



# New species and combinations in the Cerrenaceae (Polyporales, Basidiomycota)

## Nuevas especies y combinaciones en Cerrenaceae (Polyporales, Basidiomycota)

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### ABSTRACT

The classification and taxonomy of the Polyporales have undergone tremendous change and made significant progress in the last ten years. A case in point is the Cerrenaceae that was created just five years earlier. This is one of the smaller, lesser-known families with just five recognized genera and is well-defined and supported by phylogenetic analyses but difficult to characterize by morphology. Some genera and species in the Cerrenaceae display a range in basidiome habit, hymenophore configuration, and hyphal system that overlap with species from other families in the Polyporales and Agaricales. In this study, we clarify the morphological features that distinguish genera in the Cerrenaceae by conducting taxonomic studies in *Irpiciporus*, *Pseudolagarobasidium*, *Pseudospongipellis*, and *Radulodon* and presenting keys to the accepted species. Generic descriptions for *Irpiciporus* and *Radulodon* are revised. Two new taxa are described and illustrated, namely, *Irpiciporus rajchenbergii* from Brazil and *Pseudospongipellis tomsovskyi* from southwestern United States. In addition, four new combinations are proposed — *Irpiciporus africanus*, *I. decolorans*, *I. revolubilis*, and *Pseudolagarobasidium cirrhatinum*. *Radulodon acacia*, from India, is placed in synonymy under *Pseudolagarobasidium acaciicola*, and *Irpiciporus noharae*, from Japan, is confirmed to be a synonym of *Lopharia mirabilis*.

**Keywords** — Crust fungi; four new combinations; two new taxa.

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## RESUMEN

La clasificación y taxonomía de los Polyporales ha experimentado grandes cambios y ha progresado significativamente en los últimos diez años. Un ejemplo de ello es en Cerrenaceae que se creó sólo cinco años antes. Esta es una de las familias más pequeñas y menos conocidas que está bien definida y respaldada por análisis filogenéticos, pero difícil de caracterizar usando la morfología. Algunos géneros y especies de Cerrenaceae son difíciles de identificar y clasificar porque muestran una variedad de hábitos del basidioma, configuración del himenóforo y sistema de hifas que se superponen con especies de otras familias en los Polyporales y Agaricales. En este estudio, aclaramos las características morfológicas que distinguen los géneros en Cerrenaceae mediante la realización de estudios taxonómicos en *Irpiciporus*, *Pseudolagarobasidium*, *Pseudospongipellis* y *Radulodon*, y presentando claves para las especies aceptadas. Se revisan las descripciones genéricas de *Irpiciporus* y *Radulodon*. Se describen e ilustran dos taxones nuevos, *Irpiciporus rajchenbergii* de Brasil y *Pseudospongipellis tomšovskyi* del suroeste de los Estados Unidos. Además, se proponen cuatro combinaciones nuevas: *Irpiciporus africanus*, *I. decolorans*, *I. revolubilis* y *Pseudolagarobasidium cirrhatinus*. *Radulodon acacia*, de India, se ubica en sinonimia bajo *Pseudolagarobasidium acaciicola*, y se confirma que *Irpiciporus noharae*, de Japón, es sinónimo de *Lopharia mirabilis*.

**Keywords** — Hongos de corteza; tres nuevas combinaciones; dos taxones nuevos.

## INTRODUCTION

The Cerrenaceae Miettinen, Justo & Hibbett was described in 2017 as revealed by phylogenetic analyses and included *Cerrena* Gray, the generic type, *Irpiciporus* Murrill, *Pseudolagarobasidium* J.C. Jang & T. Chen, and *Radulodon* Ryvarden as well as a species of *Rigidoporus* Murrill and three species of *Spongipellis* Pat. (Justo *et al.*, 2017). These results were supported and expanded by taxonomic studies in the Cerrenaceae by Tomšovský (2012), Nakasone & Lindner (2012), Kotiranta *et al.* (2017), and Han *et al.* (2021). Recently, *Pseudospongipellis* Y.C. Dai & Chao G. Wang was created for *Spongipellis delectans* (Peck) Murrill, *S. litschaueri* Lohwag, and *S. unicolor* (Fr.) Murrill that formed a distinct clade in the family (Wang & Dai, 2022). The Cerrenaceae is not readily distinguished by basidiome characters, nevertheless, the five genera in the family are distinct from each other morphologically as well as phylogenetically. Basidiomes range from effused to pileate with poroid, labyrinthine or spinose hymenophores and monomitic to trimitic hyphal systems with clamped generative hyphae. Cystidia or cystidioles may be present or not, basidia are clavate with 4-sterigmata, and the basidiospore walls are smooth, thin to thick, non-amyloid, non-dextrinoid, sometimes cyanophilous (Justo *et al.*, 2017). Most species in the family are associated with a white rot decay, but a few are pathogens of living plants, endophytes, or symbionts with insects (Pažoutová & Šrůtka, 2007; Hallenberg *et al.*, 2008).

In this study, the genera *Irpiciporus* and *Radulodon* are emended. New species in *Irpiciporus* and *Pseudospongipellis* are described, and new combinations are proposed in *Irpiciporus* and *Pseudolagarobasidium* based on morphological data and, when available, phylogenetic analyses of sequence data. Keys to the accepted species in *Irpiciporus*, *Pseudolagarobasidium*, *Pseudospongipellis*, and *Radulodon* are provided.

## MATERIALS AND METHODS

### Morphological studies

Thin, freehand sections or scrapings from basidiomes were mounted in 2% (w/v) aqueous potassium hydroxide (KOH), 1% (w/v) aqueous phloxine, or Melzer's reagent. Cyanophily of hyphal and basidiospore walls was observed in 1% (w/v) cotton blue in 60% (w/v) lactic acid. Line drawings were made with a camera lucida attached on an Olympus BH2 compound microscope. Basidiospores in adaxial view were measured in KOH and phloxine mounts under oil immersion. Q values were calculated from mean spore length divided by mean spore width of at least 30 spores unless noted otherwise. Color codes and names follow Kornerup & Wanscher (1978) whereas capitalized names are from Ridgway (1912). Herbarium code designations follow Index Herbariorum (Thiers, 2022). Mycobank ([www.mycobank.org](http://www.mycobank.org), Robert *et al.*, 2013), Index Fungorum ([www.indexfungorum.org](http://www.indexfungorum.org)), and MyCoPortal (<http://www.mycportal.org/portal/index.php>) websites were visited many times throughout this study.

### DNA sequence and phylogenetic analyses

DNA extraction and amplification were performed from cultures at the Center for Forest Mycology Research (CFMR) following a standard CTAB protocol (Mercado & Ortiz-Santana, 2018). Sequencing was conducted at the University of Wisconsin Biotechnology Center (UWBC) in Madison, WI. The internal transcribed spacer region (ITS), including ITS1, 5.8S and ITS2, was amplified with primer pairs ITS1F/ITS4 (White *et al.*, 1990; Gardes & Bruns, 1993). Newly generated sequences were edited with Sequencher 4.8 (Gene Codes Corp., Ann Arbor, Michigan). For this study, six new ITS sequences of *Pseudospongipellis* were generated and 29 were retrieved from GenBank. Taxa selection for phylogenetic analyses of the *Pseudospongipellis* species is based primarily on Tomšovský (2012). Two ITS sequences of *Cerrena unicolor* were used as outgroup. GenBank accession numbers are given in Table 1. DNA sequences were compared using two phylogenetic analyses: Bayesian inference (BI) and Maximum likelihood (ML). The sequences were aligned with MAFFT 7 (Katoh *et al.*, 2019). The alignments were manually adjusted with AliView 1.18 (Larsson, 2014). Bayesian inference analysis was performed with MrBayes 3.2.2 (Ronquist *et al.*, 2012) on XSEDE through CIPRES Science Gateway (Miller *et al.*, 2010), for 1 000 000 generations in two runs and four chains with trees sampled every 100 generations. The burn-in period was set to 0.25. The best substitution model of DNA evolution

**Table 1.** List of samples with GenBank accession numbers of ITS sequences used in the phylogenetic analyses. New sequences are in boldface.

**Tabla 1.** Lista de las muestras con números de acceso de GenBank de las secuencias ITS utilizadas en los análisis filogenéticos. Las nuevas secuencias están en negrita.

