood. *Phanerochaete chrysosporium* Burds. has been extensively studied as a microorganism used in the pulp and paper industry (Kirk and Chang, 1990). More than ninety species of *Phanerochaete* are known (Burdsall, 1985; Parmasto, 1997; Hjortstam, 1997; Wu, 1998). Thus it is the largest genus of the Corticiaceae s.l.


**Materials and Methods**

Materials for this study were collected from Taiwan during 1991-1996. All studied specimens and cultures are deposited at the herbarium of the National Museum of Natural Science Taiwan (TNM). Some isotypes will be distributed to BPI and K.

Descriptions of basidiomata were based on dried specimens. Free-hand, thin sections of basidiomata were prepared for microscopic studies. For observations and measurements of microscopic characters, 5% KOH was used as a mounting medium to ensure rehydration. Melzer’s reagent (IKI) was employed to detect amyloidity and dextrinoidity. Cotton blue in lactic acid (CB) was used as a mounting medium to determine cyanophily.
Cultural descriptions and species codes follow Nobles (1965) with amendments by Boidin and Lanquetin (1983). Minor modifications to Nobles’ code system have been made by other mycologists. Nobles’ code as detailed by Nakasone (1990) is adopted in this study. Nuclear staining of mycelia for P. odontoidea and P. subodontoidea were made with Giemsa according to Boidin (1958). Other practical details adopted in the cultural study were previously described (Wu, 1996).

**Taxonomy**

**Phanerochaete angustocystidiata** Sheng H. Wu, sp. nov.  
(Figures 1, 7A)

Basidiocarpus effusus, membranaceous, 100-200 μm crassus; superficies hymenialis plana. Systema hypharum monomiticum; hyphae efilulatae. Lamprocystidia subulata. Basidia clavata, 18-28 × 4.5-5.5 μm., 4 sterigmatibus. Basidiosporae cylindraceae, laeves, tenuitunicatae, 6.3-8 × 2.3-3 μm, IKI-, CB-.

**Figure 1.** *Phanerochaete angustocystidiata* (holotype). A, Basidiome section with substratum (cross hatched) at top; B, Hyphae from basal layer; C, Lamprocystidia; D, Basidia; E, Basidiospores. Scale bars = 10 μm.
Basidiome resupinate, effuse, adnate, membranaceous, 100-200 μm thick in section. Hymenial surface ivory color or light cream, smooth, cracked; margin rather determinate, white, slightly flamentous. Hyphal system monomitic; hyphae simple-septate. Subiculum composed of a basal layer and a medullary layer. Basal layer up to ca. 50 μm thick, with compact texture; medullary layer with loose texture. Subicular hyphae colorless, 2.5-5 μm diam., thin-walled near subhymenium, ± thick-walled near substratum, occasionally encrusted, horizontal and glued together in basal layer, ± vertical towards subhymenium. Hymenium thickening, with dense texture; hyphae colorless, thin-walled. Lamprocystidia numerous, immersed or projecting, cylindrical, subulate, conical when small, colorless, 30-70 × 5-9 μm (with encrustation). Basidia clavate, 18-28 × 4.5-5.5 μm, 4-sterigate. Basidiospores cylindrical, adaxially slightly concave or flattened, smooth, thin-walled, 6.3-8 × 2.3-3 μm, IKI-, CB-.

Etyymology. From angustus (narrow) + cystidium, referring to the shape of the cystidia.

Holotype. TAIWAN. NANTOU HSIEN: Yushan National Park, Nanhsi Forest Road, alt. 1,800 m, on branch of angiosperm, 13 Jun 1996, Wu 9606-39 (TNM; isotypes: BPI, K).

Additional specimens examined. TAIWAN. NANTOU HSIEN: Yushan National Park, Nanhsi Forest Road, alt. 1,850 m, on branch of angiosperm, 13 Oct 1993, Wu 9310-18 (TNM); Tunpu, alt. 1,300 m, on branch of angiosperm, 8 Oct 1992, Wu 9210-100 (TNM), 9210-106 (TNM); alt. 1,350 m, on branch of angiosperm, 23 Nov 1993, Wu 9311-27 (TNM), Wu 9311-29 (TNM), Wu 9311-31 (TNM), Wu 9311-32 (TNM). Hoshe, alt. 750 m, on branch of angiosperm, Wu 9405-10 (TNM), Wu 9405-14 (TNM). HUALIEN HSIEN: Hsienpaotai, alt. 850 m, on branch of angiosperm, 6 Dec 1991, Wu 911206-22 (TNM), Wu 911206-55 (TNM).

