Two new species of *Junghuhnia* (Polyporales) from Taiwan and a key to all species known worldwide of the genus

H. S. Yuan[1], Y. C. Dai[1] & S. H. Wu[2]*

[1] State Key Laboratory of Forest and Soil Ecology, Institute of Applied Ecology, Chinese Academy of Sciences, Shenyang 110164, People's Republic of China
[2] Department of Botany, National Museum of Natural Science, Taichung, Taiwan 404, Republic of China

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Junghuhnia taiwaniana and *J. tropica* are described as new species from tropical and subtropical Taiwan. The former has resupinate basidiomata with slightly fimbriate margins, bearing angular to irregular pores, and ellipsoid to subglobose basidiospores. The latter is characterized by having resupinate basidiomata, by the presence of both thin-walled encrusted cystidia and encrusted skeletocystidia, and fairly small basidiospores. Descriptions and line drawings of these two species are given. A key to the 26 species known worldwide of *Junghuhnia* is provided.

Keywords: Basidiomycota, lignicolous fungi, Meruliaceae, polypore, taxonomy

The genus *Junghuhnia* Corda emend. Ryvarden was established based on *Laschia crustacea* Jungh. (Ryvarden 1972) as type species. The main characteristics of this genus are effuse, effuse-reflexed to substipitate basidiomata with a poroid hymenophore, a dimitic hyphal system with clamp connections on the generative hyphae and cyanophilous skeletal hyphae, encrusted or smooth skeletocystidia, and smooth, inamyloid, acyanophilous, cylindrical, ellipsoid to subglobose basidiospores (Núñez & Ryvarden 2001, Ryvarden & Gilbertson 1993). *Junghuhnia* spp. are saprobic lignicolous Basidiomycota, inhabiting coniferous wood and hardwood and causing white rot. *Junghuhnia* is closely related to *Antrodiella* Ryvarden & I. Johans. and *Steccherinum* Gray in microscopic characters by sharing a similar hyphal structure, cyanophilous skeletal hyphae and small basidiospores (Dai & Niemelä 1997, Dai *et al.* 2004). Species of *Junghuhnia* and *Antrodiella* have poroid hymenophores, and *Steccherinum* spp. have hydnaceous to odontioid hymenophores. The latest molecular study on this group shows very complicated relationships among the species of the three genera (Miettinen et al. 2011). *Junghuhnia* is a cosmopolitan genus and comprises about 26 species (Spirin *et al.* 2007; Yuan & Dai 2008 a, 2008 b; CBS database: http://www.cbs.knaw.nl/databases), including the two new species proposed herein. Ten species of *Jung-*

* e-mail: shwu@mail.nmns.edu.tw

huhnia have been recorded from East Asia (Núñez & Ryvarden 2001, Yuan & Dai 2008 b, Cui *et al.* 2008, Dai 2012), but only one species was recorded in Taiwan (Chang 1994). We have studied specimens of *Junghuhnia* collected in the last two decades in Taiwan. Two unknown species have been found in this study. They are described based on specimens collected from Orchid Island (tropical isle southeastern to Taiwan) and Kungliao (northern lowland Taiwan).

Materials and methods

Specimens are deposited in the herbarium of the National Museum of Natural Science (TNM), Taichung, Taiwan. The microscopical procedure follows Dai (2010). Microscopical studies were done from thin-sections of a basidioma mounted in Cotton Blue (abbreviated as CB): 0.1 mg aniline blue dissolved in 60 g pure lactic acid; CB+ = cyanophily, CB– = acyanophily. Amyloid and dextrinoid reactions were tested in Melzer's reagent (IKI): 1.5 g KI (potassium iodide), 0.5 g I (crystalline iodine), 22 g chloral hydrate, aq. dest. 20 ml; IKI– = neither amyloid nor dextrinoid reaction. For observations and measurements of microscopic characters, 5 % KOH was used as the standard mounting medium for all measurements. Sections were studied at magnifications up to ×1000 using a ZEISS Axioskop phase contrast microscope. The apiculus was excluded in spore measurements. For presenting the spore size variation, 5 % of the measurements out of each end of the range are given in parentheses. The following abbreviations are used: L = mean spore length (arithmetical average of all spores), W = mean spore width (arithmetical average of all spores), Q = extreme values of the length/width ratios among the studied specimens, and n = the number of spores measured from a given number of specimens. The color terms follow Anonymous (1969) and Petersen (1996).