Species name	Voucher specimen	Country	GenBank accession number
<i>Pseudospongipellis unicolor</i>	FP-59199-T	USA: MO	HQ728310
	FP-71791-T	USA: VA	HQ728313
	FP-102487	USA: IL	<b>ON876768</b>
	FP-55549	USA: LA	<b>ON876769</b>
	FP-67903	USA: MO	<b>ON876770</b>
	FP-105339	USA: WI	<b>ON876771</b>
	FP-71815	USA: NC	<b>ON876772</b>
	FP-50211	USA: LA	HQ728312
	FP-71354	USA: MI	HQ728311
	CBS-487-72	Canada	MH860539
	FP-101471	USA: WI	HQ728309
FP-101551	USA: WI	HQ728308	
CIRM-BRFM 627	France	FJ349625	
<i>Pseudospongipellis litschaueri</i>	BRNM 712626	Czechia	HQ728305
	BRNM 670693	Czechia	HQ728303
	WU 26759	Austria	HQ728306
	WU 28871	Czechia	HQ728307
	WU 7441	Austria	HQ728304
<i>Pseudospongipellis tomsovskyi</i>	RLG-10818	USA: NM	<b>ON876773</b>
	RLG-7701	USA: AZ	HQ728302
	RLG-7638	USA: AZ	KY948751
<i>Pseudospongipellis "litschaueri"</i>	H&G&H 150707	China	MH425279
	CIRM-BRFM 29	China	FJ789779
<i>Pseudospongipellis "delectans"</i>	Dai-3041 (X1182)	China	KY415961
	10780	India	MT126488
<i>Pseudospongipellis delectans</i>	HHB-10489	USA: MI	KP135301
	FP-90125	USA: MD	HQ728301
	ERT-853	USA: MS	HQ728299
	FP-71380	USA: PA	HQ728300
	FP-71341	USA: PA	HQ728298
	FP-71312	USA: PA	HQ728297
	FP-101579	USA: MD	KY948750
	CBS:147.40	USA	MH856070
	838	Czechia	HQ728294
	OSM-F925	Czechia	HQ728296
<i>Cerrena unicolor</i>	Miettinen-9443	Finland	FN907915
	FD-299	USA: MA	KP135304

**Table 2.** Critical features to differentiate genera in the Cerrenaceae.

**Tabla 2.** Caracteres críticos para diferenciar los géneros en Cerrenaceae.

Feature	Genus				
	<i>Cerrena</i>	<i>Irpiciporus</i>	<i>Pseudo-lagarobasidium</i>	<i>Pseudo-spongipellis</i>	<i>Radulodon</i>
Basidiome pileate	+ (-) <sup>a</sup>	+ or -	-	+	-
Hymenophore poroid	+ (-)	+ or -	-	+ or -	-
Hyphal system monomitic	-	+	(+)	+	(+)
di- or trimitic	+	-	+	-	+
skeletal hyphae	+	-	-	-	-
microbinding hyphae	-	-	+ (-)	-	+ (-)
Cystidia or cystidioles					
hymenial	+ or -	-(+)	+	-	+
tramal	- (+)	-	+	-	-
Fruiting on living trees	- (+)	- (+)	-	+	-

<sup>a</sup> Parentheses indicate a rare condition or occurrence of feature.

was estimated using jModelTest2 in CIPRES, the best-fit model for BI was HKY+I (parameters  $nst=2$ ,  $rates=propinv$ ). Maximum likelihood (ML) analysis was performed using RAxML-HPC2 on XSEDE through CIPRES under the GTR model with GAMMA distributed rate heterogeneity and 1000 rapid bootstrap replicates; other parameters were kept at their default settings. Phylogenetic trees were visualized and edited in FigTree 1.4.4 (Rambaut, 2018); final tree was edited in Adobe Illustrator CC 2018 (San José, California).

## RESULTS AND DISCUSSION

### Taxonomy of *Irpiciporus* Murrill [MB# 17861], emended

Basidiomes annual, effused, effused-reflexed or pileate, solitary or imbricate, soft to firm when fresh, then membranous, subceraceous, cartilaginous, crustaceous or corky when dry. Pilei broadly attached, flabelliform to dimidiate; pileus surface white, cream to buff yellow, glabrous, velutinous to tomentose, azonate, sometimes finely zonate near the margin. Hymenophore poroid, irpicoid to spinose, often short lamellate to labyrinthine then lacerate near margins, white, buff yellow to ochraceous. Context indistinctly duplex, white to cream, spongy to corky, non-agglutinated. Hyphal system monomitic, generative hyphae with clamp connections, walls hyaline to pale yellow, thin to thick, smooth, usually cyanophilous. Cystidia absent; cystidioles usually present, inconspicuous, fusiform, rarely cylindric,  $30\text{--}45 \times 5\text{--}8 \mu\text{m}$ . Basidia clavate to cylindric,  $(15\text{--})20\text{--}40(\text{--}50) \times 4\text{--}7 \mu\text{m}$ , clamped at base, 4-sterigmate. Basidiospores ellipsoid, broadly ellipsoid to globose, hyaline, often uniguttulate, walls slightly thickened, smooth, weakly to strongly cyanophilous, not reacting in Melzer's reagent.

The generic description is based on Wang & Dai (2022) and supplemented with our observations. Although *Irpiciporus* is often treated as a later synonym of *Spongipellis* by many authors, phylogenetic analyses confirm that the two genera are distinct with their type species in the Cerrenaceae and Meripilaceae Jülich, respectively (Justo *et al.*, 2017; Wang & Dai, 2022). Basidiomes of *Irpiciporus* species are varied in habit, color, texture, and hymenophore configuration. A case in point is *Irpiciporus pachyodon* (Pers.) Kotl. & Pouzar [MB# 299102]. This well-known species from north temperate North America and Europe produces basidiomes that are effused, effused-reflexed, or pileate with a hymenophore of coarse flattened teeth and spines but often developing short lamellae or pores at the margins. This variability resulted in its placement in nine different genera; see complete synonymy in MycoBank and Index Fungorum.

Wang & Dai (2022) accepted two additional species in *Irpiciporus*, namely, *I. sinuous* Y.C. Dai & Chao G. Wang [MB# 843476] from Yunnan Province in China and *I. xuchilensis* (Murrill) Y.C. Dai & Chao G. Wang [MB# 843481] from Mexico and Ecuador. We describe a new taxon from Brazil, *I. rajchenbergii*, and propose transfers from *Irpex*, *Radulodon*, and *Spongipellis*. A key to the seven accepted species in *Irpiciporus* is presented below. Except for *I. pachyodon*, taxa in *Irpiciporus* occur in the tropics and are uncommon, often represented by just a few specimens.

*Radulodon* is morphologically similar to *Irpiciporus* but differs in having widely effused basidiomes with an agglutinated context, a dimitic (but monomitic in one taxon) hyphal system with micro-binding hyphae, and hymenial cystidia (Nakasone, 2001); see discussion below.

### Key to the species of *Irpiciporus*

- 1 Basidiomes effused ..... 2
- 1' Basidiomes effused-reflexed or pileate ..... 5
- 2 Spines up to 10 mm long, basidiospores  $5\text{--}7 \times 4.3\text{--}6 \mu\text{m}$ , from north temperate U.S.A., Canada, and Europe ..... *I. pachyodon*
- 2' Spines up to 5 mm long, basidiospores up to  $5 \mu\text{m}$  broad, from tropical America or Africa ..... 3
- 3 Basidiospores  $< 3.5 \mu\text{m}$  diam. .... *I. decolorans*
- 3' Basidiospores typically  $> 3.5 \mu\text{m}$  diam. .... 4
- 4 Hymenophore spinose to sublamellate, basidia  $18\text{--}22 \mu\text{m}$  long, from Venezuela ..... *I. revolubilis*
- 4' Hymenophore spinose, basidia  $(17\text{--})25\text{--}40 \mu\text{m}$  long, from Brazil ..... *I. rajchenbergii*
- 5 Hymenophore spinose, basidia small,  $12\text{--}15 \times 4\text{--}6 \mu\text{m}$  ..... *I. africanus*
- 5' Hymenophore spinose to poroid, basidia larger ..... 6
- 6 Pileus surface silky, basidiospores small,  $4.3\text{--}5 \times 3.9\text{--}4.3 \mu\text{m}$ , from Mexico and Ecuador ..... *I. xuchilensis*
- 6' Pileus surface smooth to velutinous, basidiospores larger, from China or temperate North America and Europe ..... 7
- 7 Pores sinuous, basidia  $17\text{--}23 \times 5\text{--}6 \mu\text{m}$ , basidiospores  $5\text{--}6 \times 4\text{--}5 \mu\text{m}$ , from southwest China ..... *I. sinuous*
- 7' Pores irregular, irpicoid to labyrinthine, basidia  $30\text{--}40 \times 4\text{--}7 \mu\text{m}$ , basidiospores  $5\text{--}7 \times 4.3\text{--}6 \mu\text{m}$ , from north temperate U.S.A., Canada, Europe ..... *I. pachyodon*

#### *Irpiciporus africanus* (Ipulet & Ryvarden)

Nakasone, comb. nov. [MB# 844557]

≡ *Spongipellis africana* Ipulet & Ryvarden, *Synopsis Fungorum* 20: 97 (2005). [MB# 344194]

**Habitat and distribution.**— On decayed hardwoods, reported from Uganda and South America.

**Specimen examined.**— VENEZUELA. Estado Aragua, Parque Nacional Henri Pittier, Rancho Grande Research Station, on decayed hardwood, 25-IV-1998, *L. Ryvarden* 40797 (O, as *Radulodon revolubilis*).



