

Four species of *Oudemansiella* and *Xerula* newly recorded from Thailand

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Abstract – Three species of *Oudemansiella* and one species of *Xerula* collected from northern Thailand are described and illustrated with line drawings. They are *O. canarii*, *O. aff. crassifolia*, *O. submucida* and *X. sinopudens*, all of which are first records for Thailand.

***Oudemansiella* / *Xerula* / new records / Thailand**

INTRODUCTION

We are studying the macrofungi at the Mushroom Research Centre in northern Thailand (Le et. al 2007a, b) and in this paper deal with the genus *Oudemansiella* and *Xerula*. Studies on the genera *Oudemansiella* and *Xerula* have been carried out in Africa (Petersen, 2008), America (Singer, 1964; Redhead et al. 1987; Corner, 1994; Baroni & Ortiz, 2002; Petersen et al. 2008), Asia (Natarajan & Purushothama 1992; Yang & Zang, 1993; Corner, 1994; Yang, 2000; Yang & Zhang 2003; Mizuta, 2006; Petersen & Nagasawa, 2006; Wang et al. 2008; Yang et al. 2009), Europe (Patouillard, 1887; Moser, 1955; Dörfelt, 1979, 1985; Boekhout & Bas, 1986; Pegler & Young, 1987; Rexer & Kost, 1989; Ronikier, 2003; Mats & Mikael, 2005), and Oceania (Petersen, 2008). However, only 2 species of these genera, *Xerula chiangmaiae* R.H. Petersen & Nagas. And *X. chiangmaiae* var. *raphanipes* (Berk.) R.H. Petersen & Nagas., have been reported from Thailand (Petersen & Nagasawa, 2006).

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The genus *Oudemansiella* Speg., was proposed by Spegazzini (1881), and *O. platensis* (Speg.) Speg is the generic type. The genus *Xerula* was established by Maire (1933) and *X. longipes* was the only included species at that time. Singer (1975) used *Xerula* (Maire) Singer as a subdivision of *Oudemansiella* Speg., however, Dörfelt (1979) restricted *Oudemansiella* as a genus with annulate, non-rooting stipes, and raised *Xerula* again to generic level. Pegler & Young (1987) divided *Oudemansiella* into five sections under two subgenera, *Oudemansiella* and *Xerula*. Wang et al. (2008) treated *Xerula* as a distinct genus, but in a restricted sense that includes only hispid species such as *X. pudens*, and Yang et al. (2009) revised and circumscribed the genus *Oudemansiella* s. str. as an assemblage of taxa excluding the genus *Xerula* s. str. as defined by Wang et al. (2008). Four sections, i.e., *Oudemansiella*, *Mucidula*, *Dactylosporina* and *Radicatae*, were included in the genus by Yang et al. (2009). In this study, we accept the arrangements of Wang et al. (2008) and Yang et al. (2009). Specimens studied are deposited in the herbarium of Mae Fah Luang University (MFU), Chiang Rai, Thailand.

MATERIALS AND METHODS

Samples were collected from northern Thailand. Macromorphological characters were described based on fresh material, colour photos and field notes. Colour designations (e.g., 4B5) are from Kornerup and Wanscher (1978) while the colour names with the first letters capitalized (e.g., Grayish Yellow) are from Ridgway (1912). Samples were dried, and then kept in plastic bags separately. For micromorphological examination, sections cut with a razor blade from dry specimens and mounted on slides in 5% KOH, and then observed, measured and illustrated under a compound microscope (Zeiss Axioskop 40, Germany). In the description of the basidiospores, “n” indicates the number of spores which were measured; L^m = median spore length over a population of spores; W^m = median spore width over a population of spores; Q = “length/width ratio” of a spore in side view; \bar{Q} = average Q of all spores measured.

TAXONOMY

Oudemansiella canarii (Jungh) Höhn. (Fig. 1, Fig. 2a)
Sitzungber. Kaiserl. Akad. Wissenschaft. Wien 118: 276 (1909)
Agaricus canarii Jungh., Batav. Geroot. Kunst. Wetens. Verh. 17: 82 (1838)

Basidiocarps (Fig. 2a) small to medium-sized. Pileus 26-65 mm in diam, circular, plano-convex, slightly depressed in center, white to brownish orange (5C3) at disc, white to yellowish grey (4B2) towards the margin, often becoming whitish (3A2) to cream-colored after rainfall, viscid when moist; context white, 4 mm thick at disc, fleshy. Lamellae, ventricose, adnate with decurrent tooth, white (1A2) to yellowish white (4A2), with 4-6 series of lamellulae, close to substiant. Stipe 12-42 × 3-5 mm, cylindrical, central, curved, fibrous, solid, surface yellowish white to yellowish grey; annulus rudimental and fugacious; base of stipe subdiscooid enlarged; pseudorrhiza absent.

