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COMMUNICATION

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Occurrence of gilled fungi in Puducherry, India

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Abstract: Thirty-three species of gilled fungi belonging to 23 genera and 14 families were recorded from Puducherry, southern India. *Agaricaceae* were represented by eight species, followed by *Psathyrellaceae* (5), *Lyophyllaceae* & *Marasmiaceae* (3 each), *Hymenogastraceae*, *Pleurotaceae*, *Pluteaceae*, & *Polyporaceae* (2 each), and *Biannulariaceae*, *Bolbitiaceae*, *Omphalotaceae*, *Schizophyllaceae*, *Strophariaceae*, & *Tricholomataceae* (1 each). Fourteen species of agarics are new reports from Puducherry. *Chlorophyllum rhacodes*, *Lactocollybia epia*, *Leucoagaricus meleagris*, and *Schizophyllum commune* were widely distributed. Phylogenetic relationships of the abundant species *C. rhacodes*, *L. epia*, and *L. meleagris* were inferred by maximum likelihood method.

Keywords: Agarics, *Agaricaceae*, mushrooms, phylogeny, southern India, taxonomy.

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Author contributions: VK—carried out field trips to various places in Puducherry to record gilled fungi. He did the major part of morphological and microscopic characterization of gilled fungi and wrote the manuscript. SC—Ph.D. scholar carrying out research work under the supervision of Dr. Vadivelu Kumaresan helped in sampling gilled fungi and carrying out part of microscopic analysis. TSM—sequenced the ITS region of three gilled fungi and carried out phylogenetic analysis. SG—assisted in identifying and describing some of the species of agarics mentioned in the present study.

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INTRODUCTION

Gilled fungi belonging to *Agaricales* Underw. constitute ~10% of fungal species described so far (Kirk et al. 2008). It has been assumed that India hosts one-third of the global fungal taxa (Manoharachary et al. 2005) and hence there is an urgent need to document fungi in the unexplored parts of this country covering all possible habitats and seasonal variations. This will help in maintaining the germplasm of these important fungi, as well as to screen these macrofungi for their unique and versatile metabolic potential.

Gilled fungi in Puducherry have not been extensively studied. Studies on the diversity of macrofungi in adjacent areas are by Mani & Kumaresan (2009a,b). Thirty species of white-spored agarics have been reported from Puducherry (Kumaresan et al. 2011), although their identity was not confirmed by phylogenetic inferences. With the rapid deterioration of natural habitats due to human activity, it has become imperative to record these fungi before they become extinct. The study becomes even more interesting considering the fact that these basidiomata are ephemeral, especially the gilled fungi. Moreover, scientists have taken recourse to molecular techniques for identification of these poorly-studied organisms. Many Indian species are called after their North American or European lookalikes (Cannon & Kirk 2007). Sequencing the internal transcribed spacer region for as many fungi as possible from different regions will help immensely in creating or adding to the existing sequence database, to resolve the identities of species complexes and uncover new taxa.

MATERIALS AND METHODS

Basidiomata were sampled during the rainy season of 2007–2009 and 2016–2019 from different places in Puducherry, located 160 km south of Chennai on the southeastern coast of India. The area has a tropical climate and receives a mean annual rainfall of around 126 cm during the north-east monsoon in the months of October–December. During collection, photographs of fresh specimens were taken and morphological characters of fresh basidiomata such as colour (Kornerup & Wanscher 1978), size, and gill attachment were recorded in the field (Senthilarasu & Kumaresan 2018). Dried basidiomata were sealed in zip lock polythene covers after labeling for further microscopic studies. Samples are maintained in the mushroom herbarium collection in the Department of Botany, Kanchi

Mamunivar Government Institute for Postgraduate Studies and Research, Puducherry, India.

Microscopic examination

Thin hand-made sections of the pileus and gills were taken and revived in 5–10 % KOH and stained with phloxine (1 %). Microscopic features were recorded following Largent (1977). Approximately, 30 basidiospores sections were measured, excluding the apiculus. The spore quotient (Q) was obtained by dividing the mean length by the mean width in profile view.

DNA extraction and PCR amplification

Few nuclear ribosomal internal transcribed spacer sequences are available for a majority of the species observed here, thus we isolated whole genomic DNA and amplified the ITS sequence to compare it with available sequences in the NCBI database.

The pure fungal culture of *Leucoagaricus meleagris* was inoculated onto potato dextrose agar and grown for 10 days at 26 °C, and the mycelia were processed for genomic DNA isolation (Paranetharan et al. 2018). Dried basidiomata of *Chlorophyllum rhacodes* and *Lactocollybia epia* were processed for genomic DNA isolation following the method of Gardes & Bruns (1993). Using the fungal specific primers ITS1F (CTTGGTCATTAGAGGAAGTAA) and ITS4B (CAGGAGACTTGTACACGGTCCAG) (Gardes & Bruns 1993), a PCR reaction was performed to amplify the internal transcribed spacer (ITS) region. The PCR mix consisted of PCR buffer, forward and reverse primers (10 µM each), dNTPs (4 mM), Taq Polymerase (1 U), DMSO (1 %), MgCl₂ (25 mM) and genomic DNA (10–25 ng).

The PCR amplification was performed as follows: 95 °C for 10 min, 30 cycles of 95 °C for 30 s, 55 °C for 30 s and 72 °C for 60 s; and 72 °C for 10 min. The PCR products were purified and sequenced using ABI 3130 genetic analyzer using primers ITS1F and ITS4B.

Phylogenetic analyses

Sequences were compared using NCBI Blast. Sequences with significant matches were selected and aligned using ClustalW (Thompson et al. 1994), checked visually and edited as required, and evolutionary trees were inferred using the maximum likelihood approach (Kimura 1980) using MEGA v6.06 (Tamura et al. 2013). Bootstrap analysis (1,000 replicates) was performed to calculate the branch support (Felsenstein 1985).