**Descriptions and illustrations.**— Ipulet & Ryvardeen (2005), Gerlach (2009: 19–20), Gerlach & Loguercio-Leite (2011).

**Remarks.**— *Irpiciporus africanus* is characterized by a soft, effused-reflexed to pileate basidiome with basally fused, flattened spines up to 4 mm long, and globose to subglobose basidiospores with slightly thick to thick walls,  $4\text{--}5\text{--}(6) \times 4\text{--}5 \mu\text{m}$ . It is transferred to *Irpiciporus* because its soft texture and spinose hymenophore are consistent with other species in the genus but not with the poroid hymenophores of *Spongipellis sensu stricto* or *Pseudospongipellis* as described by Wang & Dai (2022). More specimens are needed to determine the intraspecific variation of this taxon because metuloid cystidia were reported by Gerlach & Loguercio-Leite (2011) but not observed by other authors. Phylogenetic data is also desirable, but Wang & Dai (2022) were unable to obtain DNA sequences from the type specimen. We were unable to examine the type of *S. africana*, but the specimen cited above agrees well with the description of the type. Ryvardeen 40797 was listed as paratype of *R. revolubilis* but is clearly different from the holotype; see discussion of *Irpiciporus revolubilis* below.

*Irpiciporus decolorans* (Cooke)

Nakasone, comb. nov. [MB# 844559]

≡ *Irpex decolorans* Cooke, *Grevillea* 19(92): 109 (1891). [MB# 440033]

≡ *Cristinia decolorans* (Cooke) Nakasone, *Czech Mycology* 64: 33 (2012). [MB# 564708]

**Habitat and distribution.**— On rotting logs, known only from type locality, Cuba.

**Type specimen examined.**— CUBA. On rotting logs, *C. Wright* 835 (K: K(M) 62571, holotype; FH: HUH 00301397, isotype).

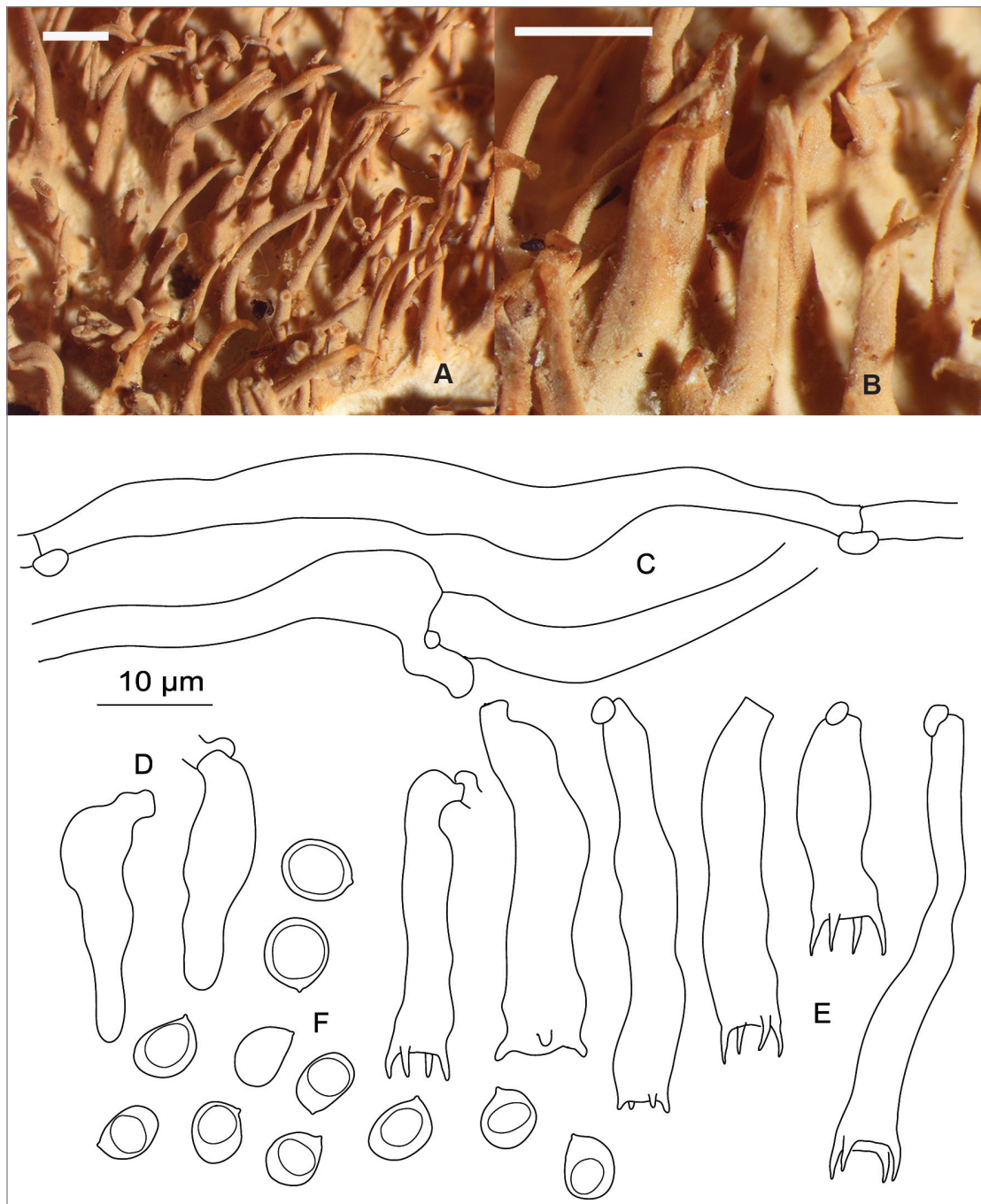
**Description and illustration.**— Nakasone (2012: 33).

**Remarks.**— After reviewing the literature and re-evaluating observations of the type specimens, the transfer of *I. decolorans* to *Irpiciporus* is proposed. Because cyanophilous granules in the basidia were not observed, this taxon does not belong in *Cristinia* Parmasto. The effused basidiomes that change from white to brown on drying and small, broadly ellipsoid basidiospores,  $3.6\text{--}4.5\text{--}(5) \times (2.5\text{--})2.9\text{--}3.5 \mu\text{m}$ , distinguish *I. decolorans* from other species in the genus.

*Irpiciporus rajchenbergii* Nakasone, sp. nov.

[MB# 844558] Fig. 1

**Diagnosis.**— Different from *Irpiciporus pachyodon* by its effused habit, shorter aculei, smaller basidiospores  $5\text{--}6\text{--}(7) \times (3.5\text{--})4\text{--}5\text{--}(5.8) \mu\text{m}$ , and occurrence in Brazil.



**Fig. 1.** *Irpiciporus rajchenbergii*. A) Spines. B) Close-up of fused spines. C) Hyphae from subiculum. D) Cystidioles. E) Basidia. F) Basidiospores. Rick s.n., holotype (BPI: 259635). Scale: A and B = 1 mm.

**Fig. 1.** *Irpiciporus rajchenbergii*. A) Espinas. B) Espinas fusionadas de cerca. C) Hifas del subículo. D) Cistidiolos. E) Basidios. F) Basidiosporas. Rick s.n., holotipo (BPI: 259635). Escala: A y B = 1 mm.

**Typification.**— BRAZIL. São Leopoldo, 1931, *Rick s.n.* (BPI: 0259635, holotype).

**Etymology.**— Named in honor of Mario Rajchenberg, mycologist from Argentina, who made significant contributions to our knowledge of wood decay fungi of South America.



Basidiomes resupinate, effused, up to  $80 \times 40$  mm, thin, up to  $500 \mu\text{m}$  thick, membranous to subceraceous, spinose with smooth areas between aculei, sometimes degraded, pale orange (5A3) to greyish orange (5B4); hymenophore composed of narrowly conical aculei, terete to compressed, 2–4 mm long, up to 3 aculei per mm, single or fused along entire length, subceraceous but brittle, smooth, slightly darker than area between aculei; margin distinct, slightly detached, curled inward.

Hyphal system monomitic with clamped generative hyphae. Aculei a dense fascicle of non-agglutinated, distinct hyphae enclosed by a hymenial layer, apex sterile, apical hyphae not differentiated; tramal hyphae  $3\text{--}4.5 \mu\text{m}$  diam., clamped, sparingly branched, walls hyaline, slightly thickened, smooth, acyanophilous. Subiculum a dense tissue of non-agglutinated, distinct, intertwined hyphae, more or less parallel to substrate; subicular hyphae  $3.5\text{--}5 \mu\text{m}$  diam., sometimes inflated up to  $7.5 \mu\text{m}$  diam., clamped, moderately branched, walls hyaline, slightly thickened, smooth, acyanophilous. Hymenium a dense palisade of cystidioles and basidia. Cystidioles rare, enclosed, subfusiform, tapering to an obtuse apex,  $20\text{--}22 \times 5\text{--}6 \mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. Basidia cylindric to narrowly clavate,  $(17\text{--})25\text{--}40 \times 4\text{--}6.5 \mu\text{m}$ , clamped at base, 4-sterigmate, walls hyaline, thin, smooth. Basidiospores abundant, subglobose to broadly ellipsoid,  $5\text{--}6(-7) \times (3.5\text{--})4\text{--}5(-5.8) \mu\text{m}$ , average of two specimens  $5.3\text{--}5.5 \times 4.2\text{--}4.6 \mu\text{m}$ ,  $Q = 1.2\text{--}1.3$ , uniguttulate, walls hyaline, slightly thickened, smooth, cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.**— On dead hardwood branches; known only from Brazil.