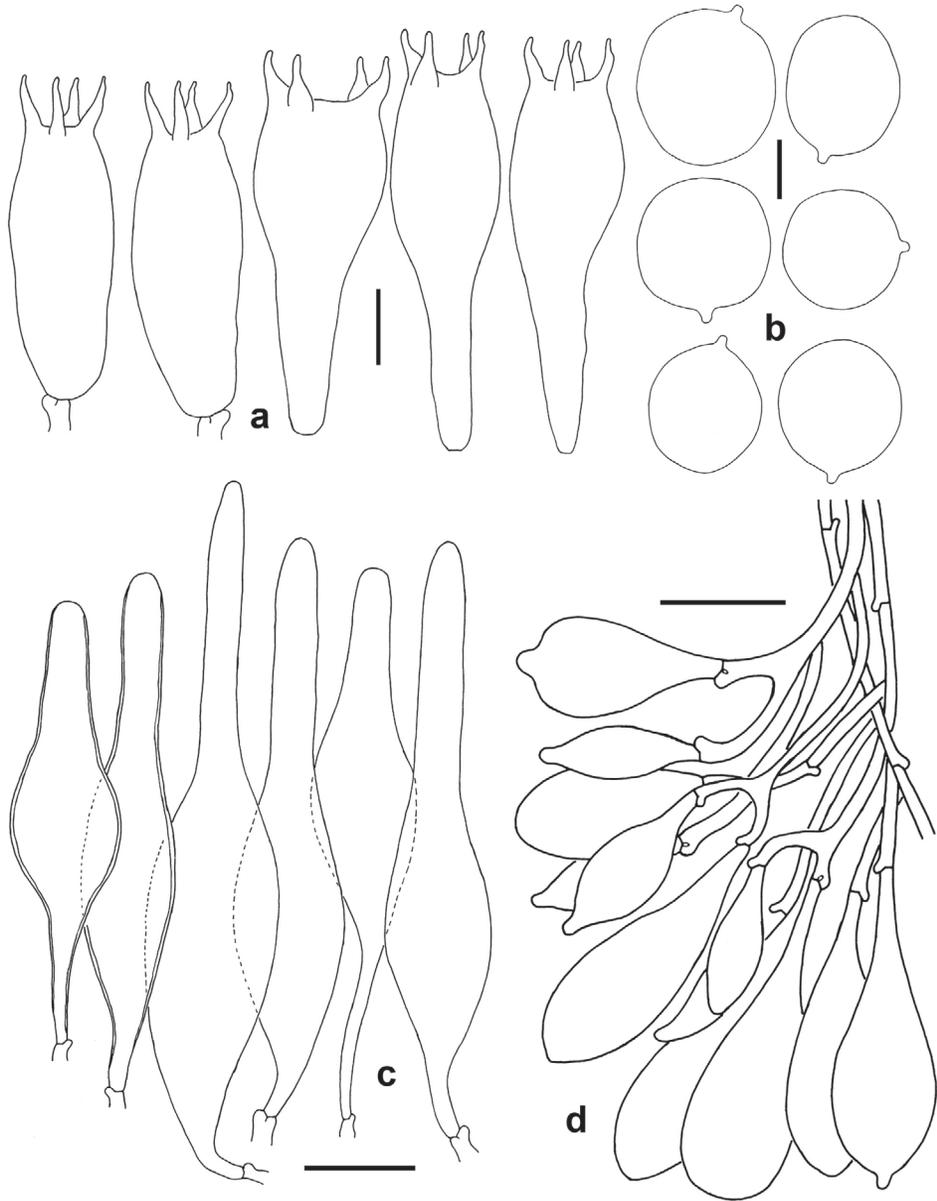


Fig. 1. *Oudemansiella canarii*. a: Basidia; b: Spores; c: Pleurocystidia; d: Cheilocystidia. Scale bars: a = 20 μ m; b = 10 μ m; c, d = 40 μ m

Basidiospores (Fig. 1b) $(18)20-27(28) \times 18-25(26) \mu\text{m}$ [$n = 80$, $L^m = 22.4$, $W^m = 21.1$, $Q = 1.00-1.18$, $Q = 1.07$], globose to subglobose, occasionally broadly ellipsoid, smooth, colourless, hyaline, thick-walled (up to $2 \mu\text{m}$ thick). Basidia (Fig. 1a) $65-103 \times 23-35 \mu\text{m}$, broadly clavate to suburniform from a severely pinched base, 4-spored, thick-walled (up to $1.5 \mu\text{m}$ thick), sometimes thin-walled, basal clamp connections common; sterigmata $9-14 \mu\text{m}$ long. Pleurocystidia (Fig. 1c) scattered, $150-245 \times 32-45 \mu\text{m}$, fusiform, narrowly pedicellate, broadly proximally inflated, subcylindrical neck, rounded apex, thick-walled (wall up to $2 \mu\text{m}$ thick), colourless, hyaline; basal clamp connections common. Cheilocystidia (Fig. 1d) numerous, $50-100 \times 10-38 \mu\text{m}$, clavate to broadly clavate, hyaline, colourless, thin-walled, sometimes slightly thick-walled (up to $1 \mu\text{m}$ thick), basal clamp connections common, from a sterile edge along the margin of lamellae. Pileipellis an ixotrichoderm consisting of partly mellifluous brown pigmented trama in which fusiform to ellipsoid chains of cells are mixed with filamentous hyphae, appearing as though an erect system but repent at or near surface of glutin. The whole system arising from the congested interwoven outer pileus tramal hyphae as thin-walled, side branches, without clamp connections.

Habitat: Scattered on fallen trees in forests.

Specimens examined: THAILAND, Chiang Mai Prov., Mae Teng Dist., Tung Joaw village, forest trail, $N19^\circ08.07' E98^\circ38.90'$, elev. 1300 m, secondary forest with *Pinus kesiya*, *Castanopsis* etc. 26 June 2008, J.K. Liu 014 (MFU08 1332); Doi Inthanon National Park, junction of Highway 1009 and road to Mae Chem, $N19^\circ31.58' E 98^\circ29.64'$, elev. 1700 m, humid montane rainforest with *Quercus*, *Castanopsis*, *Lithocarpus echinops* etc. 16 July 2008, J.K. Liu 034 (MFU08 1352).