Key to species of *Junghuhnia*

The spore dimensions given are based on the Chinese materials or CBS database.

1. Basidiospores cylindrical to suballantoid 2
1. Basidiospores ovoid, ellipsoid to subglobose..... 6
2. Pore surface cream, yellow to ochraceous 3
2. Pore surface cinnamon to cocoa colored..... *J. collabens* (Fr.) Ryvarden
Basidiospores 3.0–3.5(4) × (1.2)1.5–1.9(2.2) µm
3. Pores ≤ 5 per mm..... 4
3. Pores > 5 per mm..... 5
4. Dissepiments entire, pores 3–5 per mm...*J. luteoalba* (P. Karst.) Ryvarden
Basidiospores (3.3)3.6–4(4.2) × 2.2–2.8(3) µm
4. Dissepiments lacerate, pores 1–2 per mm.....*J. zonata* (Bres.) Ryvarden
Basidiospores 5–7 × 2–2.5 µm
5. Gloeocystidia absent, pores 7–10 per mm..... *J. micropora* Spirin *et al.*
Basidiospores (2.8)2.9–4(4.3) × (1.5)1.7–1.9(2) µm

5. Gloeocystidia present in hymenium, pores 5–7 per mm .....
..... *J. japonica* Núñez & Ryvarden
Basidiospores (4.4)4.5–6.0(6.1) × (1.9)2–2.3(2.5) µm
6. Basidiomata effuse-reflexed, pileate to substipitate..... 7
6. Basidiomata strictly resupinate..... 15
7. Pores > 8 per mm..... 8
7. Pores < 8 per mm..... 10
8. Basidiomata effuse-reflexed, upper surface of reflexed part sulcate and zonate, pores tiny, 12–15 per mm .....*J. pseudominuta* H. S. Yuan & Y. C. Dai
Basidiospores (2)2.1–2.6(2.7) × (1.3)1.5–2(2.1) µm
8. Basidiomata distinctly pileate, pileal surface glabrous and azonate, pores 8–12 per mm 9
9. Skeletocystidia encrusted, cylindrical, pores 10–12 per mm.....
.....*J. minuta* I. Lindblad & Ryvarden
Basidiospores 2.5–3 × 2–2.5 µm
9. Skeletocystidia smooth, apically ventricose, pores 8–10 per mm .....
.....*J. neotropica* I. Lindblad & Ryvarden
Basidiospores 2.5–3 × 2–2.5 µm
10. Spore width > 3 µm..... 11
10. Spore width ≤ 3 µm..... 12
11. Pileus pure white when fresh, generative hyphae thin- to thick-walled, up to 5.7 µm wide.....*J. complicata* Blumenf. & J. E. Wright
Basidiospores 3.6–4.6 × 3.1–3.6 µm
11. Pileus ochraceous with a pinkish tint when fresh, generative hyphae thin-walled, 2–3 µm wide ..... *J. undigera* (Berk. & M. A. Curtis) Ryvarden
Basidiospores 4–5 × 3.5–4 µm
12. Pores 2–6 per mm 13
12. Pores 6–8 per mm 14
13. Pores 2–4 per mm, dissepiments lacerate, spores ellipsoid.....
..... *J. pseudozilingiana* (Parmasto) Ryvarden
Basidiospores (3.3)3.6–4(4.2) × 2.2–2.8(3) µm
13. Pores 5–6 per mm, dissepiments entire, spores ellipsoid to subglobose ....
.....*J. semisupiniformis* (Murrill) Ryvarden
Basidiospores (3.3)3.5–3.9(4.2) × (2.3)2.4–2.7(2.9) µm
14. Context duplex with dark-grayish zone .....*J. imbricata* Spirin
Basidiospores (3)3.1–3.6(3.8) × (1.9)2–2.5(2.6) µm
14. Context homogeneous.....*J. autumnale* Spirin *et al.*
Basidiospores (2.9)3.1–4.1(4.2) × (2)2.1–3(3.1) µm
15. Margin with rhizomorphs 16
15. Margin without rhizomorphs..... 18
16. Pores round to angular, dissepiments entire, 8–10 per mm .....
.....*J. rhizomorpha* H. S. Yuan & Y. C. Dai
Basidiospores (2.5)2.7–3(3.2) × (1.8)1.9–2.1(2.2) µm
16. Pores more or less sinuous, dissepiments lacerate, 3–5 per mm..... 17
17. Spore width about 3 µm .....*J. lacera* (P. Karst.) Niemelä & Kinnunen
Basidiospores (3.5)3.6–5(5.1) × (2.6)2.7–3.3(3.5) µm