RESULTS

A total of 33 species of gilled fungi from 23 genera in 14 families were recorded from Puducherry. Of these, eight species from four genera belonged to *Agaricaceae*, constituting the dominant family among the 14 agaric families. *Psathyrellaceae* was represented by five species from three genera, *Lyophyllaceae* by three species from one genus and *Marasmiaceae* by three species from three genera, and *Hymenogastraceae*, *Pleurotaceae*, *Pluteaceae*, and *Polyporaceae* by two species each (Table 1, Images 1–3).

TAXONOMY

Agaricus endoxanthus Berk. & Broome, J. Linn. Soc., Bot. 11(no. 56): 548 (1871).

Pileus 40–90 mm diam., convex to plano-convex with broad umbo, dark brown (6E8) to henna brown (7E8) at disc, fading towards margin, pileus easily peeling off, surface dry, appressed fibrillose, margin decurved, entire. Lamellae free, crowded, reddish-brown (8D6), edge smooth. Stipe 45–100 × 5–13 mm, central, terete, broadened towards base, white, greyish-brown (5D3) near base, fleshy fibrous, hollow, surface smooth. Annulus superior, membranous, large. Basidiospores 4.5–6.0 × 3–4.5 μm, Q= 1.46, ovoid to ellipsoid, brown, thick-walled.

On ground, in groups. (PY096).

Agaricus trisulphuratus Berk., Ann. Mag. nat. Hist., Ser. 5 15: 386 (1885).

Pileus 20–30 mm diam., globose-campanulate to convex, surface with cadmium orange (5A8) to salmon orange (6C4) with thick pulverulent veil, later fading away, margin appendiculate. Lamellae free, dark henna brown (7E8), crowded. Stipe 25–45 × 2–4 mm, terete, equal, surface below the annulus concolorous with the pileus and covered by pulverulent veil. Annulus superior, fugacious. Basidiospores 4.5–6.5 × 3–4 μm, Q= 1.53, ovoid to ellipsoid, brown, thick-walled.

On ground, solitary. (PY109).

Agrocybe manihotis Pegler, Kew Bull. 21(3): 508 (1968).

Pileus 30 mm diam., convex, greyish–orange (5B3), smooth, margin decurved, entire. Lamellae adnexed, brownish grey (5C2), crowded. Stipe 45 × 5 mm, central, concolorous with the pileus, cartilagenous, smooth. Spore-print brown. Basidiospores 10.5–12 × 6.5–7.5 μm, Q= 1.61, ellipsoid, thick-walled with truncated germ pore, brown. Pleurocystidia pyriform, 32–45 × 16–20

Table 1. Gilled fungal species recorded from Puducherry, India.

Family	Genus	Species
Agaricaceae	<i>Agaricus</i>	<i>Agaricus endoxanthus</i> Berk. & Broome
		<i>Agaricus trisulphuratus</i> Berk.
	<i>Chlorophyllum</i>	<i>Chlorophyllum molybdites</i> (G. Mey.) Masee*
		<i>Chlorophyllum rhacodes</i> (Vittad.) Vellinga*
	<i>Leucoagaricus</i>	<i>Leucoagaricus meleagris</i> (Gray) Singer
		<i>Leucoagaricus serenus</i> (Fr.) Bon & Boiffard*
	<i>Leucocoprinus</i>	<i>Leucocoprinus birnbaumii</i> (Corda) Singer*
		<i>Leucocoprinus cepistipes</i> (Sowerby) Pat.*
Biannulariaceae	<i>Macrocybe</i>	<i>Macrocybe lobayensis</i> (R. Heim) Pegler & Lodge
Bolbitiaceae	<i>Panaeolus</i>	<i>Panaeolus cyanescens</i> Sacc.†
Hymenogastraceae	<i>Gymnopilus</i>	<i>Gymnopilus subtropicus</i> Hesler
	<i>Naucoria</i>	<i>Naucoria conicopapillata</i> (Henn.) Sacc.*
Lyophyllaceae	<i>Termitomyces</i>	<i>Termitomyces clypeatus</i> R. Heim
		<i>Termitomyces microcarpus</i> (Berk. & Broome) R. Heim*
		<i>Termitomyces striatus</i> (Beeli) R. Heim*
Marasmiaceae	<i>Crinipellis</i>	<i>Crinipellis megalospora</i> Singer*
	<i>Lactocollybia</i>	<i>Lactocollybia epia</i> (Berk. & Broome) Pegler**
	<i>Tetrapyrgos</i>	<i>Tetrapyrgos nigripes</i> (Fr.) E. Horak*
Omphalotaceae	<i>Marasmiellus</i>	<i>Marasmiellus confluens</i> (Pers.) J.S. Oliveira
Pleurotaceae	<i>Hohenbuehelia</i>	<i>Hohenbuehelia atrocoerulea</i> (Fr.) Singer*
	<i>Pleurotus</i>	<i>Pleurotus ostreatus</i> (Jacq.) P. Kumm.*
Pluteaceae	<i>Volvariella</i>	<i>Volvariella hypopithys</i> (Fr.) Shaffer*
		<i>Volvariella volvacea</i> (Bull.) Singer*
Polyporaceae	<i>Lentinus</i>	<i>Lentinus cladopus</i> Lévl.*
		<i>Lentinus squarrosulus</i> Mont.*
Psathyrellaceae	<i>Coprinopsis</i>	<i>Coprinopsis lagopus</i> (Fr.) Redhead, Vilgalys & Moncalvo
	<i>Parasola</i>	<i>Parasola plicatilis</i> (Curtis) Redhead, Vilgalys & Hopple
	<i>Psathyrella</i>	<i>Psathyrella candolleana</i> (Fr.) Maire
		<i>Psathyrella glaucescens</i> Dennis
		<i>Psathyrella obtusata</i> (Pers.) A.H. Sm.
Schizophyllaceae	<i>Schizophyllum</i>	<i>Schizophyllum commune</i> Fr.*
Strophariaceae	<i>Agrocybe</i>	<i>Agrocybe manihotis</i> Pegler
Tricholomataceae	<i>Lepista</i>	<i>Lepista hyalodes</i> (Berk. & Broome) Pegler**

*The species have already been recorded with brief descriptions in Kumaresan et al. (2011). The remaining species are recorded for first time from Puducherry. **Incertae sedis.