Distribution: Africa (Singer 1964). ASIA: China; Indonesia; Japan; Malaysia; Singapore; Sri Lanka (Singer, 1964; Yang & Zang, 1993; Corner, 1994; Yang et al. 2009). AMERICA: Argentina; Brazil; Bolivia; Colombia; Mexico; Paraguay; Peru; Trinidad; United States; Uruguay; and Venezuela (Singer, 1964; Petersen et al. 2008). New to Thailand.

Notes: *Oudemansiella canarii*, belonging to section *Oudemansiella* (Yang et al. 2009) is similar to *O. platensis*, but differs from the latter by the flecks or warts on the pileus which are persistent in *O. platensis* while they are easily washed off by the rain drops in *O. canarii*. Most importantly, the structure of the pileipellis of *O. platensis* has a lax ixotrichodermium composed of chains of elongate-fusiform cells ending in narrowly fusiform, fusiform or subclavate terminal cells and is different with *O. canarii*. Furthermore, warts on the pileal surface of *O. platensis* are composed of moniliform to subglobose inflated cells intermixed with filamentous hyphae or mainly with filamentous hyphae which is more or less vertically arranged. In *O. canarii* the warts are composed of typical cylindrical cells, the hyphae are slender and the terminal cells become increasingly inflated, and eventually shorter and more broadly fusoid than the slender hyphae from which they arise (Petersen et al. 2008; Yang et al. 2009). In this study, the specimens are over mature, thus the pileipellis has stretched and become extensively distorted, disrupted and collapsed, in part due to gelatinization. At this stage it looks like a cutis. However, Yang et al. (2009), reported that the structure of the pileipellis in *O. canarii*-*O. platensis* complex can significantly vary at different stages of development. This is the same as observed by Yang et al. (2009).

***Oudemansiella* aff. *crassifolia* Corner.** (Fig. 2b-d, Fig. 3a, Fig. 4)
Gardens Bulletin Singapore 46: 60 (1994)

Basidiocarps (Fig. 2b-d) small to medium-sized. Pileus 18-38 mm in diam, circular, plano-convex, slightly depressed, sometimes concave, grayish yellow (4B3) to yellowish brown (5E7) at disc, yellowish white (4A3) to grayish yellow (4B4) towards the margin, viscid when moist; contexts yellowish white, 1.5-3 mm thick at disc, fleshy. Lamellae ventricose, narrowly adnate, yellowish white (4A2), with 4-6 series of lamellulae, close to subdistant. Stipe 12-30 × 1.5-5 mm, cylindrical, occasionally subcylindrical, central, curved, fibrous, solid, surface yellowish white to orange grey; non-annulus; base of stipe subdiscoid enlarged; pseudorrhiza absent.

Basidiospores (Fig. 4a) 17.5-23.5 × 16.5-22.5 μm [*n* = 120, *L*^m = 20.4, *W*^m = 19.5, *Q* = 1.00-1.14, *Q* = 1.06], globose to subglobose, smooth, colourless, hyaline, thick-walled (up to 1 μm thick). Basidia (Fig. 4b) 65-93 × 20-34 μm, clavate to broadly clavate from a pinched base, 4-spored; thick-walled (up to 1.5 μm thick), sometimes thin-walled; basal clamp connections common; sterigmata 9-14 μm long. Pleurocystidia (Fig. 4c) scattered, 140-230 × 27-42 μm, fusiform, pedicellate, inflated somewhat proximally then extended into a long, broadly cylindrical neck and rounded apex; thick-walled (up to 2 μm thick), colourless, hyaline; basal clamp connections present but rare. Cheilocystidia (Fig. 4d) numerous and forming a sterile edge along the margin of lamellae, 30-100 × 6-36 μm, clavate to broadly clavate, occasionally fusiform, hyaline, colourless, thin-walled, sometimes slightly thick-walled (up to 1 μm thick), basal clamp connections common. Pileipellis (Fig. 3a) an ixotrichoderm, stretched and extensively distorted and irregularly arranged due to the expansion of the pileus, composed of filamentous or fusiform to ellipsoid inflated hyphae, thin-walled, occasionally conspicuously clamped (but usually not so), hyaline.

Habitat: Scattered on fallen trees in rain forests, gregarious or solitary.

Specimens examined: THAILAND, Chiang Mai Prov., Mae Taeng, Ban Mae Sae village, on Hwy 1095 near 50 km marker, N19°14.599' E98°39.456', elev. 962 m, rain forest dominated by *Castanopsis armata*, *Castanopsis* sp., *Pinus* sp., *Lithocarpus* sp. 05 July 2008, J.K. Liu 022 (MFU08 1340), 18 July 2008, J.K. Liu 036 (MFU08 1354), 07 August 2008, J.K. Liu 041 (MFU08 1359).

Distribution: China (Yang et al. 2009); Malaysia (Corner, 1994). New to Thailand.