17. Spore width about 2 µm ..... *J. fimbriatella* (Peck) Ryvarden
Basidiospores 2.7–3.1(3.2) × 2–2.2(3.2) µm
18. Basidiospores mostly > 3 µm wide 19
18. Basidiospores mostly < 3 µm wide 22
19. Basidiomata white, cream to buff 20
19. Basidiomata clay pink to cinnamon to fulvous .....
..... *J. subnitida* H. S. Yuan & Y. C. Dai
Basidiospores (4.3)4.4–5(5.2) × (3.1)3.3–4(4.1) µm
20. Skeletocystidia encrusted 21
20. Skeletocystidia smooth ..... *J. glabricystidia* Ipulet & Ryvarden
Basidiospores 4–5 × 3–3.5 µm
21. Pores round, 3–4 per mm, spores 4–4.5 µm wide .....
..... *J. africana* Ipulet & Ryvarden
Basidiospores 5–6 × 4–4.5 µm
21. Pores angular to slightly irregular, 4–6 per mm, spore 2.9–4 µm wide .....
..... *J. taiwaniana*
Basidiospores (4)4.1–5.1(5.2) × (2.9)3–3.7(4) µm
22. Basidiomata white, cream to buff 23
22. Basidiomata with dark color, pinkish, reddish to chestnut tinted 24
23. Pores round to angular, 5–7 per mm, dissepiments entire ..... *J. tropica*
Basidiospores (2.8)2.9–3.3 × 1.8–2.2(2.3) µm
23. Pores angular, 4–6 per mm, dissepiments lacerate to hydnoid .....
..... *J. crustacea* (Jungh.) Ryvarden
Basidiospores 4–5 × 2.5 µm
24. Basidiomata resinous when dry, pores 3–5 per mm .....
..... *J. carneola* (Bres.) Rajchenb.
Basidiospores 3–5 × 1.5–2.5 µm
24. Basidiomata leathery to corky, pores 5–7 per mm 25
25. Basidiomata with pinkish to dirty pinkish tint, spores bigger .....
..... *J. nitida* (Pers.: Fr.) Ryvarden
Basidiospores (3.8)4–5(5.1) × (2)2.1–2.6(2.8) µm
25. Basidiomata with chestnut to orange-chestnut tint, spores smaller .....
..... *J. polycystidifera* (Rick) Rajchenb.
Basidiospores 2.6–3.6 × 1–1.6 µm

Taxonomy

Junghuhnia taiwaniana H. S. Yuan, Sheng H. Wu & Y. C. Dai, **sp. nov. –** Fig. 1. MycoBank no.: MB 518247

Carpophorum annuum, resupinatum. Facies pororum cremea vel pallide bubalina; pori angulati vel irregulares, 4–6 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae sceletales subiculi, 1,8–3,5 µm diam. Sporae hyalinae, ellipsoideae vel subglobosae, 4–5,2 × 2,9–4 µm.

Holotypus. – TAIWAN, Taipei: Kungliao, alt. 200 m, on angiosperm branch, 25 Jul 1991, *leg.* Y. F. Lin 569 (holotype: TNM F0001656; isotype: HAST 126431).