**Specimens examined** (as *Hydnum macrodon* Pers.).— BRAZIL. São Leopoldo, Rio Grande do Sul, ad ramos arbor. frond., 1903, *Rick s.n.* (BPI: 269632); 1907, *Rick s.n.* (BPI: 0259634).

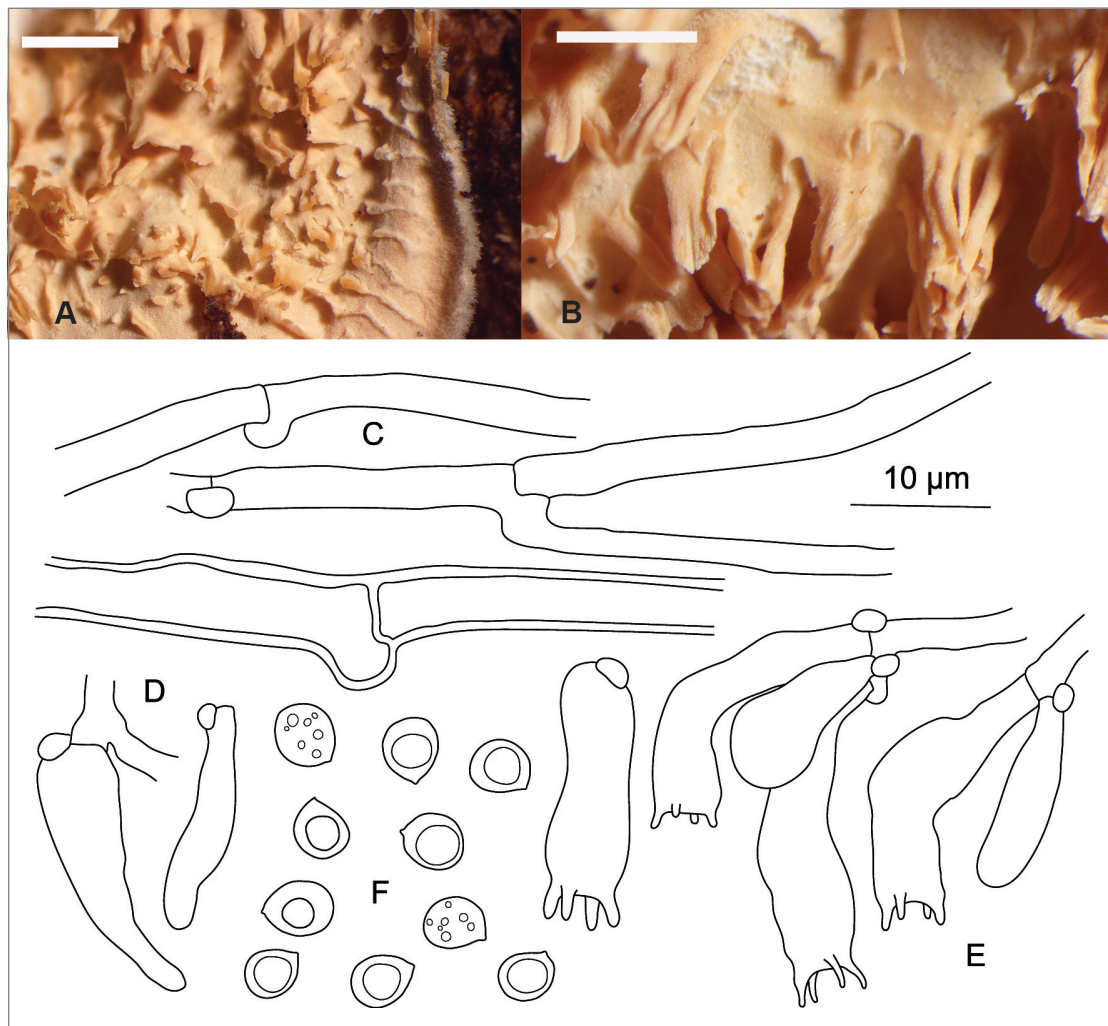
**Remarks.**— *Irpiciporus rajchenbergii* is characterized by effused basidiomes, slender spines, and broadly ellipsoid to subglobose basidiospores with cyanophilous walls. *Irpiciporus pachyodon* is similar but develops pileate or effused-reflexed basidiomes, has slightly larger basidiospores, and is found in north temperate North America and Europe. *Irpiciporus revolubilis* from Venezuela and *I. decolorans* from Cuba also have effused basidiomes but coarser or flattened aculei and smaller basidiospores.

*Irpiciporus revolubilis* (Hjortstam & Ryvardeen)

Nakasone, comb. nov. [MB# 844560] Fig. 2

≡ *Radulodon revolubilis* Hjortstam & Ryvardeen, *Synopsis Fungorum* 23: 88 (2007). [MB# 505163]

Basidiomes widely effused,  $50 \times 30$  mm, cartilaginous, spinose to irpicoid, orange white (5A2), light orange (5A4), greyish orange (5B4), Light Ochraceous Buff, or Cinnamon Buff; hymenophore composed of conical to flattened aculei often fused at base or throughout length, becoming sublamellate to lacerate, up to 3 mm long; margin distinct, abrupt, detached, curling inward, smooth to sublamellate, Light Buff.



**Fig. 2.** *Irpiciporus revolubilis*. A) Sublamellate hymenophore at margin. B) Close-up of single and fused spines. C) Hyphae from aculei trama. D) Cystidioles. E) Basidia. F) Basidiospores. Ryvarden 41417, holotype (O). Scale: A and B = 1 mm.

**Fig. 2.** *Irpiciporus revolubilis*. A) Himenóforo sublamelado en el margen. B) Espinas simples y fusionadas de cerca. C) Hijas de la trama del acúleo. D) Cistidiolos. E) Basidios. F) Basidiosporas. Ryvarden 41417, holotipo (O). Escala: A y B = 1 mm.

Hyphal system monomitic with clamped generative hyphae. Subicular and aculeal hyphae non-agglutinated, 3–6  $\mu\text{m}$  diam., walls distinct, hyaline, thin to 1  $\mu\text{m}$  thick, smooth, weakly cyanophilous. Cystidioles rare, inconspicuous, enclosed, obclavate to cylindric, 16–20  $\times$  3–6  $\mu\text{m}$ , clamped at base, walls hyaline, thin, smooth. Basidia mostly collapsed, clavate, occasionally with a short stalk, 18–22  $\times$  5.5–6  $\mu\text{m}$ , clamped at base, 4-sterigmate, walls hyaline, thin, smooth. Basidiospores subglobose to broadly ellipsoid, 4–5(–5.2)  $\times$  (3.3–)3.6–4.3  $\mu\text{m}$ , average of holotype 4.5  $\pm$  0.4  $\times$  3.9  $\pm$  0.3  $\mu\text{m}$ , Q = 1.2, typically uniguttulate, walls hyaline, slightly thickened, smooth,  $\pm$  cyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.**— On decayed hardwood; known only from type location, Venezuela.

**Type specimen examined.**— VENEZUELA. Estado Aragua, Parque National Henri Pittier, Rancho Grande Research Station, on decayed hardwood, 14-IV-1999, *L. Ryvarden 41417* (O, holotype).

**Remarks.**— Because *I. revolubilis* is monomitic with non-agglutinated subicular hyphae, it is transferred from *Radulodon* which is characterized by a dimitic hyphal system and agglutinated hyphae. *Irpiciporus revolubilis* is distinct from *I. rajchenbergii* and *I. decolorans* by its sublamellate hymenophore and from *I. africanus* by its effused habit. The description above is based on the holotype alone because the paratype (LR 40797) is *I. africanus*.

### Taxa not accepted in *Irpiciporus*

*Irpiciporus noharae* Murrill, *Mycologia* 1(4): 166 (1909)  
[MB# 178059]

= *Lopharia mirabilis* (Berk. & Broome) Pat. [MB# 122879]

**Type specimen examined.**— JAPAN. Sendai, on dead *Hibiscus syriacus*. X-1908, *S. Nohara 49* (BPI: 262984 and 325497, isotypes).

**Remarks.**— We concur with Imazeki (1939: 308) that *I. noharae* is a later synonym of *L. mirabilis*. Murrill (1909) did not observe the large, encrusted cystidia that are clearly present in the isotype specimens.