Notes: All specimens examined were in good condition. *Oudemansiella* aff. *crassifolia*, belonging to section *Oudemansiella* (Yang et al. 2009) can be separated from *O. canarii* and *O. platensis* by the absence of the flecks or warts on the pileus. In addition, the structure of pileipellis of *O* aff. *crassifolia* is an ixotrichoderm composed of filamentous or fusiform to ellipsoid inflated hyphae and these hyphae appear as loosely interwoven. In *O. canarii* and *O. platensis* the pileipellis comprises an erect branched hyphae system. Furthermore, the structure of the pileipellis of *O* aff. *crassifolia* does not vary significantly with age unlike in the *O. canarii*-*O. platensis* complex (Yang et al. 2009). Most features of our collections are similar to *O. crassifolia*. However, the spores in our study are smaller than those (21-28 × 19-24 μm) of Corner (1994).

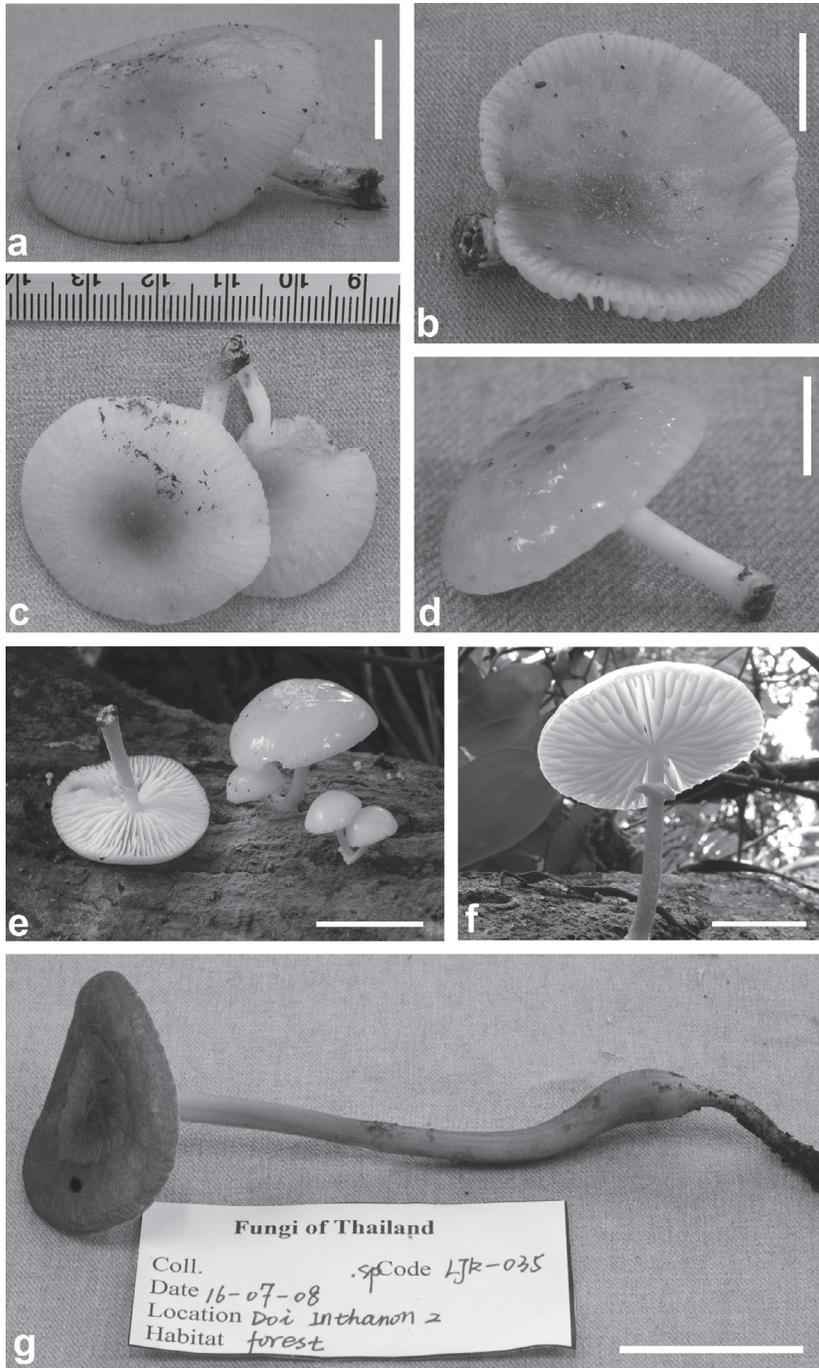


Fig. 2a. Basidiocarp of *Oudemansiella canarii*; **b-d**. Basidiocarps of *Oudemansiella* aff. *crassifolia*; **e-f**. Basidiocarps of *Oudemansiella submucida*; **g**. Basidiocarp of *Xerula sinopudens*. Scale bars: a = 20 mm; b-d = 10 mm; e-f = 20 mm; g = 30 mm.

