New species from Argentinean Yungas, Cercopemyces messii and Clitocybe cedrelae (Agaricomycetes, Agaricales)

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ORIGINAL ARTICLE

New species from Argentinean Yungas, *Cercopemyces messii* and *Clitocybe cedrelae* (*Agaricomycetes*, *Agaricales*)

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Abstract
The Argentine Northwest has a system of tropical and subtropical montane cloud forests on the Andes Mountains, where there is a significant diversity of *Agaricales* fungi yet to be discovered. Two new species from the *Cedrela* forest, inside the Baritú National Park, Argentina, are described in this work as *Cercopemyces messii* and *Clitocybe cedrelae.* Phylogenetic analysis was performed using the nuclear internal transcribed spacer (nrITS) region and the large subunit (nrLSU) of the nuclear ribosomal RNA. Complete taxonomic descriptions, field photographs, drawings, photographs captured with the scanning electron microscope (SEM) of the basidiospores, and comparisons of the similar and closely related species are provided. Both taxa have ornamented basidiospores that are hyaline, inamyloid, and clamp connections in all tissues. They were also found within the same area, and both presented a good number of specimens. These striking species should be considered in danger since their natural habitats are also at risk.

Keywords *Basidiomycetes* · Biodiversity · South America · Two new taxa · Yungas

Introduction

The Argentine Northwest has a large diversity of *Agaricomycetes* fungi that has been broadly studied by Singer (1950a, b, 1953, 1955, 1959, 1960, 1965a, b, 1969, 1970, 1973a, b, 1975, 1976); Singer and Digilio (1951); Singer and Morello (1960); Spegazzini (1912, 1919); Wicaksono et al. (2017); Dios et al. (2017); Niveiro (2012); Niveiro et al. (2012); Niveiro et al. (2014a, b, c); Nouhra et al. (2018); Malizia et al. (2012); and Baroni et al. (2012). The majority of this macrofungal biodiversity is concentrated in the Andean Yungas, which comprise a system of tropical and subtropical montane cloud forests on the eastern slope along the Andes in South America. The Argentinean Yungas constitutes the southeast extension of the Amazonian Domain (Cabrera 1994). The weather in this region is characterized by seasonal fog and persistent cloud cover (Brown et al. 2005), and it features a high altitudinal gradient and experiences various environmental conditions, such as periods of high temperatures, drought, high humidity levels, frosts, and even snow in winter. During the months of November to February, rainfall is high, while during the rest of the year, these regions have a dry environment with low rainfall. Niveiro (2012) compiled all the macrofungal taxa for the Yungas of Argentina, recording 629 species, with a total of 125 species of *Agaricales* s.l. Additionally, 12 new taxa have been discovered within the genera *Pouzarella* Mazzer, *Inocybe* (Fr.) Fr., *Clitocybula* (Singer) Singer ex Métrod, *Mycena* (Pers.) Roussel, *Pluteus* Fr., *Pholiota* (Fr.) P. Kumm, and *Hemimycena* Singer (Niveiro et al. 2012, 2014a, b). Also, based on richness estimators, Niveiro (2012) concluded that only 23–46% of the *Agaricales* were recorded, and a high diversity of new taxa remained to be studied. Nouhra et al. (2018) analyzed the soil using metabarcoding, which provided 1254 OTUs for the *Agaricomycetes* group under consideration. Based on the number of described species within the Yungas of Argentina, they predict that many more species remain undescribed. Within the Yungas, tree diversity is

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high and estimated to include more than 230 species (Grau and Brown 2000; Brown et al. 2005). According to Brown et al. (2005), three main forest types can be distinguished: premontane lowland forests (400–700 m asl); lower montane forests (700–1500 m asl); and upper temperate montane forests (1500–2500 m asl). The state of preservation of the Argentine Yungas is vulnerable and insufficient to protect its biodiversity. Unsustainable logging, extensive livestock farming, and subsistence hunting, among other reasons, contribute to the degradation and loss of the ecosystem's productive value (Brown and Malizia 2004).

An excursion to the northern province of Salta, Argentina, provided us the opportunity to document several collections of *Cercopemyces* and *Clitocybe*, within Baritú National Park. Our sampling efforts were focused on the upper temperate montane ecosystems (1500–2500 m asl). There is an area primarily composed of trees belonging to the genus *Cedrela* P. Browne, where several collections of the new species of *Cercopemyces* and *Clitocybe* were found. The genus *Cedrela* is native to Argentina (Zuloaga and Morrone 1999), and it is distributed mainly in South America, with five species in Argentina, three of which are exclusive to the northwest (*C. balansae* C. DC., *C. lilloi* C. DC., *C. saltensis* Zapater and del Castillo) and two from the northeast (*C. fissilis* Vell., *C. odorata* L., Zapater et al. (2004).

The genus *Cercopemyces* T.J. Baroni, Kropp and V.S. Evenson was proposed by Baroni et al. (2014) and is supported as a monophyletic group based on nLSU and ITS sequences. Our phylogenetic analysis results are consistent with those of Baroni et al. (2014). It is characterized by its medium to large, solid basidiomata, with whitish tones, amanitoid appearance, absence of hymenial cystidia, and ornamented spores. *Cercopemyces* forms a sister group with *Ripartitella* Singer and *Cystodermella* Harmaja, but is differentiated from both by several characteristics; *Ripartitella* typically presents smaller basidiomata generally associated with wood rather than growing directly on the ground, and it possesses encrusted pleurocystidia. *Cystodermella* is differentiated by having smooth spores and spherocytes in the pileipellis. Currently, only three species of *Cercopemyces* are known, and this new description is an important discovery that supports the monophyly of the genus.

Clitocybe (Fr.) Staude is a genus in the family *Clitocybaceae* Vizzini et al. and comprising approximately 500 species (CABI Bioscience & Landcare Research 2024). Molecular phylogenetic analyses (Matheny et al. 2006; Alvarado et al. 2015) have demonstrated that the genus is placed within the *Clitocybeae* tribe, along with *Collybia* (Fr.) Staude and *Lepista* (Fr.) W.G. Sm. This group remains taxonomically unresolved, with discrepancies between taxonomy and phylogeny (Alvarado et al. 2015). Recent multi-locus phylogenetic and phylogenomic analyses of *Clitocybaceae* revealed the presence of six generic clades: *Clitocybe*, *Collybia*, *Dendrocollybia*, *Lepista*, *Pseudolyophyllum*, and *Singerocybe* (He et al. 2023) and placed several *Lepista* species into *Collybia*. He and Yang (2024) recommended conserving the name *Clitocybe* based in a conserved type.