Image 1. A—*Agaricus endoxanthus* | B—*Agaricus trisulphuratus* | C—*Gymnopilus subtropicus* | D&E—*Leucocoprinus meleagris* | F—*Marasmiellus confluens* | G—*Macrocybe lobayensis*. © Vadivelu Kumaresan.

μm , Cheilocystidia broadly clavate to cylindric, $24\text{--}30 \times 8\text{--}10 \mu\text{m}$.

On ground along the grass, solitary. (PY1746).

Coprinopsis lagopus (Fr.) Redhead, Vilgalys & Moncalvo, in Redhead, Vilgalys, Moncalvo, Johnson & Hopple, *Taxon* 50(1): 229 (2001).

Pileus 30–45 mm diam., plano-convex to plane, initially yellowish-brown (5D8) at the disc, becoming brown (6E8), brownish-orange (5C5, 5C4) towards margin, surface dry, margin plane, crenate, plicate-striate. Lamellae adnate, subdistant, width 3 mm, teak brown (6F5), edge smooth. Stipe 30–55 \times 2–4 mm, central, terete, with slightly bulbous base (10 mm diam.), white, surface with striations and superficial pruinose scales, cartilagenous, hollow, small collar like ring at the base. Rhizomorphs present. Spore-print black. Basidiospores $9.5\text{--}12 \times 5.5\text{--}7 \mu\text{m}$, $Q = 1.78$, ellipsoid to elongate-ellipsoid, truncated by apical germ-pore, black, smooth.

Scattered, on ground. (PY098).

Gymnopilus subtropicus Hesler, *Mycol. Mem.* 3: 41 (1969).

Pileus 20–60 mm diam., convex to plane, apricot yellow (5B6) fading towards the margin to butter yellow (4A5), squamulose at the disc reddish-brown (9E8), greyish ruby (12D7) in young, surface dry, margin decurved, entire. Lamellae adnate with decurrent tooth, close, greyish-orange (5B4), gill edge smooth, lamellulae of 5 lengths, width 5 mm. Stipe 30–50 \times 3–8 mm, terete, hollow, butter yellow (4A5), base hygrophanous to reddish-brown (9F8), fleshy fibrous, striate due to appressed scales. Spore-print brownish-orange. Basidiospores $5.5\text{--}8 \times 4\text{--}5 \mu\text{m}$, $Q = 1.51$, ellipsoid, brown, verruculose.

On palm trunk, in groups. (PY119).

Leucoagaricus meleagris (Gray) Singer, *Lilloa* 22: 422 (1951) [1949].

Pileus 25–35 mm diam., convex to expanded convex, broadly parabolic when young, dark brown (8F8) at the disc, white towards the margin, surface pruinose, margin decurved, entire. Lamellae free, white, crowded. Stipe 60–110 \times 5–8 mm, central, terete, expanding towards the base, fleshy fibrous, smooth, solid. Annulus superior. Spore-print white. Basidiospores $6\text{--}8 \times 5\text{--}6 \mu\text{m}$, $Q = 1.53$, broadly ellipsoid to ellipsoid, slightly truncated with germ-pore, hyaline, dextrinoid with a thickened wall, guttulate. Pleurocystidia absent. Chielocystidia 25–45 \times 10–15 μm ellipsoid to short cylindric with pronounced

mucronate apex.

On decaying wood, in groups and scattered. (PY19111).

Macrocybe lobayensis (R. Heim) Pegler & Lodge, in Pegler, Lodge & Nakasone, *Mycologia* 90(3): 498 (1998).

Pileus 50–120 mm diam., convex, white, plane, dry, margin decurved, entire. Lamellae adnate, whitish to cream, crowded. Stipe 40–100 \times 15–35 mm, central, white, fleshy fibrous, smooth, solid. Spore-print white. Basidiospores $4\text{--}6 \times 3\text{--}4.5 \mu\text{m}$, $Q = 1.32$, broadly ellipsoid to ellipsoid, thin-walled, hyaline.

On ground, on soil root interface, solitary. (PY19126).

Marasmiellus confluens (Pers.) J.S. Oliveira, in Oliveira, Vargas-Isla, Cabral, Rodrigues & Ishikawa, *Mycol. Progr.* 18(5): 734 (2019).

Pileus 15–25 mm diam., convex to plane, dry, reddish brown (9E8) at the disc, brown (6D8) towards the margin, margin decurved, striate. Lamellae adnexed, white to yellowish-white (1A2), crowded. Stipe 25–60 \times 2–3 mm, central to slightly eccentric, concolorous with the pileus, terete to compressed. Spore-print white. Basidiospores $5\text{--}6.5 \times 2\text{--}3 \mu\text{m}$, $Q = 2.34$, elongate to cylindric, nearly fusoid, hyaline, inamyloid. Pleurocystidia absent. Chielocystidia $32\text{--}40 \times 3.5\text{--}5.5 \mu\text{m}$, cylindric to subfusoid, flexuous, often somewhat lobed and diverticulate.

On leaf litter in groups, scattered. (PY1931).

Panaeolus cyanescens Sacc., *Syll. fung.* (Abellini) 5: 1123 (1887).