Cultural description (combined from polysporous mycelia of Wu 9210-100 and Wu 9606-39, and mycelium derived from woody substratum of Wu 9310-18). 1 wk growth: Colony radius 30-65 mm. Advancing zone fairly even. Mat white. Aerial mycelium pellicular or almost absent near inoculum, pellicular or downy towards growth margins. Advancing hyphae colorless, usually simple-septate, occasionally with single, double, or multiple clamp connections, 2.5-5 μm diam., thin-walled. 2 wk growth: Plates covered. 6 wk growth: Mat white, not discoloring in KOH. Aerial mycelium pellicular or almost absent, occasionally zonate. Hyphal system monomitic. Hyphae mostly simple-septate, rarely with single, double, or multiple clamp connections, colorless, 1.5-6.5 μm diam., thin-walled, occasionally shorty septate, sometimes with adhered crystals. Odor fruity or fragrant. Not fruiting.

Oxidase reactions. TAA: -; 0; -; 0. GAA: (+); 0; (+); 0. TYA: - (yellow); 58-75; - (brownish yellow), 90+.

Species code. (2a). 5. 7. 32. 36. 38. 42. 50. 54.

This new species resembles *Phanerochaete leptoderma* Sheng H. Wu, but is distinguished from it in having a distinct basal layer and narrower basidiospores (2.9-3.3 μm wide in *P. leptoderma*, according to Wu (1990)).

**Phanerochaete canolutea** Sheng H. Wu, sp. nov. (Figures 2, 7B)

Basidiocarps effusus, subceraceous, 50-150 μm crassus; superficies hymenialis plana. Systema hypharum monomiticum; hyphae fibulatae. Cystidia destituta. Basidia clavata, 15-25 × 4-5 μm, 4 sterigmatibus. Basidiosporae anguste ellipsoideae, laeves, tenuitunicatae, 4.7-6.3 × 2.5-3 μm, IKI-, CB-.

Basidiome resupinate, effuse, adnate, subceraceous, 50-150 μm thick in section. Hymenial surface grayish yellow, smooth, extensively cracked; margin thinning, colorless or paler, byssoid-flamentous. Hyphal system monomitic; hyphae simple-septate. Subiculum composed of a medullary layer, with fairly dense texture; hyphae colorless, 3-8 μm diam., with 0.5-1.5 μm thick walls. Hymenium thickening, with dense texture; hyphae mainly vertical, colorless, thick-walled. Cystidia lacking. Basidia clavate, 15-25 × 4-5 μm, thick-walled except the apical parts, 4-sterigate. Basidiospores narrowly ellipsoid, adaxially slightly concave, smooth, thin-walled, 4.7-6.3 × 2.5-3 μm, IKI-, CB-.

Etyymology. From canus (= gray) + luteus (= yellow), referring to the color of the hymenial surface.

Holotype. TAIWAN. TAIPEI HSIEN: Yangmingshan, alt. 600 m, on branch of angiosperm, 20 Nov 1992, Wu 9211-105 (TNM).

Cultural description (mycelium derived from woody substratum of the holotype). 1 wk growth: Colony radius 40 mm. Advancing zone even. Mat white. Aerial mycelium pellicular. Advancing hyphae colorless, usually simple-septate, occasionally with single, double, or multiple clamp connections, 2.5-7.5 μm diam., thin-walled. 2 wk growth: Plates covered. 6 wk growth: Mat white, not discoloring in KOH. Aerial mycelium downy-felt. Hyphal system monomitic. Hyphae usually simple-septate, occasionally with single, double, or multiple clamp connections, colorless, 2.5-7.5 μm diam., thin-walled. Cuboid crystals present. No distinct odor. Not fruiting.

Oxidase reactions. TAA: -; 0; -; 0. GAA: (+); 0; (+); 0. TYA: - (yellow); 58-75; - (brownish yellow), 90+.

Species code. 2a. 5. 7. 32. 36. 38. 42. 54.

Both *Phanerochaete canolutea* and *P. avellanea* (Bres.) J. Erikss. & Hjortstam lack cystidia and have similar-sized basidiospores. However, several features separate these two species. First, the subiculum of *P. avellanea* is composed of a very thin basal layer (Burdass, 1985; Eriksson et al., 1981), while that of *P. canolutea* is composed of a medullary layer. Secondly, basidia of *P. canolutea* are shorter (15-25 μm) than those of *P. avellanea* (25-30-40 μm (Burdass, 1985)); see also the ba-
Figure 2. *Phanerochaete canolutea* (holotype). A, Basidiome section with substratum (woody cells) at top; B, Subicular hyphae; C, Basidia; D, Basidiospores. Scale bars=10 μm.