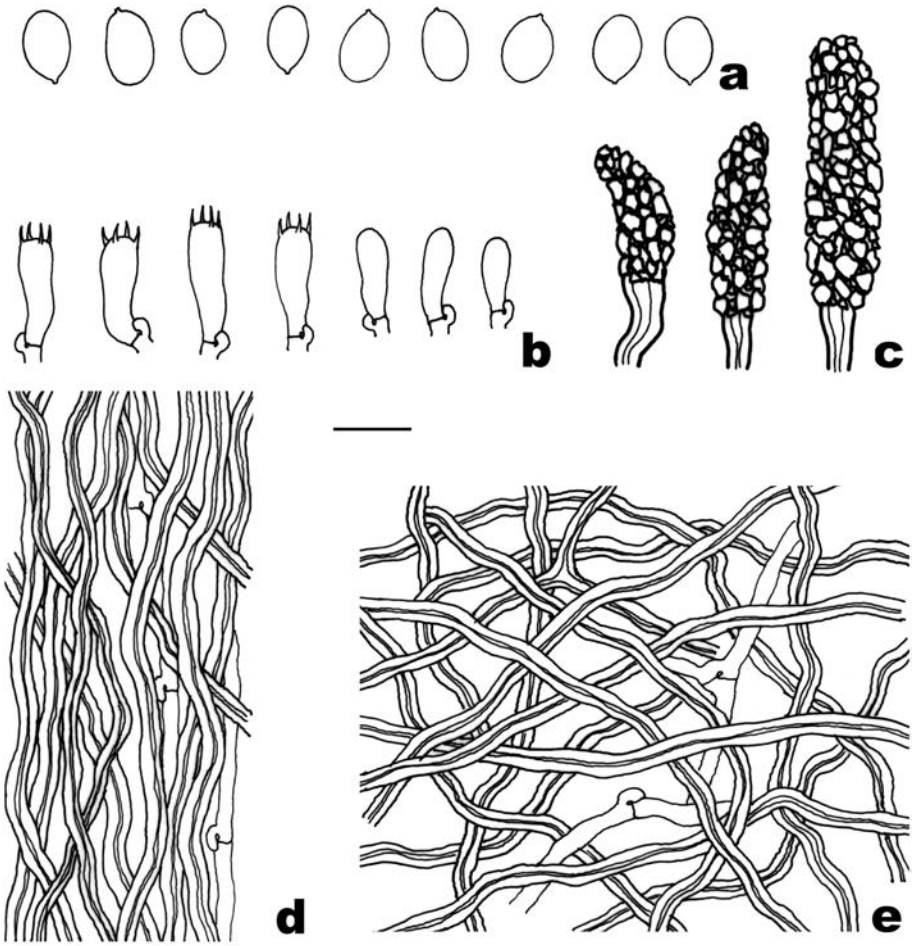

Fig. 1. Microscopic structures of *Junghuhnia taiwaniana* (holotype). **a.** Basidiospores; **b.** Basidia and basidioles; **c.** Upper part of encrusted skeletocystidia; **d.** Hyphae from trama; **e.** Hyphae from subiculum. Bar: a = 5 µm, b-e = 10 µm.

Basidiomata annual, resupinate, coriaceous, tightly adnate, unseparable, without special odor or taste when fresh, corky when dry, up to 15 cm long, 5 cm wide and 1 mm thick. Pore surface cream to straw-yellow upon drying; sterile margin indistinct, cream, membranous, slightly fimbriate; pores angular to slightly irregular, 4–6 per mm, dissepiments thin, slightly lacerate. Subiculum cream to pale buff, corky when dry, very thin, ca. 0.3 mm thick. Tubes concolorous with pore surface, corky, ca. 0.7 mm long. Tissue unchanged in KOH. – Hyphal system dimitic; generative hyphae with clamp connections, skeletal hyphae IKI–, CB+. – Subiculum dominated by skeletal hyphae; generative hyphae hyaline, thin-walled, occasionally

branched, 1.8–2.8 µm in diam.; skeletal hyphae colorless, thick-walled to subsolid, straight to flexuous, occasionally branched, interwoven, 1.8–3 µm in diam. – Tubes. Trama dominated by skeletal hyphae; generative hyphae hyaline, thin-walled, rarely branched, 1.5–3 µm in diam., skeletal hyphae colorless, thick-walled to subsolid, unbranched, straight to flexuous, interwoven, 1.8–3.5 µm in diam. Skeletocystidia numerous, clavate, thick-walled, originating from trama, embedded or projecting above hymenium, heavily encrusted, 15–50 × 4–13 µm (with encrustation). Basidia clavate, bearing four sterigmata and a basal clamp connection, 13–17 × 4–5 µm. – Basidiospores ellipsoid to subglobose, colorless, thin-walled, smooth, IKI–, CB–, (4)4.1–5.1(5.2) × (2.9)3–3.7(4) µm, L = 4.65 µm, W = 3.22 µm, Q = 1.43–1.46 (n = 60/2).

Etymology. – From taiwanianus (relating to Taiwan), referring to the type locality.

Additional specimen examined. – TAIWAN, Taitung: Orchid Island, Tienchih, 22.01 N, 121.34 E, alt. 350 m, on angiosperm trunk, 26 Aug 2002, *leg.* S. Z. Chen 1146 (TNM F0014775).