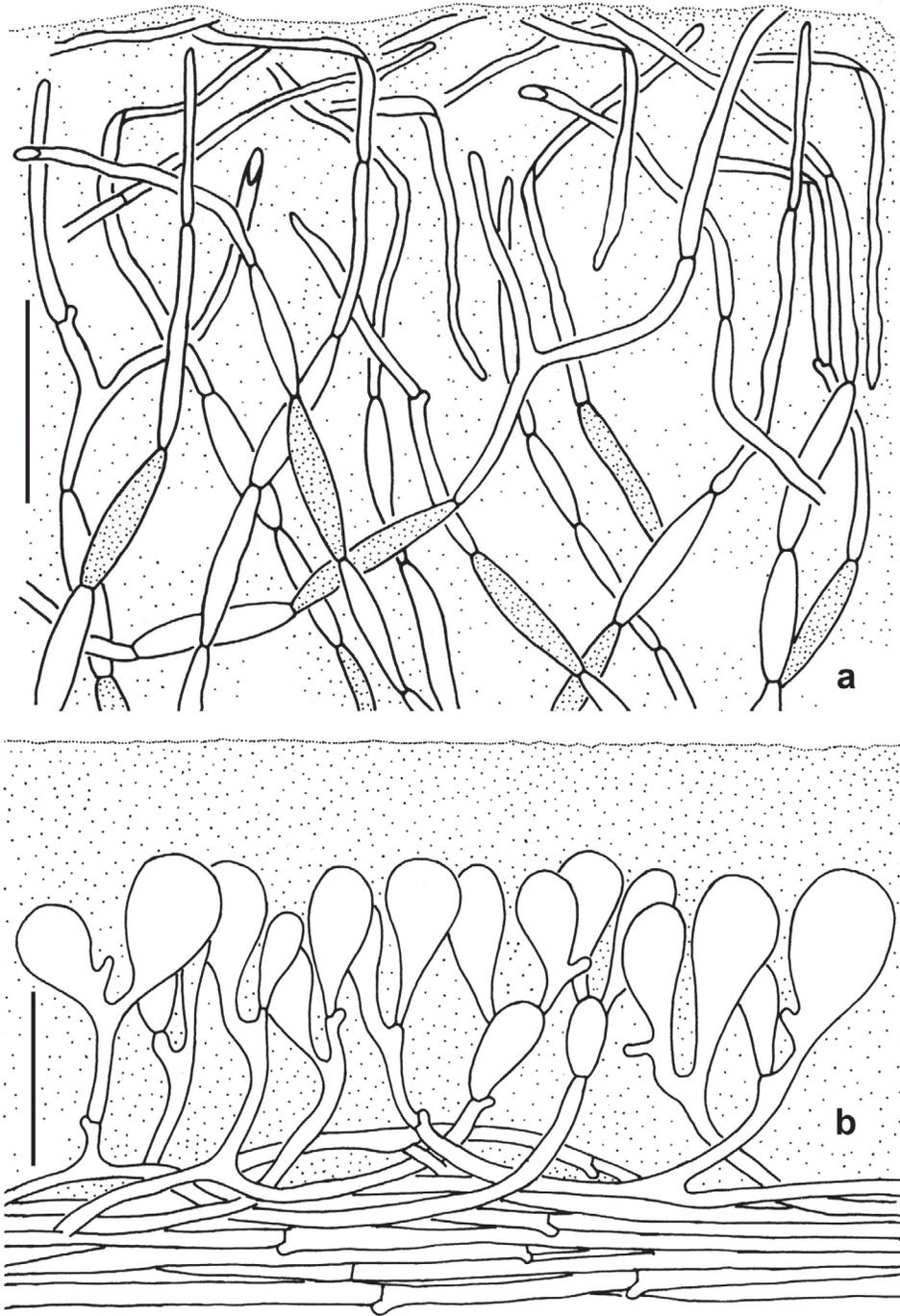


Fig. 3a. Pileipellis of *Oudemansiella* aff. *crassifolia*; b. Pileipellis of *Oudemansiella* *submucida*. Scale bars: a, b = 40 μ m.

Oudemansiella submucida Corner.
Gardens Bulletin Singapore 46: 70 (1994)

(Fig. 2e, f, Fig. 3b, Fig. 5)

Basidiocarps (Fig. 2e, f) small to medium-sized. Pileus 20-52 mm in diam, circular, plano-convex, subumbonate, grayish yellow (4B5) at disc, yellowish white (4A2) towards the margin, viscid when moist; context yellowish white, 4 mm thick