Figure 3. *Phanerochaete ginnisi* (holotype). A, Basidiome section with substratum (hatched) at top; B–C, Basidia; C, Basidiospores. Scale bars = 10 μm.
Phanerochaete ginnisi
d Sheng H. Wu, sp. nov.
(Figures 3, 7C)
Basidiocarpus effusus, suberaceus, 40-80 μm crassus; superficies hymenialis plana. Systema hypharum mononiticum; hyphae efilubatae. Cystidia destituta. Basidia subclavata, 17-25 × 5-5.5 μm, 4 sterigmatibus. Basidiosporae late ellipsioidae, laeves, tenutunicaeae, 4-5 × 2.7-3 μm, IKI-, CB-.

Phanerochaete laxa
Sheng H. Wu, sp. nov. (Figures 4, 7D)
Basidiocarpus effusus, membranaceus, 100-250 μm crassus; superficies hymenialis plana. Systema hypharum mononiticum; hyphae efilubatae. Lamprocytstidia subulata. Basidia clavata, 20-30 × 6-7 μm, 4 sterigmatibus. Basidiosporae ellipsioidae, laeves, tenutunicaeae, 8-10 × 4-5 μm, IKI-, CB-.

Phanerochaete odontoides
Sheng H. Wu, sp. nov.
(Figures 5, 7E)
Basidiocarpus effusus, ceraceus, 50-200 μm crassus; superficies hymenialis odontoidae. Systema hypharum mononiticum; hyphae efilubatae. Cystidia destituta. Ba-
Figure 4. *Phanerochaete laxa* (holotype). A, Basidiome section; B, Lamprocystidia; C, Basidia; D, Basidiospores. Scale bars = 10 μm.
sidia clavata, 14-18 × 4.5-5.5 μm, 4 sterigmata. Basidiosporae cylindraceae vel angustae cylindraceae, laeves, tenuitunicatae, 6-7.2 × 2.6-3 μm, IKI-, CB-.

Basidiome resupinate, effuse, adnate, ceraceous, 50-200 μm thick in section (aculei excluded). Hymenial surface pale brown, odontoid, cracked; margin fairly determinate, paler to whitish. Aculei conical to subulate, usually separate, 2-4 per mm, 100-250 μm wide, up to 700 μm long. Hyphal system monomitic; hyphae simple-septate. Subiculum fairly uniform, a basal layer of compact texture; hyphae colorless, mainly horizontal, 4-6 μm diam., with ca. 1 μm thick walls. Hymenium thickening, with compact texture; hyphae mainly vertical, colorless, slightly thickwalled. Trama of aculei of compact texture, some with crystal masses near apex; hyphae mainly vertical, other aspects similar to those of subiculum. Cystidia lacking. Basidia clavate, 14-18 × 4.5-5.5 μm, 4-sterigmate. Basidiosporae cylindrical or narrowly ellipsoid, smooth, thin-walled, 6-7.2 × 2.6-3 μm, IKI-, CB-.

Etymology. From odonotoideus (= odontoid), referring to the hymenial surface.


Additional specimens examined. TAIWAN. NANTOU HSIEN: Yushan National Park, Nanshi Forest Road, alt. 1, 850 m, on branch of angiosperm, 13 Oct 1993, Wu 9310-8 (TNM). Tunpu, alt. 1,300 m, on branch of angiosperm, 23 Nov 1993, Wu 9311-46 (TNM).

Cultural description (mycelium derived from woody substratum of Wu 9310-8). 1 wk growth: Colony radius 70-80 mm. Advancing zone fairly even. Mat white. Aerial mycelium pellicular. Advancing hyphae colorless, simple-septate, 2.5-7 μm diam., thin-walled. 2 wk growth: Plates covered. 6 wk growth: Mat pale yellow, not discoloring in KOH. Aerial mycelium slightly pellicular. Hyphal system monomitic. Hyphae colorless, simple-septate, 1-10 μm diam., thin- or slightly thick-walled, occasionally encrusted with fine crystals. Cubical crystals present. No distinct odor. Not fruiting.

Oxidase reactions. TAA: ++, 20; ++++, 30-35. GAA: ++++, tr; ++++, tr. TYA: - (brownish yellow), 90+; - (brownish yellow), 90+.

Cytology. Mycelium derived from woody substratum is multinucleate.