The genus *Clitocybe* is characterized by its gregarious to clustered basidiomata, a white spore print, small ellipsoidal and inamyloid spores, hyphae with clamp connections, absence of cystidia, and a poorly differentiated pileipellis (Singer 1986). Due to the limited morphological characteristics and variations caused by the environment, species identification remains difficult (Bigelow and Smith 1969), requiring molecular phylogenetic analyses to resolve their taxonomic positions.

In this study, two new species, *Cercopemyces messii* and *Clitocybe cedrelae*, were described from specimens collected in the Andean Yungas during a survey using both phylogenetic analyses and detailed morphological examinations.

Material and methods

Specimens studied

The specimens for this research were collected within Baritú National Park, located in Salta, Argentina, during the initial months of 2023. All the collections were found in a forest composed of trees of the genus *Cedrela*, locally known as the "Cedral" site. They were meticulously documented and preserved using the established methodologies for Agaricales (Largent 1986). The collections were deposited in the mycological herbarium of the Departamento de Biodiversidad y Biología Experimental of the Facultad de Ciencias Exactas y Naturales, UBA (BAFC).

Morphological studies

For the macroscopic descriptions, colors were noted following Kornerup and Wanscher (1987). Microscopic description followed the standard method used for *Agaricales* (Lechner 2021). Longitudinal radial sections were made on the surface of the pileus to observe the pileipellis and transverse perpendicular sections on the gills to describe basidia, cystidia, and spores and longitudinal sections on the stem to characterize caulocystidia. Different media and stains were used to facilitate the observation of structures, ornamentations, and reactions on the fresh basidiomata: 3% KOH, 1% aqueous phloxine, and Melzer's reagent. All microscopic work was conducted using a bright field Leica DM750 microscope, and images were captured using a Leica iCC50 W integrated camera. All observed structures were measured, and the following symbols were employed: *Q* for the ratio of length to width of spores; *Qe* for the mean of

Q values; *N* for the number of spores measured; *Me* for the average size of spores. For the presented basidiospore photographs, a scanning electron microscope FE SEM SUPRA 40 Carl Zeiss AG was used.

DNA extraction, PCR conditions, and sequencing

Genomic DNA was extracted from all collections with NaOH (Steiner et al. 1995), and the PCR amplification was performed with the primer pairs ITS4–ITS5 (White et al. 1990) and LR0R-LR5 (Vilgalys and Hester 1990), for the nuclear ITS and partial LSU regions, respectively. The amplification program used for ITS was an initial denaturation at 95 °C for 2 min, followed by 40 cycles at 95 °C for 30 s, 55 °C for 45 s, 72 °C for 1 min, and a final extension at 72 °C for 15 min; and for nLSU, it was an initial denaturation at 95 °C for 3 min, followed by 40 cycles at 95 °C for 30 s, 55 °C for 30 s, 72 °C for 1 min, and a final extension at 72 °C for 15 min. PCR products were checked through 1% agarose gel electrophoresis and processed by the services of Macrogen Inc. (South Korea) for sequencing. All the sequences obtained were manually reviewed with BioEdit v7.2.5 (Hall 1999) and checked with a Blast search in the GenBank to compare with the existing sequence data. New sequences were deposited in the GenBank database.

Phylogenetic analyses

Two datasets were constructed for each species using the internal transcribed spacers including the 5.8S gene (ITS1-5.8S-ITS2) and the large subunit 28S gene (LSU). An additional concatenated analysis comprising the ITS–nLSU regions was also constructed. The selection of sequences was based on Baroni et al. (2014); Hakizimana et al. (2023); Carbone et al. (2020); Zhang et al. (2019); Saar et al. (2009); Varga et al. (2019); Vizzini et al. (2011); Alvarado et al. (2015); Putra et al. (2022); Sjökvist et al. (2012); Wang et al. (2019); Hartley et al. (2009); He et al. (2023); and He and Yang (2024) and NCBI Blast best hits. Members of *Tricholomataceae* (*Tricholoma ligusticum* M. Carbone, Boccardo and Calledda and *Lepista nuda* (Bull.) Cooke), *Agaricaceae* (*Lepiota cristata* (Bolton) P. Kumm. and *Smithiomyces mexicanus* (Murril) Singer), and *Pseudoclitocybaceae* (*Musumecia bettlachensis* Vizzini and Contu), which remain clearly outside the *Cercopemyces* and *Lepista* clade, were selected for the outgroup (Baroni et al 2014; Wang et al. 2019). The species, location, and GenBank accession numbers for the sequences used in the datasets are presented in Tables 1 and 2. All alignments were performed using the Muscle tool (Edgar 2004) as implemented in MegaX, and then manually optimized in BioEdit v7.2.5 (Hall 1999).

Best maximum likelihood (ML) tree was obtained with MegaX, after testing for the best evolutionary model for each region. Support values were obtained using 1000 bootstrap iterations. Gaps and missing data were completely deleted. The obtained topologies were then visualized in FigTree version 1.4.0 (Rambaut 2009), and the alignments were submitted to TreeBase under the submission ID: 30888.

Taxonomy

For taxonomic treatment, names and synonyms were cited and consulted according to the ICNafp (Turland et al. 2018) and Index Fungorum—Authors of Fungal Names (CABI Bioscience and Landcare Research 2020). Herbarium acronyms were cited following Thiers (2012), and reference descriptions were consulted (Singer 1950a; Bigelow and Smith 1969; Franco-Molano 1993; Baroni et al. 2014; Heluta et al. 2019; Wright and Albertó 2002). New taxa were submitted to MycoBank database.

Results

Molecular phylogeny

The maximum likelihood (ML) analysis of the nLSU dataset of *Cercopemyces* and related species (Fig. 1) indicates that the collections of *Cercopemyces messii* form a highly supported monophyletic group within the *Cercopemyces* clade, with *Ripartitella* as sister clade and *Cystodermella* as sister to both. The final alignment used for the nLSU dataset consisted of 26 sequences of 616 bp in length, with 531 of these sites being conserved and 85 being variable. The topology obtained is consistent with the work of Saar et al. (2009), Baroni et al. (2014), Varga et al. (2019), Zhang et al. (2019), Carbone et al. (2020), and Hakizimana et al. (2023).