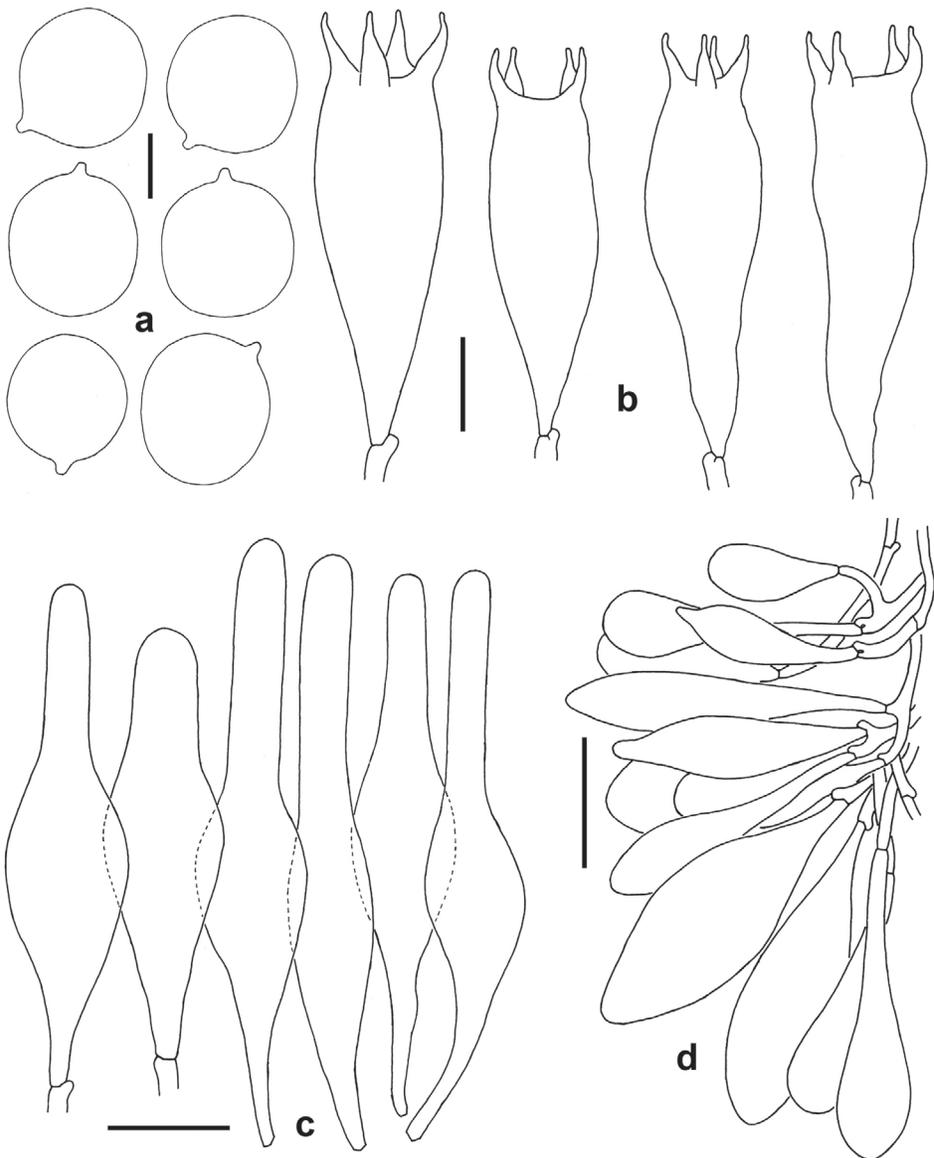


Fig. 4. *Oudemansiella* aff. *crassifolia*. a: Spores; b: Basidia; c: Pleurocystidia; d: Cheilocystidia. Scale bars: a = 10 µm; b = 20 µm; c, d = 40 µm.

at disc, fleshy. Lamellae ventricose, emarginated with decurrent tooth, yellowish white (4A2), with 4-6 series of lamellulae, close to subdistant, breath 10mm. Stipe 15-50 mm long, 1-2 mm broad at apex, 1-4 mm broad at base, cylindrical, central, fibrous, fistulose, surface yellowish white to greyish yellow finely longitudinally, covered with whitish hairs; annulus present; base of stipe subdiscoid enlarged; pseudorrhiza absent.

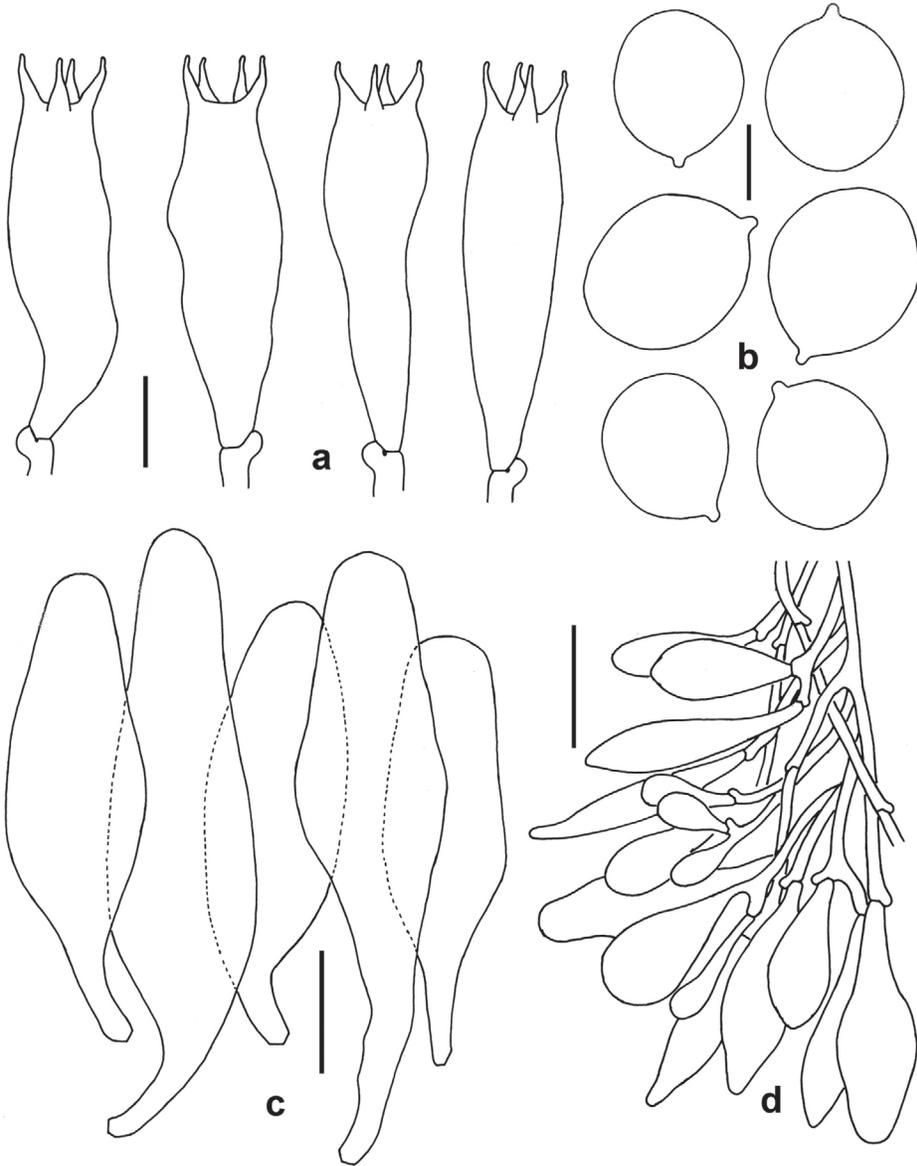


Fig. 5. *Oudemansiella submucidia*. a: Basidia; b: Spores; c: Pleurocystidia; d: Cheilocystidia. Scale bars: a = 20 μ m; b = 10 μ m; c, d = 40 μ m.