Pileus 20–35 mm diam., convex to conico-convex, disc brownish-grey (5C3), yellowish-white (4A2) to yellowish-grey (4B2), towards margin, surface dry, smooth, becoming bluish-green on bruising, margin decurved, entire. Lamellae adnate to adnexed, close, yellowish-brown (5D8) to raw umber (5F8). Stipe 50–60 \times 2–3 mm, terete, equal, yellowish white (4A2) to yellowish-grey (4B2), cartilaginous, hollow, surface superficially pruinose, bluish-green on bruising. Basidiospores $11.5\text{--}14 \times 7\text{--}8.5 \mu\text{m}$, $Q = 1.65$, lenticular, limoniform in face-view, elongate-ellipsoid in side view, blackish-brown, smooth apically truncated by a germ-pore.

On soil and decaying litter, in groups. (PY092).

Parasola plicatilis (Curtis) Redhead, Vilgalys & Hopple, in Redhead, Vilgalys, Moncalvo, Johnson & Hopple, *Taxon* 50(1): 235 (2001).

Pileus 20–25 mm diam., membranous, convex to plane, greyish-yellow (4B5) at the disc, grooves orange white (6A2), olive brown (4D8) elsewhere, surface dry,



Image 2. A—*Psathyrella obtusata* | B—*Panaeolus cyanescens* | C—*Chlorophyllum rhacodes* | D—*Crinipellis megalospora* | E—*Termitomyces clypeatus*. © Vadivelu Kumaresan.

plicate striate, margin plane, crenate. Lamellae free, brownish grey (4D2), subdistant. Stipe 85–100 × 1–2 mm, central, terete, white, cartilagenous, smooth, inserted. Basidiospores 11.5–14.5 × 8.5–10.5 μm, Q= 1.47, lenticular, ellipsoid in side view, with abaxially inclined germ-pore, black, smooth.

Solitary, on ground. (PY065).

Psathyrella candolleana (Fr.) Maire, in Maire & Werner, Mém. Soc. Sci. Nat. Maroc. 45: 112 (1937).

Pileus 20–35 mm diam., convex to broadly campanulate, brown (6E8) to brownish-orange (5C4), margin appendiculate. Lamellae adnexed, dark brown (9F7), crowded. Stipe 40–70 × 3–4 mm, central, white, terete, smooth, hollow. Spore-print dark brown. Basidiospores 6–7.5 × 3.5–4.5 μm, Q= 1.69, ellipsoid to elongate ellipsoid, with a truncated end, smooth, dark brown. Pleurocystidia absent. Chielocystidia 20–30 × 7–12 μm, cylindrical with rounded apex.



Image 3. A—*Leucocoprinus birnbaumii* | B—*Schizophyllum commune* | C—*Lepista hyalodes* | D—*Lentinus squarrosulus*. © Vadivelu Kumaresan.

On ground, in groups and scattered. (PY101).

Psathyrella glaucescens Dennis, Kew Bull. 15(1): 128 (1961).

Pileus 10–40 mm diam., conico-convex to convex, pale orange (5A3) to brownish-orange (6C4), margin white to light grey (1C3), surface dry, smooth, margin appendiculate. Lamellae adnate, brownish-orange (7C4) to greyish red (8C4). Stipe 30–70 × 2–4 mm, white, silky fibrillose, cartilagenous, hollow. Basidiospores 6.5–8 × 4–5 μm, Q = 1.63, ellipsoid, purplish-brown, apically truncated by a germ-pore.

On ground, in groups. (PY003).

Psathyrella obtusata (Pers.) A.H. Sm., Contr. Univ. Mich. Herb. 5: 55 (1941).

Pileus 15–40 mm diam., convex to broadly campanulate, cinnamon brown (6D6) at the disc, brownish-orange (6C4) elsewhere, dry, smooth, margin decurved, plane and uplifted, striate at extreme margin, crisped. Lamellae adnate, close, greyish-orange (6B3). Stipe 25–35 × 1–2 mm, terete, equal, white, cartilagenous, smooth, hollow, inserted. Basidiospores 6.5–8 × 5–6 μm, Q= 1.31, broadly ellipsoid to ellipsoid, truncated by an apical germ pore.

On ground, in groups and scattered. (PY108).

Termitomyces clypeatus R. Heim, Bull. Jard. bot. État Brux. 21: 207 (1951).

Pileus 40–70 mm diam., convex to expanded convex with a spiniform perforatium, broadly parabolic when young, surface dark brown (7F8) at the disc, fading towards the margin, smooth, margin decurved, entire. Lamellae adnexed to free, pinkish white (8A2), crowded. Stipe 50–60 × 8–10 mm, central, terete, expanding towards the base, fleshy fibrous, smooth, solid. Pseudorrhiza present. Spore-print pink. Basidiospores 5–7 × 3–4 µm, Q= 1.62, ellipsoid to elongate ellipsoid, hyaline, guttulate. Pleurocystidia pyriform. Chielocystidia subglobose.

On soil, solitary to scattered. (PY1878).

Phylogenetic analysis

The sequences obtained from *Chlorophyllum rhacodes*, *Leucoagaricus meleagris* and *Lactocollybia epia* have been deposited in GenBank with the accession numbers MT229200, MT229202, KU320581, respectively. We constructed maximum likelihood trees to compare our sequences to understand their phylogenetic relationship with related sequences from the database (Figures 1–3). The phylogenetic tree generated using ITS dataset for *C. rhacodes* and related species included 28 nucleotide sequences. The tree with the highest likelihood (-2549.8398) is depicted (Figure 1). For constructing the tree, all positions with less than 95 % site coverage were eliminated and the final dataset included 537 positions. The ITS sequence of *C. rhacodes* from this study (MT229200) was placed in the same subclade containing sequence belonging to ITS sequence of *C. rhacodes* isolated from Gorakhpur, India (MH820354) with 100 % support. The maximum likelihood tree generated for ITS sequence of *L. meleagris* and its other related species included 17 nucleotide sequences. The tree with the highest likelihood (-1609.0537) is depicted (Figure 2). The final dataset included 604 positions after removing all positions with less than 95 % site coverage. Our isolate (MT229202) clustered in the same subclade with other *L. meleagris* isolate (GQ249888) from Rajasthan, India with 100 % bootstrap support. For *L. epia* and its related isolates, the maximum likelihood tree generated included 20 nucleotide sequences and the tree with the highest likelihood (-3410.7721) is shown (Figure 3). The final dataset included 412 positions after removing all positions with less than 95 % site coverage. Our isolate (KU320581) clustered together with *L. epia* (MN523272), an isolate obtained from China, and showed 100 % bootstrap support.