Species code. 2a. 6. 7. 32. 36. 38. 42. 54.
**Phanerochaete odontoidea** is very similar to *P. subodontoidea*: both species have odontoid hymenial surface, compact subiculum, and lack cystidia. Multinucleate condition of secondary mycelia reported for both species in this paper, indicates a holocoenocytic nuclear behavior which supports their placement in *Phanerochaete*. *Phanerochaete odontoidea* has narrower basidiospores (2.6-3 μm) than *P. subodontoidea* (3-3.7 μm).

**Phanerochaete subodontoidea** Sheng H. Wu, sp. nov.
(Figures 6, 7F)

Basidiocarp effusus, ceraceous, 50-170 μm crassus; superficies hymenialis odontoidea. Systema hypharum mononiticum; hyphae efiulatae. Cystidia destituta. Basidia clavata, 16-20 × 5-6 μm, 4 sterigmatibus. Basidiosporae anguste cylindricae, laeves, tenuniticatae, 6.5-8.5 × 3-3.7 μm, IKI-, CB-.

Basidioma resupinate, effuse, adnate, ceraceous, 50-170 μm thick in section (aculei excluded). Hymenial surface pale brown, odontoid, occasionally cracked; margin fairly determinate or thinning, paler brown or concolorous. Aculei conical to subulate, usually separate, 2-4 per mm, 50-250 μm wide, up to 700 μm long. Hyphal system mononitic; hyphae simple-septate. Subiculum fairly uniform, composed of a basal layer, with compact texture; hyphae colorless, mainly horizontal, 3-6 μm diam., with ca. 1 μm thick walls. Hymenium thickening, with compact texture; hyphae mainly vertical, colorless, slightly thick-walled. Trama with compact texture, sometimes with crystal masses close to apices; hyphae mainly vertical, similar to those of subiculum. Cystidia lacking. Basidia clavate, 16-20 × 5-6 μm, 4-sterigate. Basidiospores narrowly ellipsoid, smooth, thin-walled, 6.5-8.5 × 3-3.7 μm, IKI-, CB-.

**Etymology.** From sub (= somewhat, not completely) + odontoidea, referring to the resemblance of this new species to *Phanerochaete odontoidea*.

**Holotype.** TAIWAN. NANTOU HSIEN: Yushan National Park, Leleku, alt. 1,450 m, 13 Apr 1994, **CWN 00776** (TNM; isotype: K).

**Additional specimen examined.** TAIWAN. TAICHUNG HSIEN: Chiapaotai, alt. 850 m, on branch of angiosperm, 6 Dec 1996, *Wu 911206-38* (TNM).

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**Figure 6.** *Phanerochaete subodontoidea* (holotype). A, Basidiome section with substratum (hatched) at top; B, Aculeus section; C, Basidia; D, Basidiospores. Scale bars = 10 μm.
Cultural description (polysporous mycelium of the holotype). 1 wk growth: Colony radius 55-67 mm. Advancing zone uneven. Mat white. Aerial mycelium slightly pellicular. Advancing hyphae colorless, simple-septate, 2.5-5.5 μm diam., thin-walled. 2 wk growth: Plates covered. 6 wk growth: Mat yellow, not discoloring in KOH. Aerial mycelium slightly pellicular. Hyphal system monomitic. Hyphae colorless, or occasionally yellow from the yellow aerial solid mat lining the plate margin, simple-septate, 1-7 μm diam., thin- or slightly thick-walled, occasionally encrusted with crystals. Crystals present. No distinct odor. Not fruiting.

Oxidase reactions. TAA: +++, 30; ++++, 30-35. GAA: ++++, tr; ++++, tr. TYA: - (yellow), (90); - (brownish yellow), 90+.

Cytology. Both monosporous and polysporous mycelium are multinucleate.

Species code. 2a. 6. 7. 32. 36. 38. 42. 54.

Acknowledgments. This study was supported by the National Science Council of ROC (No. NSC 85-2311-B-178-001) and the National Agriculture Council of ROC (No. 88-AST-1-2-FCD01(3)2).

Figure 7. Cultures after 6 wk of growth on 1.5% MEA at 25°C. A, Phanerochaete angustocystidiata; B, P. canolutea; C, P. ginnisi; D, P. laxa; E, P. odontoidea; F, P. subodontoidea.

Literature Cited

臺灣産顯絲菌屬六新種

吳聲華

國立自然科學博物館植物學組

本文報告臺灣産顯絲菌屬六新種，即 P. angustocystidiata, P. canolutea, P. ginsii, P. laxa, P. odontoida，以及 P. subodontoida。這些標本採於 1991 至 1996 年。文中提供六種之形態描述、顯微特徵之針筆描圖以及培養研究。

關鍵詞：皮殼菌科；新種；顯絲菌屬；臺灣；分類學。