*Irpiciporus cubensis* (Berk. & M.A. Curtis) Murrill,  
*North American Flora* 9(1): 15 (1907). [MB# 160241]

**Type specimen examined.**— CUBA. Summit of Lomo del Gaso, on rotting logs, *C. Wright 240*, Fungi Cubensis Wrightiani no. 355 (FH: 00301398, isotype).

**Remarks.**— The isotype agrees with the description of the holotype by Maas Geesteranus (1974: 470) except that a few clavate to cylindrical cystidia (or oleiferous hyphae),  $37\text{--}48 \times 8\text{--}11 \mu\text{m}$ , arising from trama, projecting up to  $7 \mu\text{m}$ , with homogeneous contents, were observed. Because the type specimens lack basidiospores, the identity of this taxon remains unknown. Researchers have speculated that *I. cubensis* is a species of *Spongipellis* (Hjortstam, 1990: 419), *Radulodon* (Ryvarden, 2020: 38), or a synonym of *Irpex zonatus* (Cunningham, 1965: 74).

### Taxonomy of *Pseudolagarobasidium* J.C. Jang & T. Chen [MB# 25731]

This genus was created in 1985 based on *Pseudolagarobasidium leguminicola* J.C. Jang & T. Chen, a later synonym of *Hydnum subvinosum* Berk. & Broome (Jang & Chen,

1985). Over time 13 taxa were placed in *Pseudolagarobasidium*; see Index Fungorum and MycoBank for a complete list. Species of *Pseudolagarobasidium* are widely distributed in Asia and Africa and also occur in Central and South America with one taxon in Europe. They are saprobes of woody substrates, plant pathogens, and endophytes as summarized in Hallenberg *et al.* (2008) and Nakasone & Lindner (2012) or symbionts with insects (Pažoutová & Šrůtka, 2007).

Taxa in *Pseudolagarobasidium* and *Radulodon* are morphologically similar, but phylogenetic analyses of multiple loci show that they are distinct, monophyletic genera (Hallenberg *et al.*, 2008; Justo *et al.*, 2017; Han *et al.*, 2021; Wang & Dai, 2022). Basidiomes in both genera are effused, (but effused-reflexed in *P. cirrhatinum*) with odontoid to spinose hymenophores and basidiospores with hyaline, smooth, and thickened walls that may be cyanophilous or not. In addition, there is an overlap in size of basidia, basidiospores, and hymenial cystidia. A closer study, however, reveal that *Radulodon* species have ceraceous basidiomes often with agglutinated hyphae and short, hymenial cystidia. In comparison, basidiomes in *Pseudolagarobasidium* are soft to firm with fragile, brittle aculei and are composed of mostly non-agglutinated hyphae. In addition to hymenial cystidia, all *Pseudolagarobasidium* species develop larger tramal cystidia that originate in the subiculum and subhymenium. Although hyphal walls are always hyaline in *Radulodon*, hyphae in the aculei develop yellow or light brown walls in some *Pseudolagarobasidium* species. Microbinding hyphae occur in most species of both genera but are often overlooked; they may be scarce, localized, or developed only in the substrate.

A monograph of the genus by Nakasone & Lindner (2012) included a key to seven accepted species. The addition of four species, *P. baiyunshanense* M.L. Han, L.S. Bian, & Q. An [MB# 838548], *P. conspicuum* (Pouzar) Nakasone [MB# 812356], *P. pallens* Motato-Vazq. & Westphalen [MB# 840534], and *P. cirrhatinum* (discussed below), brings the total to eleven species. A key to the accepted taxa is presented below.

### Key to the species of *Pseudolagarobasidium*

- 1 Basidiomes soft, chalky to cretaceous ..... 2
- 1' Basidiomes subceraceous to submembranous ..... 3
- 2 Aculei 1–2 per mm, basidiospores (4.8–)5–5.8(–6) × 3.5–4.4 μm, from Europe ..... *P. conspicuum*
- 2' Aculei 2–5 per mm, basidiospores 4–5.5 × 3–3.7(–4.3) μm, from East Asia to West Africa and Australia .....  
..... *P. pronum* (Berk. & Broome) Nakasone & D.L. Lindner
- 3 Basidiospores small, 3.4–4.3(–4.7) × 2.9–3.2(–3.6) μm, from Australia .....  
..... *P. pusillum* Nakasone & D.L. Lindner
- 3' Basidiospores larger, widely distributed ..... 4
- 4 Aculei long, slender, 1–10(–15) mm long, from Malaysia ..... *P. cirrhatinum*
- 4' Aculei shorter, up to 4 mm long, widely distributed ..... 5
- 5 Aculei short, < 0.5 mm long, basidiospores (4.2–)4.4–5.1 × 3–3.6(–4) μm, from



- Belize ..... *P. belizense* Nakasone & D.L. Lindner
- 5' Aculei longer, basidiospores larger, widely distributed ..... 6
- 6 Aculei often purple or violet when fresh ..... 7
- 6' Aculei not purple or violet when fresh ..... 8
- 7 Aculei  $\leq 2$  mm long, basidiospores  $4-6.1(-6.3) \times (2.8-2.9-3.9(-4.4)) \mu\text{m}$ , from China ..... *P. baiyunshanense*
- 7' Aculei  $\leq 4$  mm long, basidiospores  $5-6(-6.5) \times (3-3.5-4(-4.5)) \mu\text{m}$ , from Asia and Africa ..... *P. subvinosum* (Berk. & Broome) Sheng H. Wu
- 8 Aculei yellow, orange or pale brown, 2-4 mm long, from South America ..... 9
- 8' Aculei yellowish brown to brown,  $< 2.5$  mm long, from Africa or Asia ..... 10
- 9 Aculei yellow to orange, often studded with knobs or warts .....  
..... *P. venustum* (Hjortstam & Ryvarde) Nakasone & D.L. Lindner
- 9' Aculei cream to pale brown, smooth ..... *P. pallens*
- 10 Aculei  $\leq 2.5$  mm long, basidiospores  $4.3-5.8(-6.5) \times (2.9-3.2-4(-4.3)) \mu\text{m}$ , from South Africa to East Asia ..... *P. acaciicola* Ginns
- 10' Aculei  $\leq 1$  mm long, basidiospores  $4.2-5(-5.4) \times 2.9-3.5 \mu\text{m}$ , from Mauritius .....  
..... *P. modestum* (Berk. ex Cooke) Nakasone & D.L. Lindner

*Pseudolagarobasidium cirrhatinum* (Hjortstam & Spooner)

Nakasone, comb. nov. [MB# 844561]

$\equiv$  *Radulodon cirrhatinus* Hjortstam & Spooner, *Kew Bulletin* 45(2): 312 (1990). [MB# 132979]

**Habitat and distribution.**— On hardwood log, known only from type location, Malaysia.

**Type specimen examined.**— MALAYSIA. Sabah, Danum Valley, c. 400 feet, on fallen log, 30-XI-1985, *B.M. Spooner* 295 (K(M): 625575, holotype).

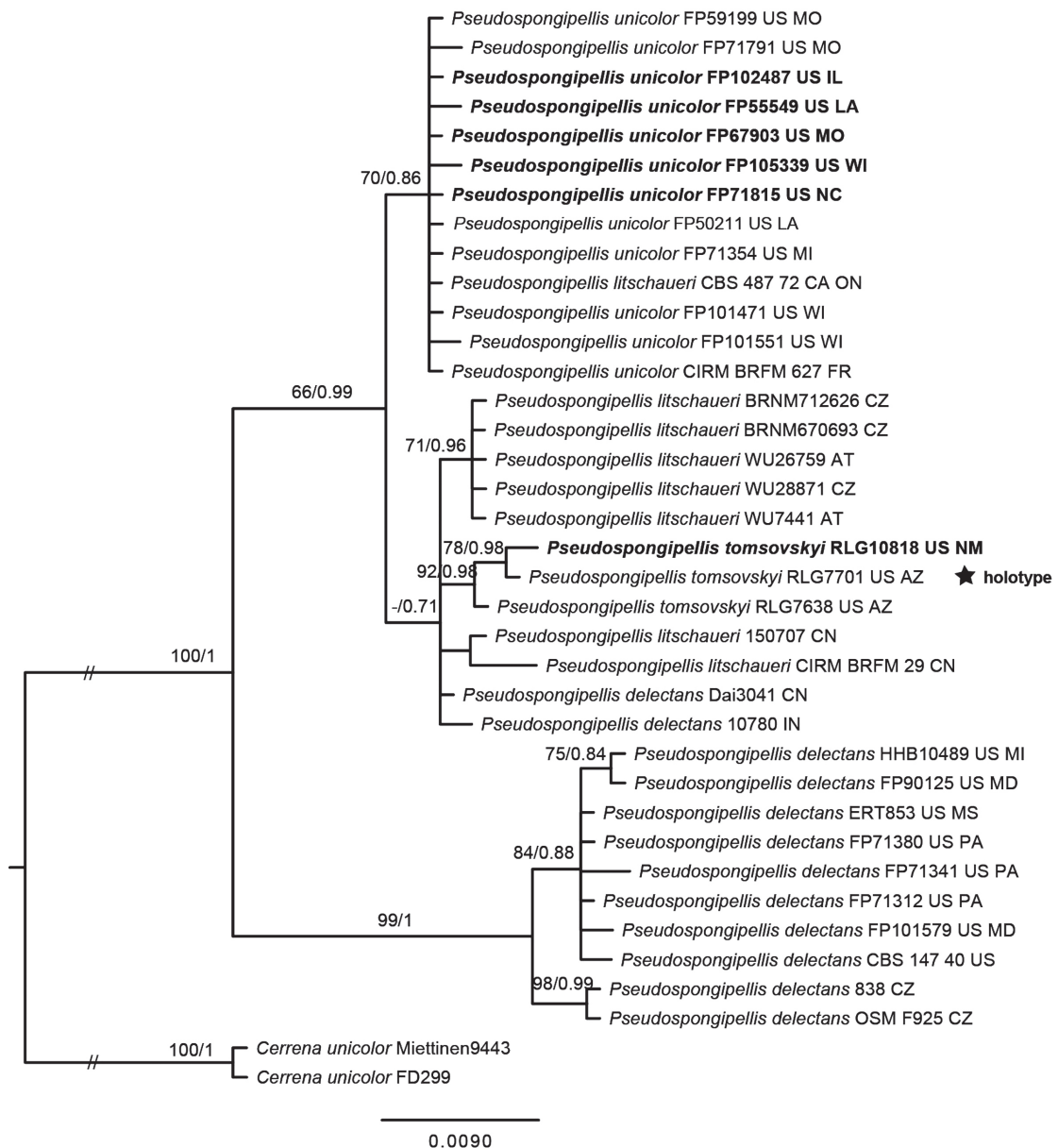
**Descriptions and illustrations.**— Hjortstam *et al.* (1990: 312-314); Nakasone (2001: 168-169, figs. 5, 9).