DISCUSSION

Puducherry does not have any major forest, but there are patches of tropical dry evergreen forest and small areas of sacred groves and mangroves (Ponnuchamy et al. 2013). Therefore, not much litter deposition occurs to create conditions favourable for litter fungi. Studies on the occurrence of agarics in Puducherry resulted in recording more gilled fungi from soil as substrate including *A. endoxanthus*, *A. trisulphuratus*, *C. molybdites*, *C. rhacodes*, *L. serenus*, *P. cyanescens*, three species of *Termitomyces*, *V. hypopithys*, *C. lagopus*, *P. plicatilis*, three species of *Psathyrella*, *A. manihotis*, *L. hyalodes*, and *M. lobayensis*. Most of the dark-spored species recorded in the present study were reported by Natarajan & Raman (1983) in tropical dry evergreen forest areas. This shows that forest type plays an important role in determining agaric species composition (Küffer & Senn-Irlet 2005). The 10 dark-spored species along with four white-spored ones recorded in the present study are reported for the first time from Puducherry (Table 1). Among the three species of *Psathyrella* sampled in the present study, *P. candolleana* is known to be widely distributed (Manjula 1983; Natarajan et al. 2005; Farook et al. 2013; Amandeep et al. 2015a). Interestingly, a total of 53 species of *Psathyrella* have been recorded from India (Amandeep et al. 2015a); however, *P. glaucescens* and *P. obtusata* recorded in the present study have so far not been reported from southern India. Similarly, the genus *Termitomyces*, one of the mushrooms of tribal importance (Varghese et al. 2010), was represented by three species, of which *T. microcarpus* has been reported widely (Karun & Sridhar 2013).

Vellinga (2002) based on similarities in morphology and molecular studies transferred a few species previously placed in *Macrolepiota* Singer or *Lepiota* (Pers.) Gray, into *Chlorophyllum*. Most of the *Chlorophyllum* species occur in arid habitats in subtropical to tropical regions (Ge et al. 2018). In India, *C. rhacodes* is known to be widely distributed and recorded as *Macrolepiota rhacodes* earlier (Manjula 1983; Amandeep et al. 2015b). We found *C. rhacodes* to occur in a number of places in Puducherry and the identity of the species was confirmed through ITS sequence analysis by constructing maximum likelihood based phylogenetic tree (Figure 1). Interestingly, phylogenetic analysis of ITS sequences from two species which occurred widely in Puducherry showed that *L. meleagris* (Syn: *Leucocoprinus meleagris*) (Figure 2) clustered with *L. meleagris* reported from Rajasthan, India while *L. epia* (Figure 3) formed a tight cluster with *L. epia* reported earlier from China.