The ML analysis of the combined nITS and nLSU dataset of *Clitocybe*, *Lepista* and related species (Fig. 2) places the three collections of *Clitocybe cedrelae* within the *Lepista* clade with high BS values. Currently, this clade is better positioned within the genus *Clitocybe* (He et al. 2023; He and Yang 2024). These collections form a monophyletic clade with *Lepista sordida* and *L. tarda* as the closest related species to *C. cedrelae*. These species are found within the violet *Lepista* clade with *L. nuda* and *L. personata*. The final alignment consisted of 43 sequences of 1528 bp in length, with 1221 of these sites being conserved and 298 being variable. The topology obtained is consistent with the work of Hartley et al. (2009), Vizzini et al. (2011), Alvarado et al. (2015), and Wang et al. (2019).

Table 1 Species name and GenBank accession numbers of the sequences included in this study for the *Cercopemyces messii* phylogenetic analyses

Species	Location	nLSU	Reference
Cercopemyces crocodilinus T.J. Baroni, Kropp & V.S. Evenson	USA	JX409897.1	Baroni et al. (2014)
Cercopemyces crocodilinus Type	USA	NG071239.1	Baroni et al. (2014)
Cercopemyces messii 1 J.M. Suárez, A.P. Martínez, B. E. Lechner & J. Aliaga Type	Argentina	OR896541	–
Cercopemyces messii 2	Argentina	PP458237	–
Cercopemyces rickenii (Bohus) Dima and L. Nagy	Hungary	MK277686.1	Varga et al. (2019)
Cystodermella adnatifolia (Peck) Harmaja	Estonia	AM946421.1	Baroni et al. (2014)
Cystodermella cinnabarina (Alb. and Schwein.) Harmaja	Estonia	AM946429.1	Baroni et al. (2014)
Cystodermella granulosa (Batsch) Harmaja	Estonia	AM946431.1	Baroni et al. (2014)
Cystodermella granulosa var. ambrosii (Bres.) I. Saar	Finland	AM946422.1	Saar et al. (2009)
Cystodermella papallactae Isotype	Ecuador	AM946439.1	Baroni et al. (2014)
Laccaria bicolor (Maire) P.D. Orton	Germany	DQ071702	Garnica et al. (2007)
Laccaria galerinoides Singer	Argentina	KU685776	Wilson et al. (2017)
Laccaria laccata var. pallidifolia (Peck) Peck	France	KU685901	Wilson et al. (2017)
Laccaria ochropurpurea (Berk.) Peck	USA	AY700200	GenBank, unpublished
Laccaria tetraspora Singer	Argentina	KU685775	Wilson et al. (2017)
Laccaria umbilicate Ming Zhang	China	OR785485	Zhang et al. (2023)
Lepiota cristata (Bolton) P. Kumm.	China	JN940284.1	Baroni et al. (2014)
Lepista nuda (Bull.) Cooke	Estonia	AM946453.1	Saar et al. (2009)
Ripartitella alba Halling and Franco-Mol.	Costa Rica	AM946464.1	Baroni et al. (2014)
Ripartitella brasiliensis (Speg.) Singer	Colombia	AM946465.1	Baroni et al. (2014)
Ripartitella brunnea Ming Zhang, T.H. Li and T.Z. Wei	China	MH660410.1	Zhang et al. (2019)
Ripartitella degreefii Rizinde, Desjardin, Amalfi and Decock	Africa	OQ813455.1	Hakizimana et al. (2023)
Ripartitella sp. B	Belize	JX462553	GenBank, unpublished
Ripartitella sp. NZ	New Zeland	KF727348	GenBank, unpublished
Smithiomyces mexicanus (Murrill) Singer	USA	JX409900	Baroni et al. (2014)
Tricholoma ligusticum M. Carbone, Boccardo and Calleddа	Italy	NG075426.1	Carbone et al. (2020)

Taxonomy

Cercopemyces messii **J.M. Suárez, A.P. Martínez, B.E. Lechner & J. Aliaga**, sp. nov. (Fig. 3).

MycoBank: MB851202.

GenBank: rDNA LSU: OR896541.

Diagnosis: *Cercopemyces messii* is easily distinguishable by its light coloration, medium to large size, pileus convex to campanulate, white with pale orange over the disc, covered by verrucose squamules over the disc, closely spaced lamellae, and large scales on the stipe, basidiospores (5.4)5.7–6.8(7.6) × (2.6)2.9–3.6(4.1) µm, hyaline, oblong, with small verrucose ornamentation, basidia 4-sterigmate, clavate, 19.6–26.2 × 4.6–5.7 µm, with granular content, pileipellis a cutis with transitions to a trichodermium in areas where scales occur, stipitipellis a cutis with hyaline interwoven cylindrical hyphae, 3.9–4.4 µm wide, with scale elements, hyphae of scale elements clavate, cylindric, rarely ventricose, some with H- or Y-shaped, 10.9–16.3 µm wide, sometimes with the apex slightly capitate.

Etymology: The proposed name is as a tribute to the illustrious Lionel Andrés Messi Cuccittini, whose remarkable talent has brought immense joy and pride to the people of Argentina.

Holotype: Argentina, Salta, Parque Nacional Baritú, Bosque El Cedral, 1700 m., 03 Mar. 2023, 22°27′39.24″ S 64°44′31.56″ W, leg. J.M. Suárez, A.P. Martínez & J. Aliaga (BAFC53456).