**Remarks.**— Previous descriptions of *P. cirrhatinum* reported that either tramal cystidia or hymenial cystidia were present. A re-examination of the holotype, however, confirmed that both kinds of cystidia are present. Cylindric to elongate, subfusiform tramal cystidia,  $75-115 \times 8-9 \mu\text{m}$ , were observed in addition to the hymenial cystidia described by Nakasone (2001). Thick-walled hyphae at the base of the aculei were scarce and should be interpreted as sclerified generative hyphae instead of skeletal hyphae. Based on overall morphological features such as the non-agglutinated tissue, monomitic hyphal system with sclerified generative hyphae, and tramal cystidia, the transfer of *R. cirrhatinus* to *Pseudolagarobasidium* is proposed.



### Phylogeny and taxonomy of *Pseudospongipellis* Y.C. Dai & Chao G. Wang [MB# 843486]

**Phylogenetic analyses of *Pseudospongipellis*.**— Figure 3 illustrates the phylogenetic relationships of species within *Pseudospongipellis* based solely on analyses of ITS sequences; because ML and Bayesian analyses resulted in congruent trees, only the BI tree is presented. In this tree, there are three major lineages with potential cryptic taxa. In the first lineage, strains of *P. unicolor* from eastern North America and



**Fig. 3.** Phylogeny of *Pseudospongipellis* inferred from BI analysis of ITS sequences. The values on branches are from ML bootstrap ( $\geq 50\%$ ) and Bayesian posterior probabilities (PP  $\geq 0.70$ ), respectively.

**Fig. 3.** Filogenia de *Pseudospongipellis* inferida del análisis BI de secuencias ITS. Los valores a en las ramas son de ML Bootstrap ( $\geq 50\%$ ) y probabilidades posteriores bayesianas (PP  $\geq 0.70$ ), respectivamente.

CIRM–BRFM–27 from western France are moderately supported at 0.86 BP. Note that CBS 487–72 from Ontario is misidentified as *P. litschaueri*. The second lineage consists of two strongly supported clades represented by samples of *P. litschaueri sensu stricto* from Europe (0.96 BP) and the new taxon, *P. tomsovskyi*, from southwestern U.S.A. (0.98 BP). In addition, four samples from China and India, including two named “*P. delectans*” are also in this lineage and may be cryptic, undescribed taxa. In the third lineage, two strongly supported subclades are evident with samples of *P. delectans sensu stricto* from eastern U.S.A. and two Czechia samples that may represent a cryptic, undescribed, sister taxon.

**Taxonomic results in *Pseudospongipellis*.**— Originally, *Spongipellis* included a diverse group of white-rot decay fungi on living and dead hardwoods with diverse basidiome and hymenophore phenotypes but microscopically similar with a monomitic hyphal system of clamped generative hyphae, no cystidia, clavate basidia with 4-sterigmata, and globose to ellipsoid basidiospores with walls that are hyaline, thick, smooth, usually cyanophilous, and not reacting in Melzer’s reagent (Gilberston & Ryvardeen, 1987: 722; Bernicchia & Gorjón, 2020: 785; Rivoire, 2020: 803). *Spongipellis spumeus* (Sowerby) Pat., the generic type of *Spongipellis*, is phylogenetically related to *Meripilus giganteus* (Pers.) P. Karst. and *Physisporinus* ssp. in the *Meripilaceae* (Wang & Dai, 2022). Because *Spongipellis unicolor*, *S. litschaueri*, and *S. delectans* clustered together in the Cerrenaceae, Wang & Dai (2022) established the new genus *Pseudospongipellis* to accommodate these taxa. Tomšovský (2012) first discovered molecular and basidiospore size differences in “Eastern USA” and “Western USA” samples of *Spongipellis unicolor*. We confirm his original observations and describe the “Western USA” form as the new species, *P. tomsovskyi*. Presently, there are four species in *Pseudospongipellis*, and a key to the species is presented below.

### Key to the species of *Pseudospongipellis*

- 1 Basidiomes pileate, effused-reflexed or effused, pores  $\leq 1$  mm diam. .... 2
- 1’ Basidiomes pileate, pores  $> 1$  mm diam. .... 3
- 2 Basidiomes up to 2 cm thick at base, on various hardwoods but often on *Fagus* in Europe and *Populus* in North America .....  
..... *P. delectans* (Peck) Y.C. Dai & Chao G. Wang
- 2’ Basidiomes 2–5 cm thick at base, typically on *Quercus* Europe, not found in North America ..... *P. litschaueri* (Lohwag) Y.C. Dai & Chao G. Wang
- 3 Basidiospores (6.1–)6.3–7.5(–7.9)  $\times$  (4.2–)4.5–5.8(–5.9)  $\mu\text{m}$ , from midwestern and eastern North America ..... *P. unicolor*
- 3’ Basidiospores (6.5–)7.2–8.7(–9)  $\times$  (5.1–)5.5–7.2  $\mu\text{m}$ , from southwestern United States ..... *P. tomsovskyi*

*Pseudospongipellis tomsovskyi* Nakasone & B. Ortiz,  
sp. nov. [MB# 844562] Fig. 4

**Diagnosis.**— Different from *Pseudospongipellis unicolor* by its larger basidiospores (6.5–)7.2–8.7(–9) × (5.1–)5.5–7.2 μm, larger pores, thicker dissepiments, and restricted distribution on *Quercus* in southwestern United States.

**Typification.**— U.S.A. Arizona, Cochise County, Coronado National Forest, Chiricahua Mountains, Rucker Canyon, on *Quercus emoryi*, 27-X-1967, R.L. Gilbertson 7701 (ARIZ: AN010813, holotype; CFMR, isotype).