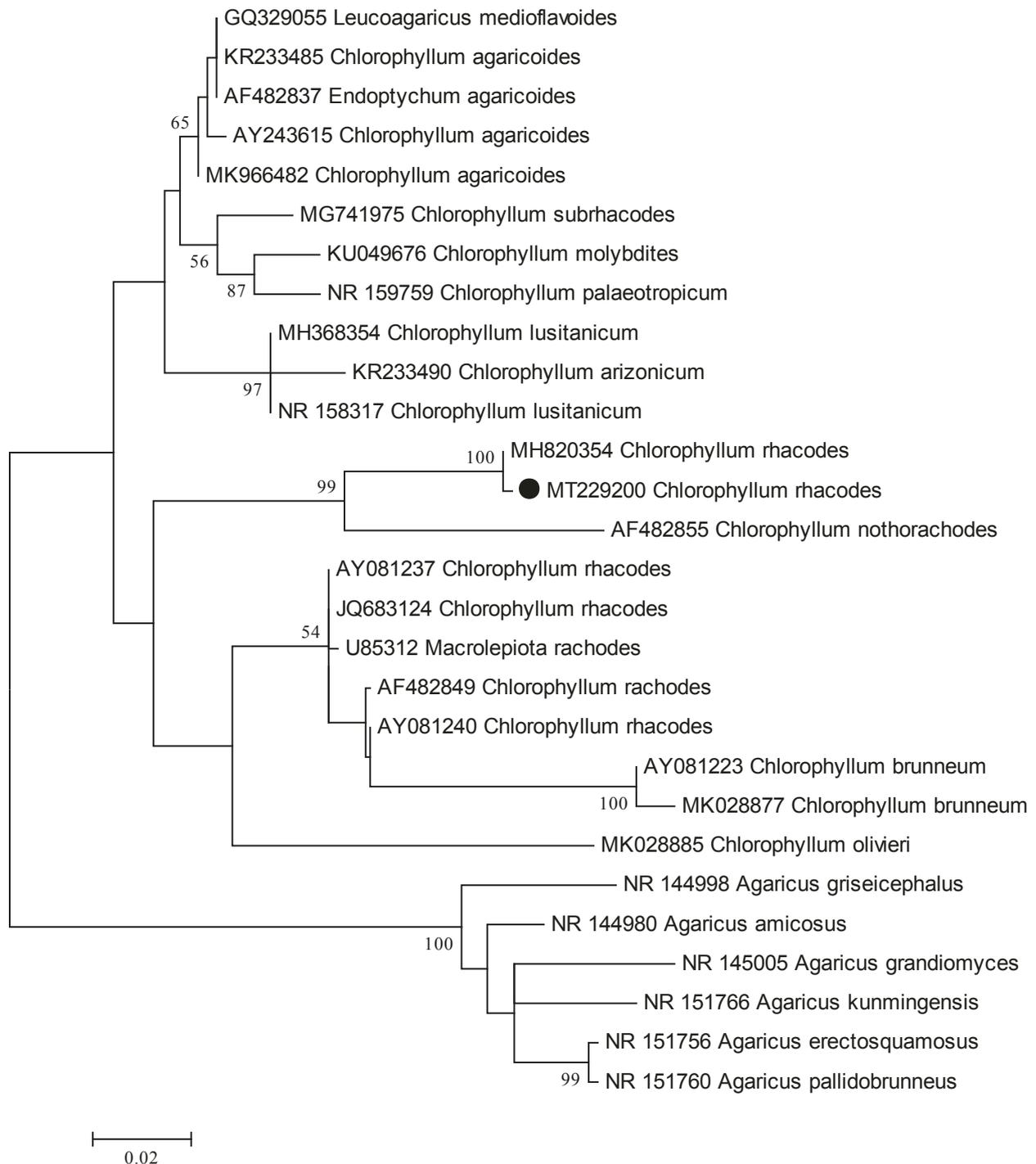


Figure 1. Phylogenetic relationship of *Chlorophyllum rhacodes* (MT229200) inferred from ITS sequences analysis by maximum likelihood method.

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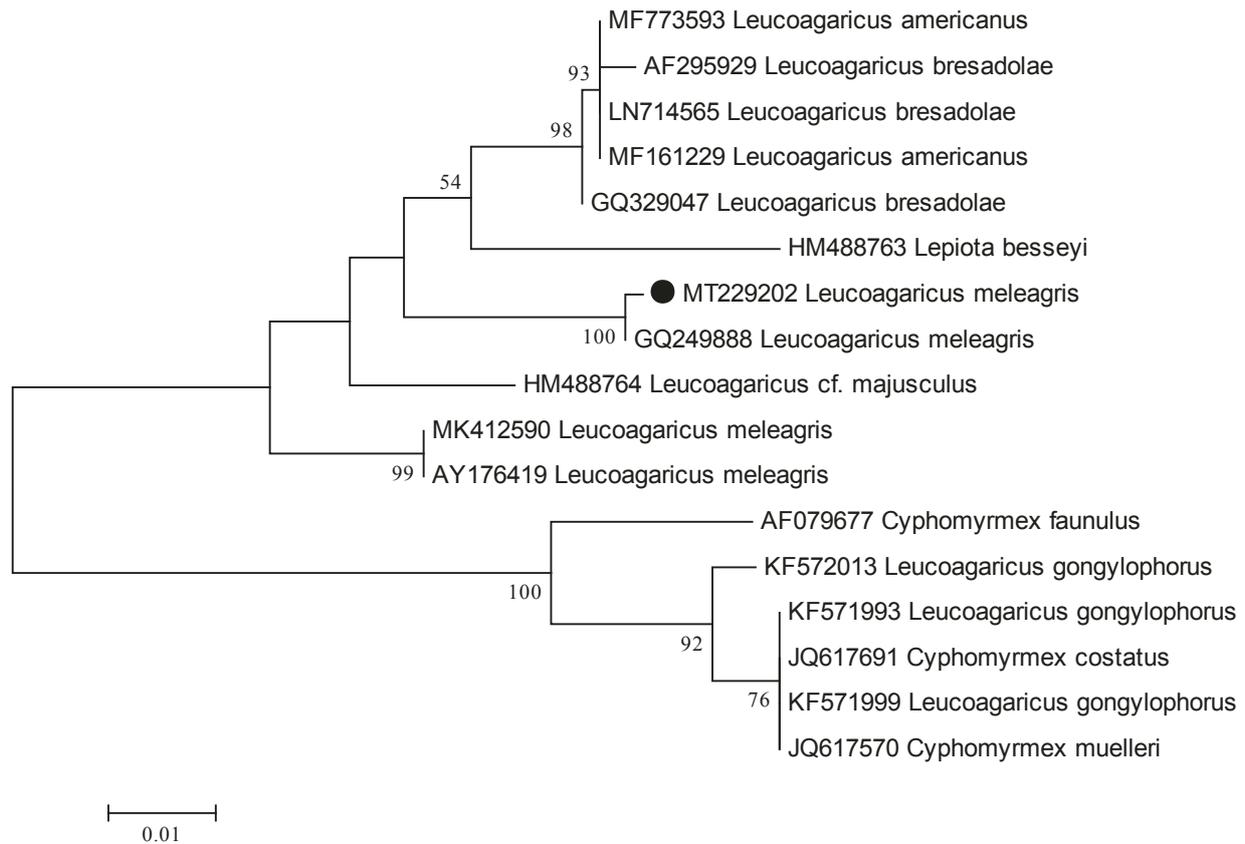