Basidiospores (Fig. 5b) $18\text{--}24.5 \times 16\text{--}21 \mu\text{m}$ [$n = 50$, $L^m = 20.7$, $W^m = 18.1$, $Q = 1.08\text{--}1.21$, $Q = 1.14$], subglobose to broadly ellipsoid, smooth, colourless, hyaline, thick-walled (up to $1 \mu\text{m}$ thick). Basidia (Fig. 5a) $62\text{--}82 \times 20\text{--}29 \mu\text{m}$, clavate, with slightly pinched base, 4-spored; thick-walled (up to $1.5 \mu\text{m}$ thick), basal clamp connections common; sterigmata $9\text{--}12 \mu\text{m}$ long. Pleurocystidia (Fig. 5c) scattered, $140\text{--}210 \times 40\text{--}51 \mu\text{m}$, clavate to broadly fusiform with obtuse apex to ventricose with prolonged subcylidri apex, copiosa, thick-walled (up to $1.5 \mu\text{m}$ thick), colourless, hyaline; basal clamp connections present but rare. Cheilocystidia (Fig. 5d) numerous, $35\text{--}85 \times 7\text{--}26 \mu\text{m}$, clavate to subfusiform, hyaline, colourless, thin-walled, sometimes slightly thick-walled (up to $1.5 \mu\text{m}$ thick); basal clamp connections common. Pileipellis (Fig. 3b) composed of partly mellifluous yellowish brown pigmented trama in which sphaeropedunculate, broadly clavate to clavate, thin-walled cells ($24\text{--}50 \times 7\text{--}25 \mu\text{m}$); clamp connections common.

Habitat: Scattered on fallen trees, gregarious.

Specimens examined: THAILAND, Chiang Mai Prov., Mae Taeng Dist., Ban Pha Deng village, Pathummikaram Temple, forest trail, $N19^{\circ}06.288'$ $E98^{\circ}44.473'$, elev. 1050 m., rain forest dominated by *Castanopsis armata*, *Dipterocarpus* sp., *Pinus kesiya*. 15 July 2008, J.K. Liu 032 (MFU08 1350).

Distribution: China (Yang et al. 2009); Malaysia (Corner, 1994). New to Thailand.

Notes: Two basidiocarps were studied and both of them were in good condition. *Oudemansiella submucida*, belonging to section *Mucidula* (Yang et al. 2009) differs from *O. yunnanensis* Zhu L. Yang & M. Zang by its smaller spores. Furthermore, *O. submucida* has been treated as *O. mucida* for a long time. However, Petersen et al. (2008) and Yang et al. (2009) demonstrated that the pileipellis of *O. mucida* is composed of coralloid terminal cells.

Xerula sinopudens R.H. Petersen et Nagasa.
Rep. Tottori Mycol. Inst. 43: 41. 2006.

(Fig. 2g, Fig. 6)

Basidiocarps (Fig. 2g) small. Pileus $30\text{--}45 \text{ mm}$ in diam, circular, applanate, depressed, brownish orange (5C3) at disc, brown (6E5) towards the margin, unpolished and dry, neither viscid nor gelatinized, covered with yellowish brown setae; context yellowish white, 4 mm thick at disc, fleshy. Lamellae broadly ventricose, adnexed, yellowish white (4A2), with 3-5 series of lamellulae, close to subdistant, breadth $4\text{--}6 \text{ mm}$. Stipe $70\text{--}90 \text{ mm}$ long, $4\text{--}5 \text{ mm}$ broad at apex, $7\text{--}8 \text{ mm}$ broad at base, tapering upwards, central, fibrous, fistulose, pale yellow to brownish yellow; surface covered with yellowish brown setae; annulus absent; pseudorrhiza present.

Basidiospores (Fig. 6b) $9.5\text{--}12 \times 8\text{--}11 \mu\text{m}$ [$n = 40$, $L^m = 10.68$, $W^m = 9.36$, $Q = (1.00) 1.05\text{--}1.25$, $Q = 1.14$], subglobose to broadly ellipsoid, sometimes globose, smooth, colourless. Basidia (Fig. 6c) $40\text{--}65 \times 13\text{--}28 \mu\text{m}$, clavate to broadly clavate, 4-spored; thin-walled, without clamp connections; sterigmata $4\text{--}6 \mu\text{m}$ long. Pleurocystidia (Fig. 6d) scattered, $80\text{--}135 \times 23\text{--}35 \mu\text{m}$, broadly fusiform, thin-walled, occasionally subcapitate, the apex without crystalline deposits, without basal clamp connections. Cheilocystidia scattered, similar to pleurocystidia. Pileipellis (Fig. 6a) hymeniform, composed of broadly clavate, subfusiform or sphaeropedunculate cells, thin-walled, often with brown vacuolar pigment.