**Etymology.**— Named for Michal Tomšovský, mycologist from Czechia, who first recognized this taxon.

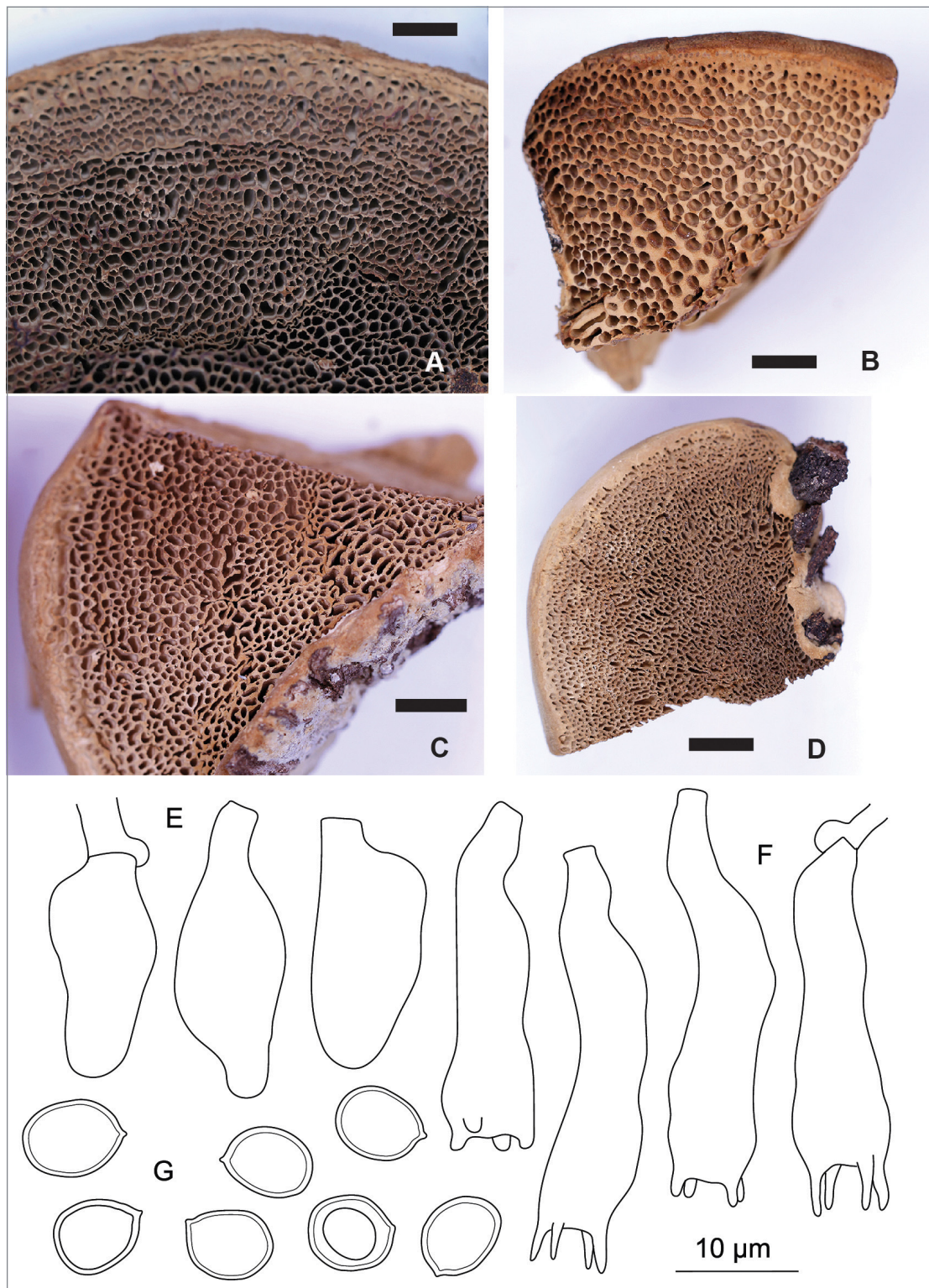
Basidiomes probably annual, sessile, pilei solitary, broadly attached to dimidiate, unguulate to applanate or triquetrous, up to 12 × 18 × 13 cm but usually smaller, light weight and corky when dried. Pileus surface mostly glabrous, azonate, sometimes zonate, smooth at first then irregular, pitted with age, sometimes with short, stiffly tomentose fibrils in a zone near margin, pale yellow (4A3), pale orange (5B3), greyish orange [5B(3–4)], brownish orange (5B5) to light brown (5D5, 6D6) or Cinnamon Buff to Sayal Brown when dried, rarely crustaceous, deeply cracked and grayish black in age. Margin concolorous or slightly darker, brownish orange (6C5), rounded and sometimes curving under edge. Hymenophore poroid, pore surface smooth, even to slightly irregular, elongate on vertical surfaces, occasionally labyrinthine, cream, light orange (5A4) to greyish orange [6(B–C)5] then darkening to reddish brown, Sayal Brown, Tawny Brown, Tawny, or Russett; pores circular to angular, ≥ 1 mm in diam.; dissepiments up to 0.5 mm thick, finely tomentose at first then thin, smooth. Context zonate, firm-fibrous, up to 7 cm thick, greyish orange (5B5), brownish orange (6C5), or Chamois. Tube layer concolorous with context, up to 20 mm thick, inner surface usually lighter in color, pale orange (5A3) to light orange (5A4).

Hyphal system monomitic with clamped generative hyphae. Context composed primarily of thick-walled hyphae with hyaline walls up to 2.5 μm thick, clamped, clamps also with thickened walls, sparsely branched, 5–7.5 μm diam., some thin-walled, clamped, moderately branched, 3–4 μm diam. Tramal hyphae of pores similar. Cystidia and cystidioles not observed. Basidia clavate, often with a short stalk, 26–33 × 6.2–8 μm, with a basal clamp, 4-sterigmate, walls hyaline, thin, smooth. Basidiospores abundant, broadly ellipsoid, (6.5–)7.2–8.7(–9) × (5.1–)5.5–7.2 μm, average of four specimens 7.3–8 × 5.6–6.6 μm, Q = 1.2–1.3, typically with a large, resinous-like globule, contents cyanophilous, walls hyaline, slightly thickened to 1.5 μm thick, smooth, acyanophilous, not reacting in Melzer's reagent.

**Habitat and distribution.**— On living oaks causing a white trunk rot, common in Arizona and New Mexico, also from Oklahoma.

**Descriptions and illustrations.**— Gilbertson & Ryvarden (1987, Fig. 375 as *Spongipellis unicolor*).





**Fig. 4.** *Pseudospongipellis tomsovskyi*. Hymenophore of basidiomes. A) Gilbertson 10818 (CFMR). B) Gilbertson 7701, holotype (ARIZ). C) Burdsall 6103 (CFMR). *Pseudospongipellis unicolor*. D) Long s.n. (CFMR: FP-12553). E) Cystidioles. F) Basidia. G) Basidiospores. E drawn from Canfield 72-16 (ARIZ), F and G from Gilbertson 7701, holotype (ARIZ). Scale: A-D = 10 mm.

**Fig. 4.** *Pseudospongipellis tomsovskyi*. Himenóforo de basidiomas. A) Gilbertson 10818 (CFMR). B) Gilbertson 7701, holotipo (ARIZ). C) Burdsall 6103 (CFMR). *Pseudospongipellis unicolor*. D) Long s.n. (CFMR: FP-12553). E) Cistidiolos. F) Basidios. G) Basidiosporas. Dibujo extraído de Canfield 72-16 (ARIZ), F y G de Gilbertson 7701, holotipo (ARIZ). Escala: A-D = 10 mm.

**Specimens examined.**— U.S.A. Arizona, Cochise County, Coronado National Forest, Chiricahua Mountains, South Fork, Cave Creek, on living *Q. hypoleucoides*, 6-X-1967, R.L. Gilbertson 7638 (ARIZ: AN010810; CFMR); Turkey Creek Recreation Area, on *Q. hypoleucoides*, 17-VIII-1971, H.H. Burdsall, Jr. 6103; Santa Cruz County, Coronado National Forest, Atascosa Mountains, Sycamore Canyon, on *Quercus reticulata*, 29-III-1972, E.R. Canfield, ERC 72–16 (ARIZ: AN010805), on *Quercus arizonica*, 23-IV-1909, G.G. Hedgcock, FP–835 (CFMR); Yavapai County, Prescott National Forest, near Prescott, Wolf Creek along Highway 86, on *Quercus* sp., 23-IV-1956, P.D. Keener (ARIZ: AN010807). New Mexico, Hidalgo County, Animas Mountains, Indian Creek, on *Q. hypoleucoides*, 31-X-1972, R.L. Gilbertson 10818 (CFMR); near Mogollon, *Q. hypoleucoides*, 10-XI-1910, G.G. Hedgcock, FP–9002 (CFMR). Oklahoma, Cache, on *Q. marylandica*, 30-IX-1912, W.H. Long, FP–12634 (CFMR).

**Remarks.**— *Pseudospongipellis tomsovskyi* is similar to *P. unicolor* but with slightly larger basidiospores, a southwestern United States distribution, and restriction to *Quercus*. In addition, the pores in *P. tomsovskyi* are typically larger and the dissepiments thicker than in *P. unicolor* which is especially noticeable in the margin. Note that the description and illustration (Fig. 375 of RLG–7701) in Gilbertson & Ryvar-den (1987: 727–729) of *Spongipellis unicolor* is the holotype of *P. tomsovskyi*. Phylogenetic analyses of the ITS region show that *P. tomsovskyi* is more closely related to *P. litschaueri* samples from Europe and Asia than to *P. unicolor* (Fig. 3), confirming results reported by Tomšovský (2012).

*Pseudospongipellis unicolor* (Fr.) Y.C. Dai & Chao G. Wang,  
*Mycological Progress* 21 (9, no. 73): 15 (2022). [MB# 843489] Fig. 4 D

= *Polyporus obtusus* Berk. [MB#208119]

Basidiomes as described for *P. tomsovskyi* above except pores white, circular to angular or sinuous, 1–2 per mm with thin dissepiments; basidiospores (6.1–)6.5–7.5(–7.9) × (4.2–)4.5–5.8(–5.9) μm, average of three specimens 6.9–7.2 × 4.9–5.3 μm, Q = 1.3–1.4.