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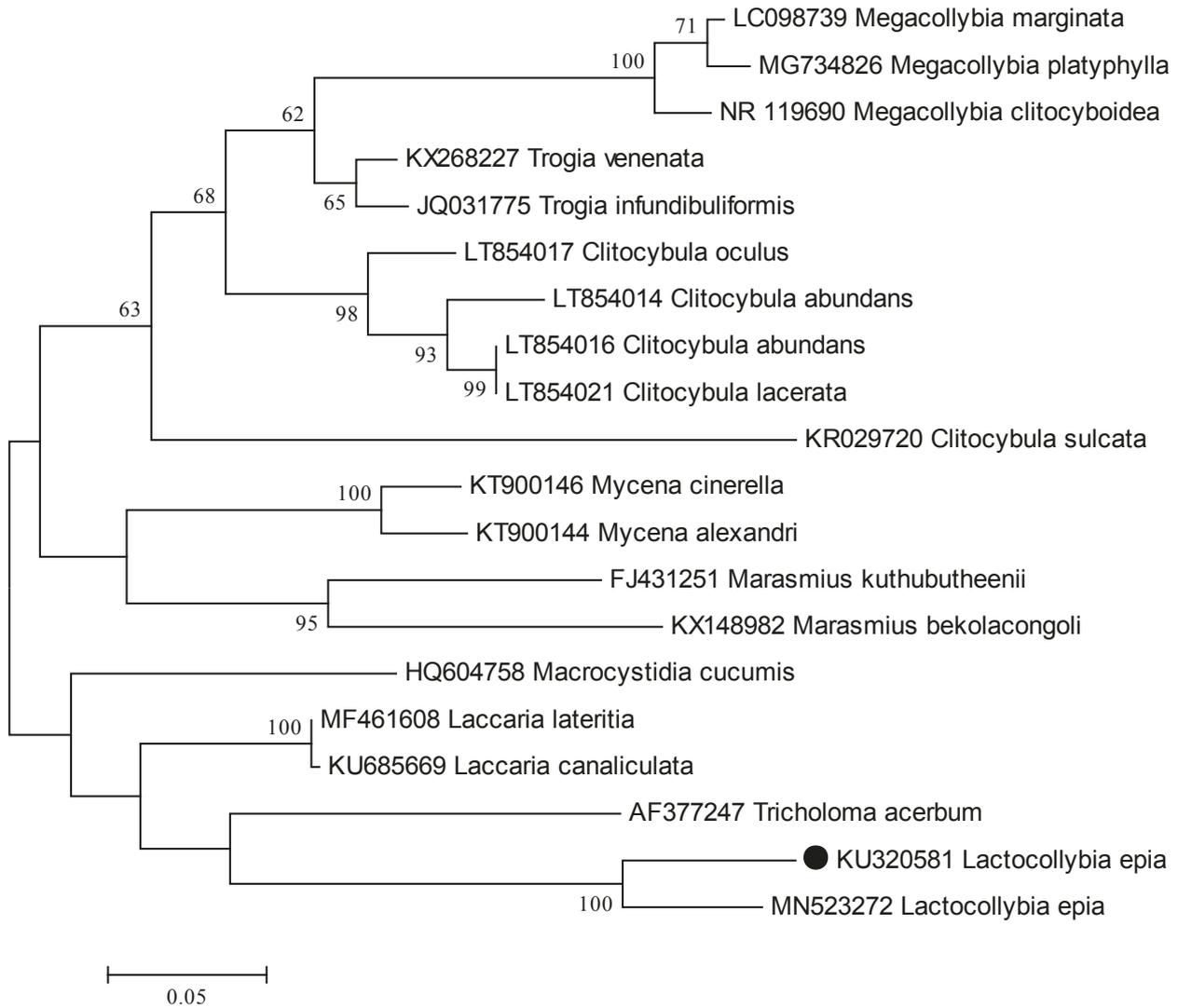


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Communications

Persistence of *Trachypithecus geei* (Mammalia: Primates: Cercopithecidae) in a rubber plantation in Assam, India

– Joydeep Shil, Jihosuo Biswas, Sudipta Nag & Honnavalli N. Kumara, Pp. 18679–18686

Population assessment of the endangered Western Hoolock Gibbon *Hoolock hoolock* Harlan, 1834 at Sheikh Jamal Inani National Park, Bangladesh, and conservation significance of this site for threatened wildlife species

– M. Tarik Kabir, M. Farid Ahsan, Susan M. Cheyne, Shahrul Anuar Mohd Sah, Susan Lappan, Thad Q. Bartlett & Nadine Ruppert, Pp. 18687–18694

Assessment of changes over a decade in the patterns of livestock depredation by the Himalayan Brown Bear in Ladakh, India

– Aishwarya Maheshwari, A. Arun Kumar & Sambandam Sathyakumar, Pp. 18695–18702

Habitat selection of Himalayan Musk Deer *Moschus leucogaster* (Mammalia: Artiodactyla: Moschidae) with respect to biophysical attributes in Annapurna Conservation Area of Nepal

– Bijaya Neupane, Nar Bahadur Chhetri & Bijaya Dhimi, Pp. 18703–18712

Sero-diagnosis of tuberculosis in elephants in Maharashtra, India

– Utkarsh Rajhans, Gayatri Wankhede, Balaji Ambore, Sandeep Chaudhari, Navnath Nighot, Vitthal Dhaygude & Chhaya Sonekar, Pp. 18713–18718

Avian species richness in traditional rice ecosystems: a case study from upper Myanmar

– Steven G. Platt, Myo Min Win, Naing Lin, Swann Htet Naing Aung, Ashish John & Thomas R. Rainwater, Pp. 18719–18737

Conservation status, feeding guilds, and diversity of birds in Doroji Sloth Bear Sanctuary, Karnataka, India

– M.N. Harisha, K.S. Abdul Samad & B.B. Hosetti, Pp. 18738–18751

Birds of Surat-Dangs: a consolidated checklist of 75 years (1944–2020) with special emphasis on noteworthy bird records and bird hotspots from northern Western Ghats of Gujarat, India

– Nikunj Jambu & Kaushal G. Patel, Pp. 18752–18780

Identification of a unique barb from the dorsal body contour feathers of the Indian Pitta *Pitta brachyura* (Aves: Passeriformes: Pittidae)

– Prateek Dey, Swapna Devi Ray, Sanjeev Kumar Sharma, Padmanabhan Pramod & Ram Pratap Singh, Pp. 18781–18791