Description: Basidiomata (Fig. 3) medium-sized to large. Pileus 40–170 mm broad, convex to campanulate, at first white (1A1), with a pale orange over the disc (5A3), then turning pale yellow (1A3) to grayish yellow (2B3); surface dry, covered by verrucose squamules of 1–2 mm broad over the disc, and with white (1A1) more delicate floccose scales arranged radially, becoming glabrescent; curved margin with traces of veil. Flesh white (1A1) when fresh, becoming pale yellow (1A3) when dried, up to 20 mm broad. Lamella white (1A1), sinuate, narrow, with lamellulae of different sizes. Stipe white (1A1) 100–180 × 12–25 mm, cylindric, central, solid,

Table 2 Species name and GenBank accession numbers of the sequences included in this study for the *Clitocybe cedrelae* phylogenetic analyses

Species	Location	ITS	nLSU	Reference
Atractosporocybe inornate (Sowerby) P. Alvarado, G. Moreno & Vizzini	China	MZ714592	MZ714593	He and Yang (2022)
Clitocybe cedrelae 1 J.M. Suárez, A.P. Martínez, B.E. Lechner & J. Aliaga Type	Argentina	OR886658	OR886661	–
Clitocybe cedrelae 2	Argentina	OR886659	OR886662	–
Clitocybe cedrelae 3	Argentina	OR886660	OR886663	–
Clitocybe odora (Bull.) P. Kumm.	China	OP626952	OP646378	He et al. (2023)
Clitocybe phyllophila (Pers.) P. Kumm.	China	OP626963	OP646389	He et al. (2023)
Collybia alboclitocyboides Z.M. He & Zhu L. Yang	China	OP626921	OP646347	He et al. (2023)
Collybia mongolica (S. Imai) Z.M. He & Zhu L. Yang	China	MT482100	MT482094	GenBank, unpublished
Collybia tomentostipes Z.M. He & Zhu L. Yang	China	OP626979	OP646405	He et al. (2023)
Lepista densifolia 22	China	MK116588	–	Wang et al. (2019)
Lepista irina 23	China	MK116589	MK389546	Wang et al. (2019)
Lepista irina 24	China	MK116590	MK389547	Wang et al. (2019)
Lepista irina 25	China	MK116591	MK389548	Wang et al. (2019)
Lepista nuda 14	China	MH428836	MK389553	Wang et al. (2019)
Lepista nuda 17	China	MH428839	MK389550	Wang et al. (2019)
Lepista nuda 19	China	MH428841	MK389551	Wang et al. (2019)
Lepista nuda 21	China	MH428843	MK389549	Wang et al. (2019)
Lepista nuda 27	China	MK116593	MK389552	Wang et al. (2019)
Lepista nuda 28	China	MK116595	MK389554	Wang et al. (2019)
Lepista panaeola 33	China	MK116600	MK389555	Wang et al. (2019)
Lepista panaeola 34	China	MK116601	MK389556	Wang et al. (2019)
Lepista panaeola 35	China	MK116596	MK389557	Wang et al. (2019)
Lepista personata 36	China	MK116602	MK389558	Wang et al. (2019)
Lepista personata 37	China	MK116603	MK389559	Wang et al. (2019)
Lepista personata 38	China	MK116604	MK389560	Wang et al. (2019)
Lepista sordida 1	Spain	KJ681018	KJ681054	Alvarado et al. (2015)
Lepista sordida 2	Spain	KJ681019	KJ681055	Alvarado et al. (2015)
Lepista sordida 3	Spain	KJ681020	KJ681053	Alvarado et al. (2015)
Lepista sordida 4	UK	FJ770391	–	Hartley et al. (2009)
Lepista sordida 42	China	MK116609	MK389564	Wang et al. (2019)
Lepista sordida 43	China	MK116610	MK389565	Wang et al. (2019)
Lepista sordida 44	China	MK116608	MK389562	Wang et al. (2019)
Lepista sordida 5	Sweden	JN649350	JN649350	Sjökvist et al. (2012)
Lepista sordida 6	Indonesia	OK273823	–	Putra et al. (2022)
Lepista tarda 1	USA (Arizona)	OR203600	–	GenBank, unpublished
Lepista tarda 2	USA (New York)	OR290830	–	GenBank, unpublished
Lepista tarda 3	USA (Oregon)	OP651098	–	GenBank, unpublished
Lepista tarda 4	USA (Oregon)	MT955145	–	GenBank, unpublished
Lepista tarda 5	Canada	KM406961	–	GenBank, unpublished
Leucocybe candicans 1 (Pers.) Vizzini, P. Alvarado, G. Moreno & Consiglio	Spain	KJ681027	KJ681051	Alvarado et al. (2015)
Leucocybe candicans 2	Spain	KJ681026	KJ681052	Alvarado et al. (2015)
Microcollybia racemose (Pers.) Lennox	USA	DQ825425	AF042598	Moncalvo et al. (2000)
Musumecia bettlachensis Vizzini & Contu	Italy	JF926520	JF926521	Vizzini et al. (2011)
Pseudolyophyllum macrobasidium Z.M. He & Zhu L. Yang	China	OP626987	OP646413	He et al. (2023)

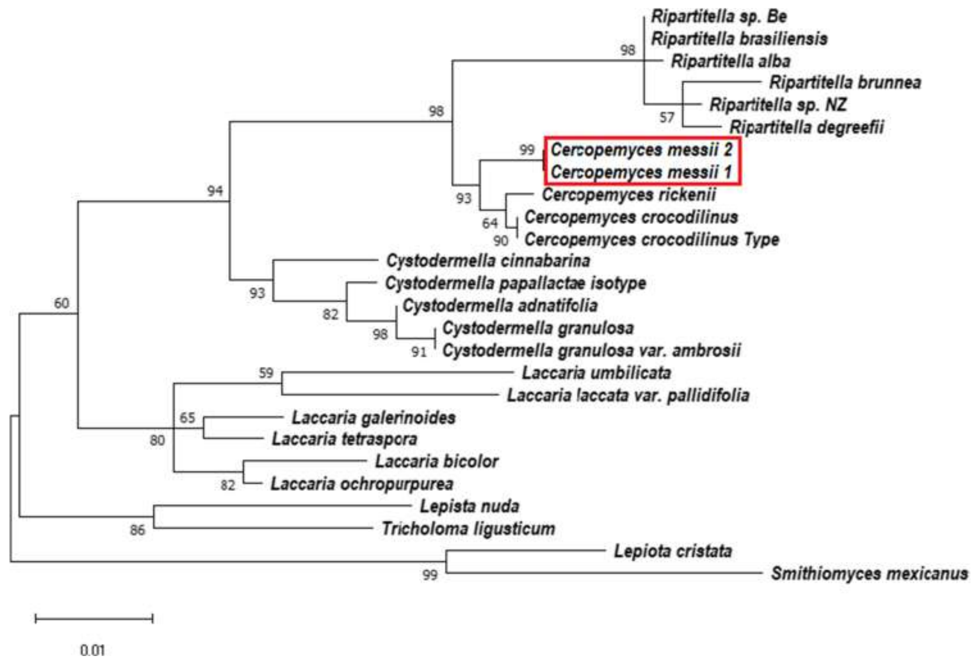


Fig. 1 Cladogram resulting from a maximum likelihood (ML) analysis of a combined nLSU dataset showing placement of *Cercopemyces messii*

occasionally widening towards the base with a small bulb, surface dry, glabrous over the apex, covered with large pale orange (5A3) floccose scales down to the base, sometimes upper scales adhering in a collar-like ring, and become small towards the base; stipe flesh turns light orange (5A4) from bruising. All basidiomata turns pale yellow (1A3) to light orange (5A4) when dried. Mild fungoid odor. Taste not recorded.