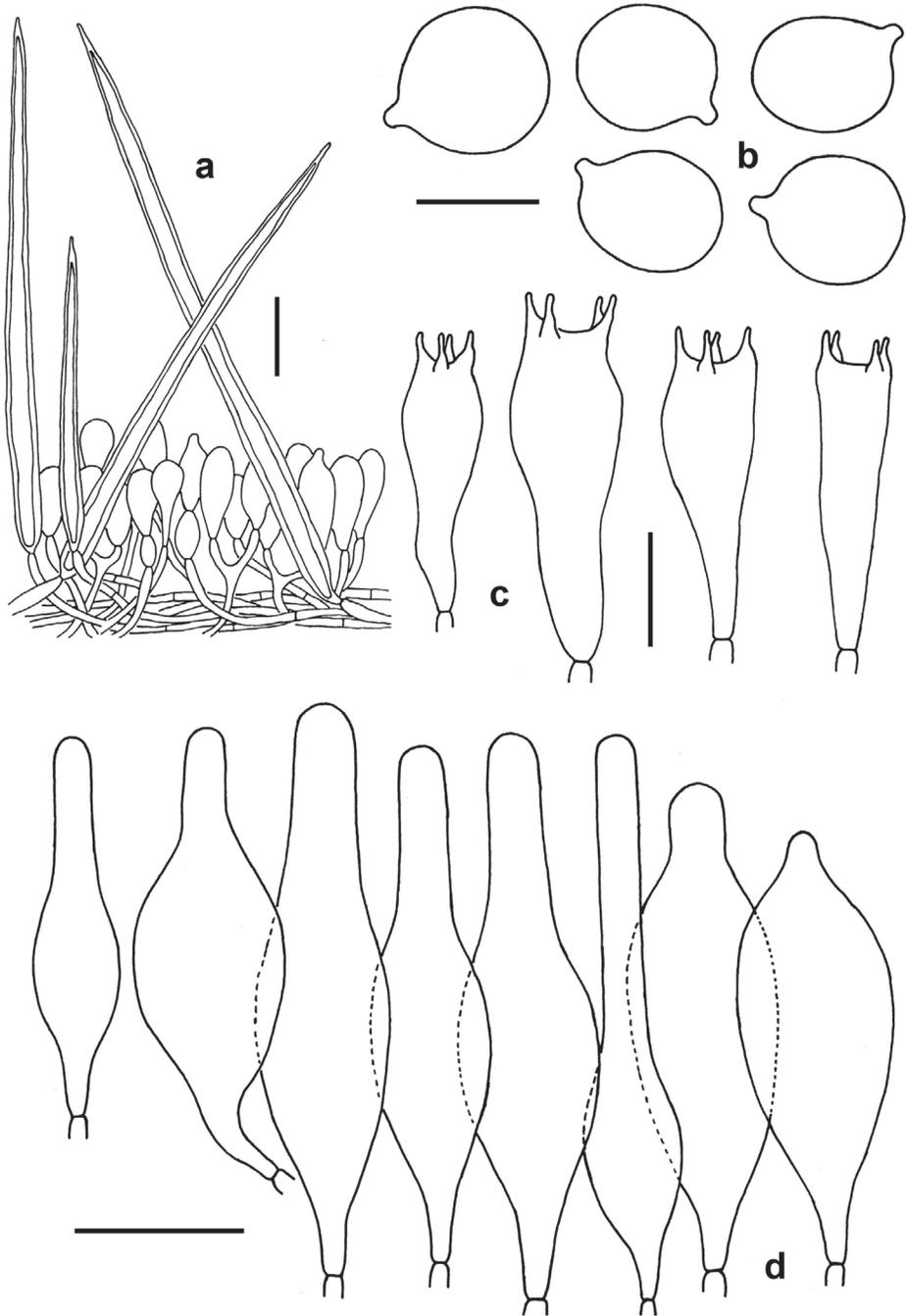


Fig. 6. *Xerula sinopudens* a: Pileipellis and pileocystidia; b: Spores; c: Basidia; d: Pleurocystidia. Scale bars: a = 60 μ m; b = 10 μ m; c = 20 μ m; d = 40 μ m.

Pileocystidia (Fig. 6a) 230-510 × 13-20 µm, erect, lanceolate with ventricose base and tapering tips, thick-walled (up to 8 µm), with dark brown cell wall; without clamp connections.

Habitat: On buried rotten wood in rain forests, solitary.

Specimens examined: THAILAND, Chiang Mai Prov., Doi Inthanon National Park, junction of Highway 1009 and road to Mae Chem, N19°31.58' E 98°29.64', elev. 1700 m, humid montane rainforest with *Quercus*, *Castanopsis*, *Lithocarpus echinops* etc. 20 June 2008, J.K. Liu 006 (MFU08 1325), 16 July 2008, J.K. Liu 035 (MFU08 1353)

Distribution: China; Indonesia; Japan; Papua New Guinea (Petersen & Nagasawa, 2006; Wang et al. 2008). New to Thailand.

Notes: *Xerula sinopudens* is similar to *X. pudens*, however, *X. pudens* differs from *X. sinopudens* by its common presence of clamp connections and much more thicker-walled (up to 6 µm) pleurocystidia. Wang et al. (2008) suggested that the presence or absence of clamp connections, the form and the thickness of the wall of pleurocystidia, and the size and the shape of basidiospores are important characters to distinguish the species within *Xerula* which was followed in this study.

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