Junghuhnia tropica H. S. Yuan, Sheng H. Wu & Y. C. Dai, **sp. nov.** – Fig 2.
MycoBank no.: MB 518248

Carpophorum annuum, resupinatum. Facies pororum cremea vel bubalina; pori rotundi vel angulati, 5–7 per mm. Systema hypharum dimiticum, hyphae generatoriae fibulatae, hyphae sceletales subiculi 1,8–3 µm diam. Sporae hyalinae, ellipsoideae, 2,8–3,3 × 1,8–2,3 µm.

Holotypus. – TAIWAN, Taitung: Orchid Island, between trash treatment field and Tienchih, 22.01 N, 121.34 E; alt. 200 m, on angiosperm branch, 13 May 1998, *leg.* S. H. Wu 9805-25 (holotype: TNM F0010022; isotype: HAST 126432).

Basidiomata annual, resupinate, coriaceous, without special odor or taste when fresh, corky when dry, up to 3 cm long, 3 cm wide and 1 mm thick. Pore surface cream to buff upon drying; sterile margin thin, cream, 0.5–1 mm wide; pores round to angular, 5–7 per mm, dissepiments thin, entire. Subiculum cream to pale buff, corky when dry, ca. 0.4 mm thick. Tubes concolorous with pore surface, corky, ca. 0.6 mm long. Tissue unchanged in KOH. – Hyphal system dimitic; generative hyphae with clamp connections, skeletal hyphae IKI–, CB+. – Subiculum dominated by skeletal hyphae; generative hyphae hyaline, thin-walled, moderate branched, 1.5–2.2 µm in diam.; skeletal hyphae colorless, thick-walled to subsolid, straight to flexuous, unbranched, interwoven, 1.8–3 µm in diam. – Tubes. Trama dominated by skeletal hyphae; generative hyphae hyaline, thin-walled, occasionally branched, 1.8–2.2 µm in diam.; skeletal hyphae colorless, thick-walled to subsolid, unbranched, straight to flexuous, interwoven, 2–3 µm in diam. Cystidia of two types: (i) Skeletocystidia numerous, clavate, thick-walled, originating from trama, embedded or projecting, heavily encrusted, 8–50 × 5–8 µm (with encrustation); (ii) Encrusted cystidia cylindrical, thin- to slightly thick-walled, originating from subhymenium, apically encrusted, 6–12 × 5–7 µm (with encrustation). Basidia clavate, bearing four sterigmata and a basal clamp con-