Basidiospores (Fig. 4a) (5.4)5.7–6.8(7.6) × (2.6)2.9–3.6(4.1) µm, *Me* = 6.2 × 3.2 µm, *Q* = (1.4)1.7–2.3, *Qe* = 1.9, *N* = 31; hyaline, oblong, inamyloid, with small verrucose ornamentation decreasing in size towards the apiculus (Figs. 4a and 5a, b), barely observable with Melzer's reagent. Basidia (Fig. 4b) 4-sterigmate, clavate, 19.6–26.2 × 4.6–5.7 µm, with granular content, sterigmata up to 2.5 µm long. Hymenial cystidia absent. Lamellar trama hyaline composed of parallel, cylindric to inflated hyphae, 25.9–69.1 × 5.6–13.8 µm, branched in the center, some with H- or Y-shaped patterns. Pileipellis (Fig. 4c), a cutis with transitions to a trichodermium in areas where scales occur, composed of cylindric hyphae, hyaline to yellowish, 6.8–11.5 µm wide, hyphae of scale elements clavate, cylindric, rarely ventricose, some with H or Y-shaped (Fig. 4d), 10.9–16.3 µm wide, sometimes with the apex slightly capitate. Stipitipellis, a cutis with hyaline interwoven cylindrical hyphae, 3.9–4.4 µm wide, with scale elements producing trichodermial hyphae, 22.9–44.5 × 4.8–11.7 µm. Clamp connections present in all tissues.

Habit and habitat: solitary to gregarious, abundant, growing in groups on the ground, among leaf litter, near the base under *Cedrela* spp. (*Meliaceae*). This species has been collected only in the Baritú National Park, Salta, within a forest mainly composed of long-lived *Cedrela* specimens.

Commentary: *Cercopemyces messii* is easily distinguishable by its light coloration, medium to large size, closely spaced lamellae, and large scales on the stipe. Within the genus, only three species are known, which are reported as infrequent and included in the red lists that encompass endangered taxa (Franco-Molano 1993; Baroni et al. 2014; Heluta et al. 2019). *Cercopemyces crocodilinus* T.J. Baroni, Kropp & V.S. Evenson is a similar species distinguished by its smaller basidiomata, the presence of a bulb at the base of the stipe, larger scales on the pileus, smaller and more globose spores, 4.8–6.4 × 3.5–5.5 µm, *Qe* = 1.37 (Baroni et al. 2014). *Cercopemyces ponderosus* (A.H. Sm. & Singer) T.J. Baroni, Kropp & V.S. Evenson is a rare species from the eastern USA and France, also differentiated by its smaller spores, 3.6–4(5) × 2.7–3 µm (Franco-Molano 1993). *Cercopemyces rickenii* (Bohus) Dima & L. Nagy also presents smaller spores with lighter ornamentation, 4.6–5.8 × 2.8–3.7 µm (Heluta et al. 2019). Singer (1986) reported *C. rickenii* as edible, although there is limited precise information available regarding its edibility. The distribution of the *Cercopemyces* species is restricted and scarce. Additionally, *C. rickenii* was included in the Current Red List of Slovak fungi, which encompasses 39 species classified as endangered according to IUCN criteria (Kautmanová 2004). It was also proposed to be included in the European Red List (Senn-Irlet 2011) and is listed in the Red Data Book as a vulnerable rare Ukrainian species with a disjunctive range (Didukh 2009). *Cercopemyces ponderosus* is a rarely collected species, apparently endemic to the