Underestimated diversity of *Cnemaspis* Strauch, 1887 (Sauria: Gekkonidae) on karst landscapes in Sarawak, East Malaysia, Borneo

– Izneil Nashriq & Indraneil Das, Pp. 18792–18799

***Aborichthys barapensis*, a new species of river loach (Cypriniformes: Nemacheilidae) from Arunachal Pradesh, the eastern Himalaya, India**

– P. Nanda & L. Tamang, Pp. 18800–18808

A study on the community structure of damselflies (Insecta: Odonata: Zygoptera) in Paschim Medinipur, West Bengal, India

– Pathik Kumar Jana, Priyanka Halder Mallick & Tanmay Bhattacharya, Pp. 18809–18816

New distribution and range extension records of geometrid moths (Lepidoptera: Geometridae) from two western Himalayan protected areas

– Pritha Dey & Axel Hausmann, Pp. 18817–18826

Butterfly diversity of Putalibazar Municipality, Syangja District, Gandaki Province, Nepal

– Kismat Neupane & Mahamad Sayab Miya, Pp. 18827–18845

New records and distribution extension of *Nassarius persicus* (Martens, 1874) and *N. tadjillii* Moolenbeek, 2007 (Mollusca: Gastropoda: Nassariidae) to India

– Sayali Nerurkar & Deepak Apte, Pp. 18846–18852

Flowering plants of Agumbe region, central Western Ghats, Karnataka, India

– G.S. Adithya Rao & Y.L. Krishnamurthy, Pp. 18853–18867

Population assessment and habitat distribution modelling of the threatened medicinal plant *Picrorhiza kurroa* Royle ex Benth. in the Kumaun Himalaya, India

– Naveen Chandra, Gajendra Singh, Shashank Lingwal, M.P.S. Bisht & Lalit Mohan Tewari, Pp. 18868–18877

Occurrence of gilled fungi in Puducherry, India

– Vadivelu Kumaresan, Chakravarthy Sariha, Thokur Sreepathy Murali & Gunasekaran Senthilarasu, Pp. 18878–18887

Short Communications

First photographic evidence and distribution of the Indian Pangolin *Manis crassicaudata* (Mammalia: Pholidota: Manidae) in Sariska Tiger Reserve, Rajasthan, India

– Hemant Singh, Gobind Sagar Bhardwaj, N. Gokulakannan, Saket Agasti & K. Aditya, Pp. 18888–18893

Population and conservation threats to the Greater Flamingos *Phoenicopterus roseus* (Aves: Phoenicopteriformes: Phoenicopteridae) at Basai Wetland and Najafgarh Jheel Bird Sanctuary, Haryana, India

– Amit Kumar & Sarita Rana, Pp. 18894–18898

First report on the occurrence of Sargassum Weed Fish *Histrio histrio* (Lophiliformes: Antennariidae) in Nigeria deep water, Gulf of Guinea

– Abdul-Rahman Dirisu, Hanson S. Uyi & Meshack Uyi, Pp. 18899–18902

A new distribution record of stomatopods *Odontodactylus japonicus* (De Haan, 1844) and *Lysiosquilla tredecimdentata* (Holthuis, 1941) from the Puducherry coastal waters, east coast of India

– S. Nithya Mary, V. Ravitchandirane & B. Gunalan, Pp. 18903–18907

New records of *Agriocnemis keralensis* Peters, 1981 and *Gynacantha khasiaca* MacLachlan, 1896 (Insecta: Odonata) from Maharashtra, India

– Yogesh Koli, Akshay Dalvi & Dattaprasad Sawant, Pp. 18908–18919

A new distribution record of the Horn Coral *Caryophyllia grandis* Gardiner & Waugh, 1938 (Anthozoa: Scleractinia) from the Karnataka Coast, India

– J.S. Yogesh Kumar & C. Raghunathan, Pp. 18920–18924

Re-collection, extended distribution, and amplified description of *Vaccinium paucicrenatum* Sleumer (Ericaceae) from the Arunachal Himalaya in India

– Subhasis Panda, Pp. 18925–18932

Notes

Photographic record of the Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in southern Western Ghats, India

– Devika Sanghamithra & P.O. Nameer, Pp. 18933–18935

Natural history notes on the highly threatened Pinto's Chachalaca *Ortalis remota* (Aves: Cracidae)

– Carlos Otávio Araujo Gussoni & Marco Aurélio Galvão da Silva, Pp. 18936–18938

Black-bellied Coral Snake *Sinomicrurus nigriventer* (Wall, 1908) (Elapidae): an extended distribution in the western Himalaya, India

– Sipu Kumar, Jignasu Dolia, Vartika Chaudhary, Amit Kumar & Abhijit Das, Pp. 18939–18942

First record of the Afghan Poplar Hawkmoth *Loathoe witti* Eitschberger et al., 1998 (Sphingidae: Smerinthinae) from India: a notable range extension for the genus

– Muzafar Riyaz, Pratheesh Mathew, Taslima Shiekh, S. Ignacimuthu & K. Sivasankaran, Pp. 18943–18946

The tribe Cnodalonini (Coleoptera: Tenebrionidae: Stenochiinae) from Maharashtra with two new records

– V.D. Hegde & D. Vasanthakumar, Pp. 18947–18948

Do predatory adult odonates estimate their adult prey odonates' body size and dispersal ability to proceed with a successful attack?

– Tharaka Suresh Priyadarshana, Pp. 18949–18952

Rediscovery of *Ophiorrhiza incarnata* C.E.C. Fisch. (Rubiaceae) from the Western Ghats of India after a lapse of 83 years

– Perumal Murugan, Vellingiri Ravichandran & Chidambaram Murugan, Pp. 18953–18955

Response

Comments on the "A checklist of mammals with historical records from Darjeeling-Sikkim Himalaya landscape, India"

– P.O. Nameer, Pp. 18956–18958

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