**Habitat and distribution.**— On various living hardwood trees such as *Acer*, *Fagus*, *Juglans*, and *Liquidambar* as well as *Quercus*, causing a white trunk rot, reported from eastern to midwestern North America.

**Descriptions and illustrations.**— Spaulding (1905, plates 13–15); Neuman (1914: 33–34, fig. 11); Lloyd (1915: 323–324, fig. 666); Overholts (1915: 40, plate 3, fig. 13); Riley (1947).

**Specimens examined** (all CFMR).— U.S.A. Arkansas, near Mt. View, on *Q. marylandica*, 8-IX-1912, W.H. Long, FP–12546; near Harrison, on *Q. velutina*, 1912, W.H. Long, FP–12553. Illinois, Warsaw, Kibbe Biological Station, at base of *Quercus* sp.,



29-IX-1990, T.J. Volk, FP-102487. Louisiana, oak grove, on trunk of living *Q. nigra*, 6-VIII-1931, F. Kaufert & L.O. Overholts, FP-50211. Michigan, Manistee National Forest, on *Quercus* sp., 6-X-1936, R.C. Lorenz, FP-71354. Missouri, Round Springs Park, on *Q. nigra*, 20-VII-1935, F.G. Liming, FP-67903. North Carolina, Jackie Cove, on *Q. nigra*, 15-IX-1937, E. Roth, FP-71815. Wisconsin, Wisconsin Rapids, on *Q. turbinella*, 6-VIII-1959, R.W. Davidson & R. Patton, FP-105339.

**Remarks.**— *Pseudospongipellis unicolor* is morphologically similar to *P. tomsowskyi*; see discussion above. Note that the distribution of the former is limited to midwestern and eastern North America and has a wider host range compared to the latter. Overall, the pores in *P. unicolor* are smaller and more sinuous with thinner dissepiments (Fig. 4 D) than in *P. tomsowskyi* (Fig. 4 A–C). The description of *P. obtusus*, a later synonym of *P. unicolor*, by Overholts (1953: 322–324) is probably inclusive of *P. tomsowskyi* also. Spaulding (1905) and Riley (1947) describe and illustrate in detail the effects of the fungus on oaks. Reports of *P. unicolor* from Oregon, Montana, Nebraska, and Kansas by Overholts (1953) and Gilbertson & Ryvardeen (1987) need to be verified.

### Taxonomy of *Radulodon* Ryvardeen [MB# 18441], emended

Basidiomes widely effused, ceraceous to cartilaginous, but soft in one species, up to 2 mm thick excluding spines; hymenophore odontoid to spinose, spines conical to cylindric, up to 8 mm long, single or fused at the base or throughout length; not reacting in KOH; hyphal system dimitic (but monomitic in one species) with clamped generative hyphae and microbinding hyphae; subicular hyphae often agglutinated; hyphidia present or absent; hymenial cystidia clavate, cylindric, or subfusiform, apex obtuse or somewhat papillate, up to 70  $\mu\text{m}$ , with a basal clamp connection, slightly projecting; basidia clavate, 15–36  $\times$  5–8.5  $\mu\text{m}$ , with a basal clamp connection, 4-sterigmate; basidiospores globose, subglobose or ellipsoid, often with a refractive globule, 4.5–7  $\times$  (3.5–)4–5.5(–6)  $\mu\text{m}$ , walls slightly thick, hyaline, smooth, cyanophilous, not reacting in Melzer's reagent.

Ryvardeen (1972) created *Radulodon* for three species, namely, *R. americanus* Ryvardeen [MB# 322216], the generic type, *R. erikssonii* Ryvardeen [MB# 322219], and *R. casearius* (Morgan) Ryvardeen [MB# 322218]. Over the last 50 years, five new species of *Radulodon* were described and seven more transferred to the genus; see Index Fungorum and MycoBank for a complete list. The revised generic description above is modified from Nakasone (2001) for it was too broad and is restricted to the three original species and *R. yunnanensis* Y.C. Dai & Chao G. Wang [MB# 843483]. *Radulodon* is most similar to *Pseudolagarobasidium* morphologically and phylogenetically; see discussion under *Pseudolagarobasidium* above.

### Key to the accepted species of *Radulodon*

- 1 Aculei > 5 mm long, from North America ..... *R. casearius*  
 1' Aculei < 5 mm long, widely distributed ..... 2  
 2 Aculei 5–7 per mm, from southwestern China ..... *R. yunnanensis*  
 2' Aculei 1–4 per mm, from North America, Europe, and Asia ..... 3  
 3 Subiculum up to 2 mm thick, on *Populus* in North America ..... *R. americanus*  
 3' Subiculum up to 0.7 mm thick, on woody angiosperms in Europe, India, and Japan ..... *R. erikssonii*

### Taxa not accepted in *Radulodon*

*Radulodon acaciae* G. Kaur, Avneet P. Singh & Dhingra,  
 Mycotaxon 127: 111 (2014). [MB# 805641]

= *Pseudolagarobasidium acaciicola* Ginns [MB# 500243]

We were unable to examine specimens of *R. acaciae*, but the description and illustrations are sufficient to conclude that it is identical to *P. acaciicola* which was first described from South Africa on *Acacia cyclops* (Wood & Ginns, 2006). *Pseudolagarobasidium acaciicola* is reported also from southern China (Zhang *et al.*, 2020), Vietnam (e.g., KM234009), and India (e.g., JX886000) as evidenced by sequences available from GenBank.

*Radulodon cirrhatinum* Hjortstam & Ryvar den [MB# 132797]

This taxon is transferred to *Pseudolagarobasidium* herein; see discussion above.

*Radulodon indicus* Jyoti & Dhingra [MB# 807509]

Probably *Radulomyces licentii*; see Nakasone *et al.* (2021: 1488).

*Radulodon revolubilis* Hjortstam & Ryvar den [MB# 505163]

This taxon is transferred to *Irpiciporus* herein; see discussion above.

### CONCLUSION

The Cerrenaceae is a small family in the Polyporales composed of five genera—*Cerrena* (13 species), *Irpiciporus* (7), *Pseudolagarobasidium* (11), *Pseudospongipellis* (4), and *Radulodon* (4). With the creation of *Pseudospongipellis* by Wang & Dai (2022) and the more clearly defined generic boundaries of *Irpiciporus*, *Pseudolagarobasidium*, and *Radulodon* presented herein, identification of taxa the family should be simpler. Table 1 summarizes the critical morphological features that distinguish these genera.

The taxonomy and phylogenetic study of the Cerrenaceae would benefit from the morphologic study and sequence data of more collections, for some taxa are known only from type specimens. A thorough morphological and phylogenetic study of *Cerrena* is needed. In addition, the taxonomic status of “*Rigidoporus vinctus*” (Justo *et al.*, 2017) and “*Rigidoporus hypobrunneus*” (Wu *et al.*, 2017; Wang & Dai, 2022) that nested within the family are unresolved.

Future systematic research in the Cerrenaceae should include cultural and mating type studies also. Although rarely undertaken, cultural characters and incompatibility systems could provide valuable information to understanding the generic and species limits within the family. For example, there are some intriguing trends that suggest mating system may be a generic level character. Bipolar mating system is found in *Irpiciporus* (for *I. pachyodon*, David, 1969) and *Radulodon* (for *R. americanus*, Nobles *et al.*, 1957 as *Radulum casearium*). In contrast, *Pseudolagarobasidium* (for *P. subvinosum*, Jang & Chen, 1985; *P. pronum*, Maekawa & Hasebe, 2002) and *Pseudospongipellis* (for *P. delectans*, David, 1969; *P. unicolor*, Eggertson, 1953 as *Polyporus obtusus*) have a tetrapolar mating system. *Cerrena unicolor* may be a species complex for it is bipolar according to Nobles (1965: 1127) but tetrapolar as reported by David (1988).

Microbinding hyphae can be difficult to find in basidiomes, but they are readily observed in aerial mycelium of cultures. Similarly, differentiating between skeletal and sclerified generative hyphae can be challenging in basidiomes. In culture, however, skeletal hyphae are often developed in the aerial mat if present in basidiomes. *Cerrena* has a trimitic hyphal system with thick-walled, much branched binding hyphae in addition to clamped generative and skeletal hyphae (Bernicchia & Gorjón, 2020). However, only clamped hyphae and skeletal hyphae are developed in culture (Nobles, 1948: 317), suggesting that binding hyphae should be interpreted as sclerified generative hyphae with degraded clamps.

Observations on geographic distribution and habitat or substrate preferences are important to understanding the scope of species and genera in the Cerrenaceae. Many taxa in *Irpiciporus* and *Pseudolagarobasidium* are found in tropical Africa, Asia, and the Americas whereas *Pseudospongipellis* and *Radulodon* species have a north temperate distribution. Lifestyles or habitats are most diverse in *Pseudolagarobasidium* but limited for species of *Pseudospongipellis* that are typically found colonizing dead parts of living angiospermous trees.

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