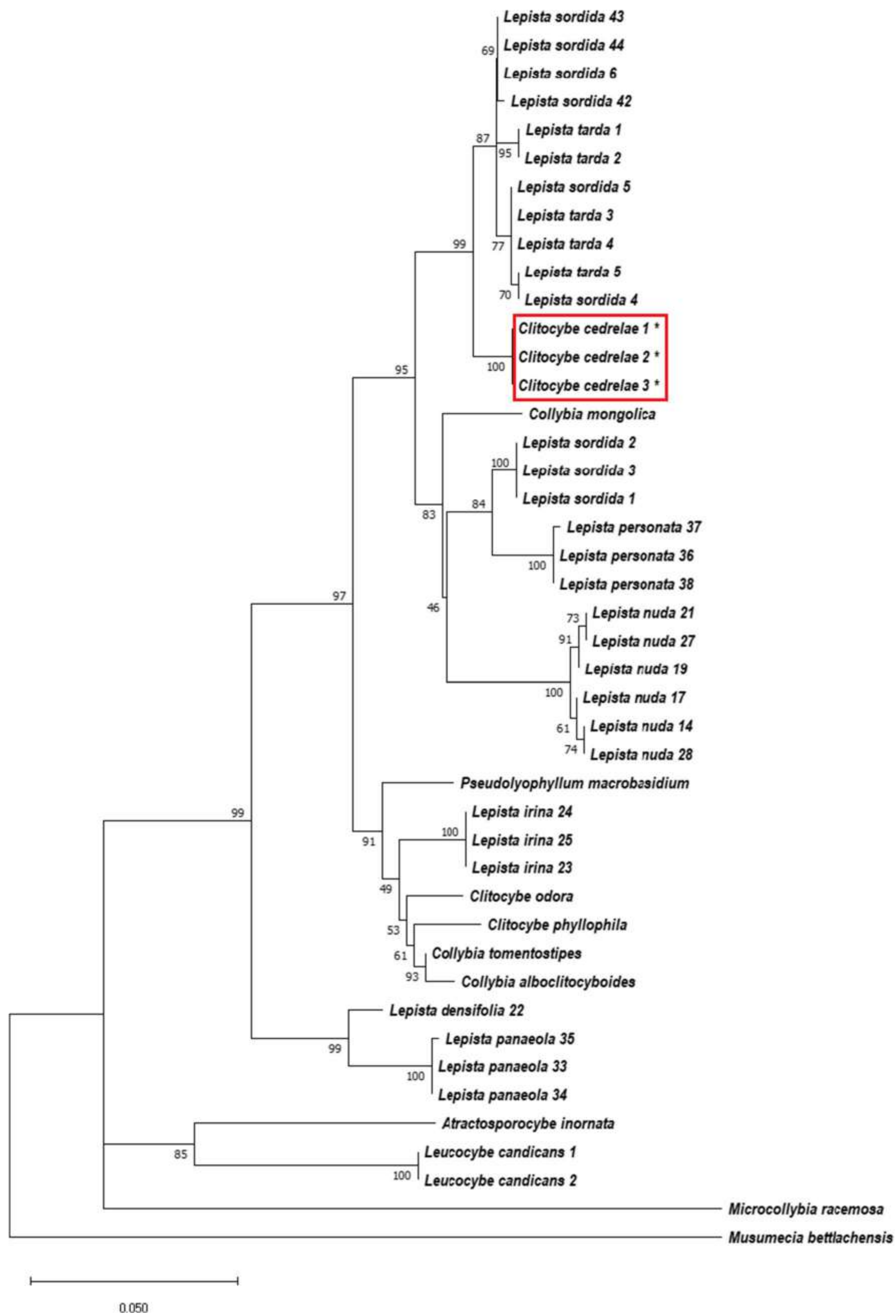


Fig. 2 Cladogram resulting from a maximum likelihood (ML) analysis of a combined ITS–nLSU dataset showing placement of *Clitocybe cedrelae*

Fig. 3 **A** Basidiomata of *Cercopemyces messii*, BAFC53456 (Holotype). Scale bars 45 mm. **B** Basidiomata of *Cercopemyces messii*, BAFC53457. Scale bars 40 mm. Images by Agustín P. Martínez

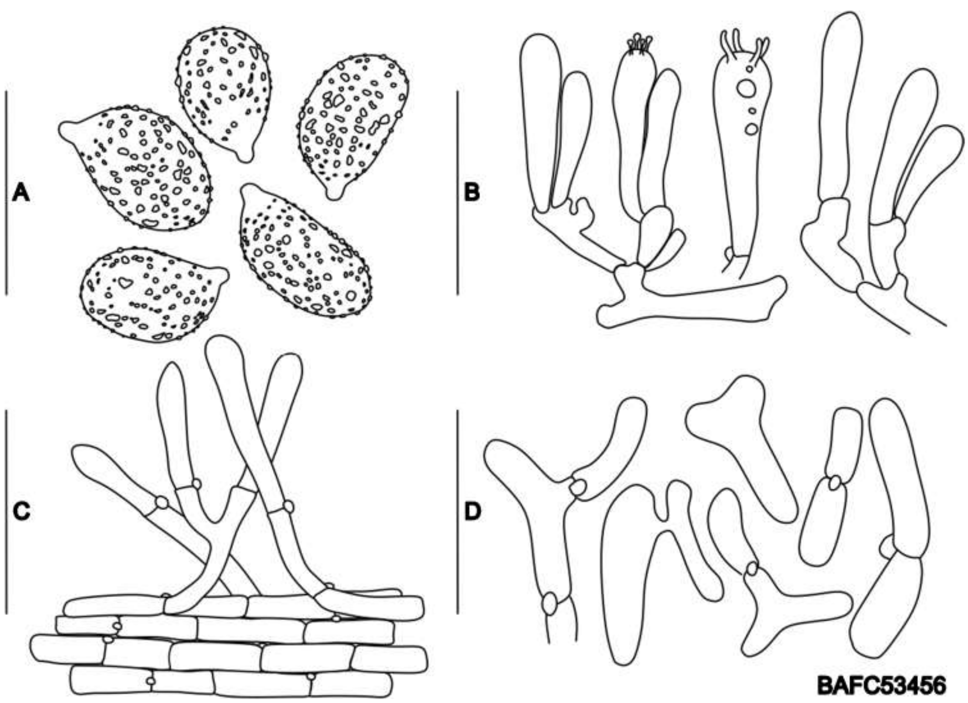


Fig. 4 A Microscopic characters of *Cercopemyces messii*, BAFC53456 (Holotype). **A** Basidiospores. **B** Basidia. **C** Cells of pileipellis. **D** Scale elements. Scale bars, **A** 9 µm, **B** 25 µm, **C** 80 µm, **D** 40 µm. Draws by Juan M. Suárez