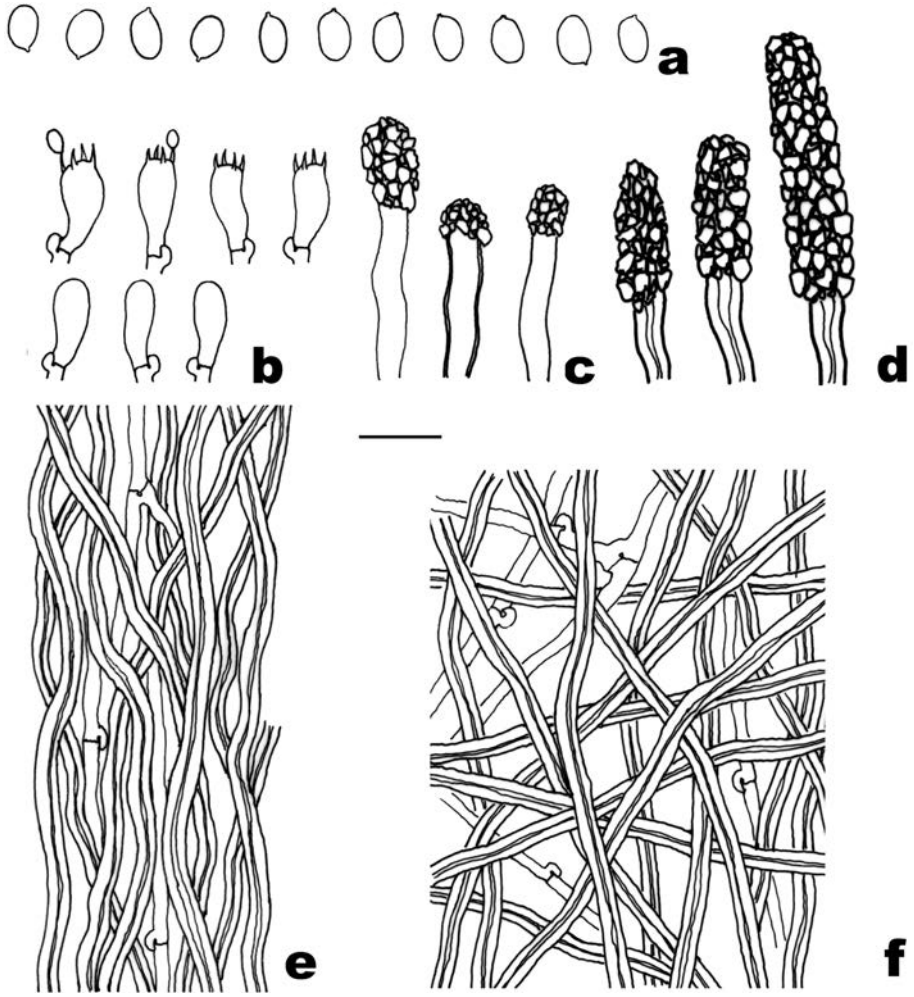

Fig. 2. Microscopic structures of *Junghuhnia tropica* (holotype). **a.** Basidiospores; **b.** Basidia and basidioles; **c.** Thin-walled encrusted cystidia; **d.** Upper part of encrusted skeletocystidia; **e.** Hyphae from trama; **f.** Hyphae from subiculum. Bar: a = 5 µm, b-f = 10 µm.

nection, 9–12 × 4–5 µm. – Basidiospores ellipsoid, colorless, thin-walled, smooth, IKI–, CB–, (2.8)2.9–3.3 × 1.8–2.2(2.3) µm, L = 3.08 µm, W = 2.03 µm, Q = 1.5–1.53 (n = 60/2).

Etymology. – From tropicus (= tropical), referring to the climate where the specimens were found.

Additional specimen examined. – TAIWAN, Taitung: Orchid Island, between trash treatment field and Tienchih, 22.01 N, 121.34 E, alt. 150 m, on angiosperm branch, 1 May 1997, *leg.* S. H. Wu 9705-18 (TNM F0008741).

Discussion

The two new species are distributed in subtropical to tropical hardwood forest, and inhabit preferably angiosperm branches.

Macroscopically, *Junghuhnia taiwaniana* resembles *J. crustacea* by having angular to slightly irregular pores in hymenial surface, similar pore size and slightly lacerate dissepiments. Microscopically, *J. crustacea* differs from *J. taiwaniana* by having narrower basidiospores (2.5 µm wide, Ryvarden & Johansen 1980).

Junghuhnia lacera and *J. undigera* share similar-sized spores with *J. taiwaniana*. The former differs from *J. taiwaniana* by having more irregular pores, cinnamon-buff pore surface, and rhizomorphic basidioma margin (Núñez & Ryvarden 2001). The latter differs from *J. taiwaniana* by having effuse-reflexed to substipitate basidiomata that often form imbricate clusters, and with ochraceous hymenial surface (Ryvarden 1984); while basidiomata of *J. taiwaniana* are strictly resupinate and with cream to buff colored hymenial surface.

Junghuhnia tropica is characterized by resupinate basidiomata, cream to buff pore surface, thin subiculum, dimitic hyphal system with cyanophilous skeletal hyphae, two types of cystidia, and fairly small ellipsoid basidiospores. Superficially basidiomata of *J. tropica* resemble juvenile ones of *J. nitida* by having cream to buff pore surface and white to cream margin; while the pore surface of mature *J. nitida* is buff-pinkish tinted and easily recognizable in the field (Núñez & Ryvarden 2001). Moreover, the latter has only one kind of cystidia and longer basidiospores (3.8–5.1 × 2–2.8 µm,Yuan & Dai 2008 b).

Junghuhnia fimbriatella, *J. minuta*, *J. neotropica*, *J. rhizomorpha* and *J. tropica* share similar-sized basidiospores. *Junghuhnia fimbriatella* differs from *J. tropica* by a strongly rhizomorphic basidioma margin, additionally it shows sinuous, irregular and bigger pores (4 per mm) (Ryvarden & Gilbertson 1993, Núñez & Ryvarden 2001). *Junghuhnia minuta* differs from *J. tropica* by pileate basidiomata and very small pores (10–12 per mm,Lindblad & Ryvarden 1999). *Junghuhnia neotropica* differs from *J. tropica* by pileate basidiomata, smaller pores (8–10 per mm, Lindblad & Ryvarden 1999) and smooth skeletocystidia. *Junghuhnia rhizomorpha* is distinguished from *J. tropica* by rhizomorphic basidioma margins and smaller pores (8–10 per mm, Yuan & Dai 2008 b).

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