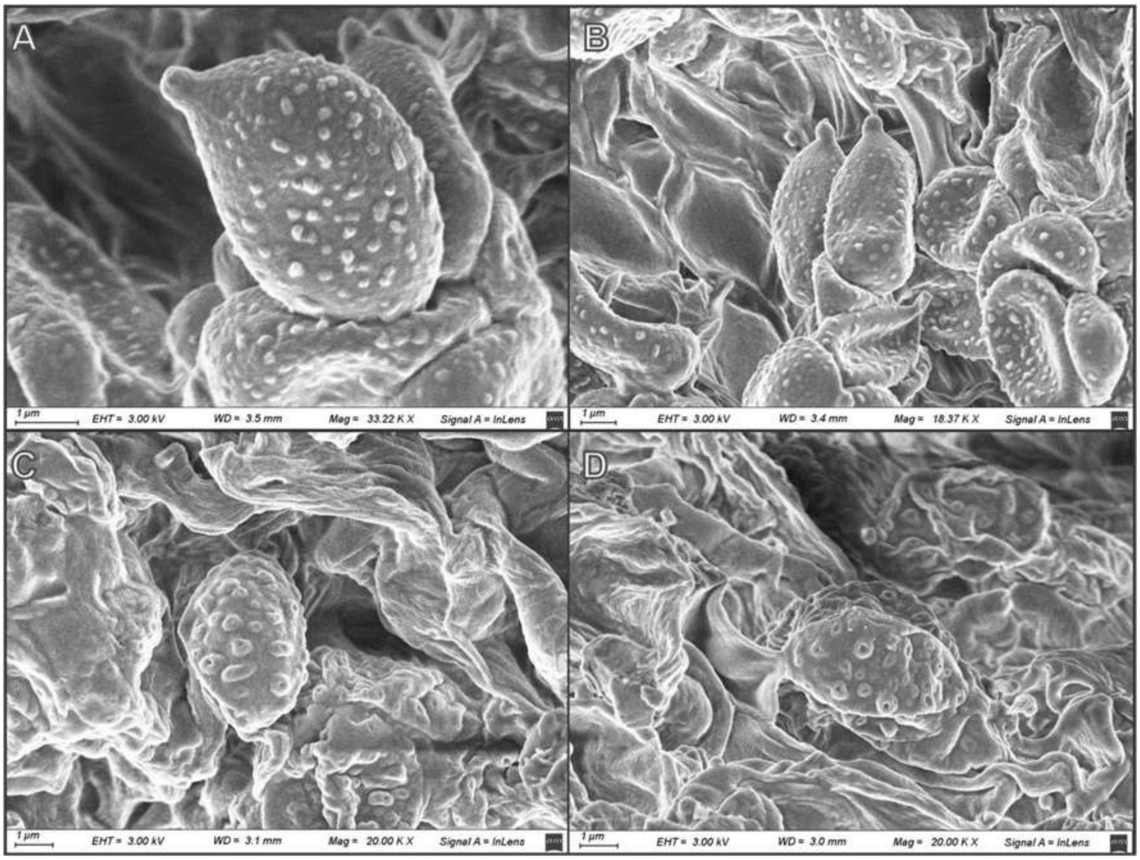


Fig. 5 **A**, **B** SEM photos of *Cercopemyces messii*, BAFC53456 (Holotype). **C**, **D** SEM photos of *Clitocybe cedrelae*, BAFC53464 (Holotype)

eastern USA, and has been proposed for consideration due to its extreme rarity (Baroni et al. 2014). The results of the phylogenetic analysis indicate that sequences from different collections of *C. messii* form a monophyletic clade within the *Cercopemyces* genus, with *Ripartitella* and *Cystodermella* as a sister group.

Material examined: *Cercopemyces messii*. ARGENTINA, Salta, Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 03 Mar. 2023, 22°27′39.24″ S, 64°44′31.56″ W, leg. Juan M. Suárez, Agustín P. Martínez & Joaquin Aliaga (BAFC53456). Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 03 Mar. 2023, 22°27′11.2″ S, 64°44′40.26″ W, leg. Agustín P. Martínez, Juan M. Suárez & Joaquin Aliaga (BAFC53457). Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 03 Mar. 2023, 22°27′33.5″ S, 64°44′50.1″ W, leg. Joaquin Aliaga, Agustín P. Martinez & Juan M. Suárez (BAFC 53458).

Clitocybe cedrelae **J.M. Suárez, A.P. Martínez, B.E. Lechner & J. Aliaga**, sp. nov. (Fig. 6).

MycoBank: MB851203.

GenBank: rDNA ITS: OR886661; LSU: OR886658.

Etymology: The proposed nomenclature is derived from the genus *Cedrela*. One of the samples was discovered thriving on the bark of a living tree belonging to this genus, while the remainder of the samples was found growing around the base of such trees. It is worth noting that *Cedrela* is a genus with a scarce global distribution and limited population. Furthermore, it is essential to highlight that all collections were acquired within a forest of exceptionally ancient *Cedrela* trees.

Diagnosis: Clitocybe cedrelae can be distinguished by its small size and bright coloration, grayish magenta to reddish lilac when young, turning grayish red to reddish brown, featuring a translucent, striated, and slightly depressed pileus at the center, basidiospores (5.6)5.8–7.4(8.6) × (3.1)3.5–4.5(4.9) µm, hyaline, ellipsoid to pip-shaped, guttulate, with finely punctate ornamentation, basidia 21.1–33.8 × 5.9–6.8 µm, clavate, 4-sterigmate, hyaline, pileipellis forming a cutis of grayish yellow, cylindrical hyphae, 3.4–6.1 µm wide, hypodermis composed of inflated, subglobose to globose hyaline cells, 5.3–30.2 µm wide, stipitipellis grayish yellow, hyphae cylindrical 4.1–5.3 µm wide, clamp connections present.

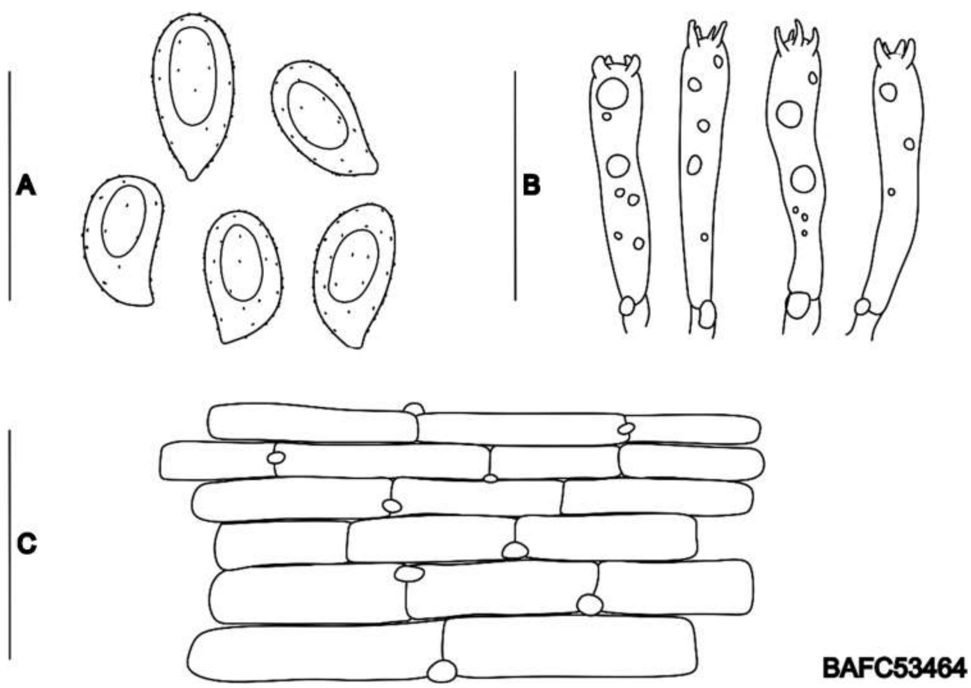
Fig. 6 **A** Basidiomata of *Clitocybe cedrelae*, BAFC53464 (Holotype). Scale bars 12 mm. **B** Basidiomata of *Clitocybe cedrelae*, BAFC53467. Scale bars 15 mm. Images by Agustín P. Martínez

Holotype: ARGENTINA, Salta, Parque Nacional Baritú, Bosque El Cedral, 1700 m., 03 Mar. 2023, 22°27′39.24″ S, 64°44′29.4″ W, leg. J. M. Suárez, J. Aliaga & A. P. Martínez (BAFC53464).

Description: Basidiomata (Fig. 6) small to medium sized. Pileus 25–55 mm convex; grayish magenta (13D4) to reddish lilac (14C3) when young, turning grayish red (9C4) to reddish brown (8D4) toward the center when mature, slightly depressed over the disc, translucently striate, hygrophanous and becoming opaque; margin crenate to irregularly wavy. Non-existent context. Lamellae, purplish pink (14A3), sinuate, subdistant to close, moderately thick, 10–23 mm broad, edge smooth, with lamellulae of different sizes. Stipe 55–84 × 7–9 mm, central, reddish lilac (14B4) with tones grayish magenta (13D4), brownish orange (7C4) at maturity, cartilaginous, cylindrical to slightly widened toward the base, sometimes twisted, slightly wrinkled, surface smooth. Odor and taste not recorded.

Basidiospores (Fig. 7a) (5.6)5.8–7.4(8.6) × (3.1)3.5–4.5-(4.9) µm; $Me = 6.5 \times 3.9$ µm; $Q = (1.3)1.5–1.8(2.1)$; $Qe = 1.7$; $N = 28$; hyaline, inamyloid, ellipsoid to pip-shaped, guttulate, with finely punctate ornamentation under the optical microscope, and with prominent crater-like warts as imaged under SEM (Fig. 5c, d). Basidia (Fig. 7b) 21.1–33.8 × 5.9–6.8 µm, clavate, hyaline, with granular content, 4-sterigmate, sterigmata long, 3.5 µm. Cystidia absent. Hymenophoral trama composed of subparallel,

Fig. 7 Microscopic characters of *Clitocybe cedrelae*, BAFC53464 (Holotype). **A** Basidiospores, scale bar = 10. **B** Basidia. **C** Cells of pileipellis. Scale bars: **A** 10 µm, **B** 30 µm, **C** 35 µm. Draws by Juan M. Suárez



hyaline, cylindrical hyphae, 7.9–20.1 µm wide. Pileipellis (Fig. 7c) forming a cutis of grayish yellow (2B3), not incrusted, parallel, cylindrical hyphae, 3.4–6.1 µm wide. Hypodermis composed of inflated, subglobose to globose hyaline cells, 5.3–30.2 µm wide. Stipitipellis grayish yellow (2B3), hyphae cylindrical, not incrusted, 4.1–5.3 µm wide. Clamp connections present.

Habit and habitat: Solitary to scattered, growing on the ground, among leaf litter, and on the bark of standing living *Cedrela* spp. (*Meliaceae*). This species has been collected only in the Baritú National Park, Salta, within a forest primarily composed of mature *Cedrela* spp. specimens.

Commentary: *Clitocybe cedrelae* can be distinguished by its small size and bright coloration, featuring a translucent, striated, and slightly depressed pileus at the center. Due to its distinctive coloration and phylogenetic placement, *C. cedrelae* is classified within the group of *Lepista* species with violet pigmentations. Its closest phylogenetic relative is *L. sordida* (Schumach.) Singer is characterized by generally darker coloring, an unstriated cap, and narrow spores, 5.7–7.9 × 2.8–4.0 µm (Singer 1950a). *L. argentina* (Speg.) Singer was reported as a species similar to *L. sordida* by Wright and Albertó (2002), and it is distinguished from C. *cedrelae* by the presence of white lamellae and its occurrence in the winter within the Province of Buenos Aires (Singer 1950a). *L. personata* (Fr.) Cooke exhibits a purplish coloration primarily on the stipe, a non-violet pileus, and spores measuring 4.5–7 × 3–4 µm (Bigelow and Smith 1969). *Lepista nuda* (Bull.) Cooke features larger basidiomes, an unstriated cap, and a more intense purplish coloration (Bigelow and Smith 1969). *L. tarda* (Peck) Murril has a larger pileus, pale-violet to avellaneous and spores 7–8 × 4–5 µm (Murril 1917). *L. irina* (Fr.) H.E. Bigelow, *L. densifolia*, and *L. panaeola* are primarily distinguished by their non-violet coloration and larger basidiomes.

Material examined: *Clitocybe cedrelae*. ARGENTINA, Salta, Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 3 Mar. 2023, 22°27′39.24″ S, 64°44′29.4″ W, leg. J. M. Suárez, J. Aliaga & A. P. Martínez (BAFC53464). Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 3 Mar. 2023, 22°27′38.16″ S, 64°44′29.4″ W, leg. J. Aliaga, A. P. Martínez & J. M. Suárez (BAFC53465). Parque Nacional Baritú, Bosque El Cedral, 1700 m asl., 3 Mar. 2023, 22°27′38.16″ S, 64°44′30.84″ W, leg. A. P. Martínez, J. M. Suárez & J. Aliaga (BAFC53466).

Discussion

The *Agaricales* comprise a diverse group of fungi, with around 13,000 described species, though the total number is believed to be significantly higher. They play a vital role in ecosystems as decomposers of organic matter and in symbiotic relationships with certain plants. The preservation of their natural environments is of utmost importance. It ensures the continuity of research and discovery of these diverse species, maintains biodiversity, and safeguards their potential contributions in medicine, biotechnology, and ecology.

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Author contribution All authors contributed to the studies described in the paper and read and approved the final manuscript.

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Data Availability DNA sequence data generated or used in the current study are deposited at GenBank as set out in Tables 1 and 2 of the present paper.

Declarations

Ethics approval and consent to participate All authors confirm that no research involving humans or animals was involved in the current study, that there are no issues relating to animal welfare relating to the current study, and that they have approval to participate in the current study.

Consent for publication All authors have given explicit consent to the submitted paper and to the inclusion of their data in it.

Competing interests The authors declare no competing interests.

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