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Research article

Two new polyporoid species of Fomitopsidaceae (Polyporales, Basidiomycota) from India

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Abstract. Two new species of Fomitopsidaceae, *Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov. and *Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov., are described from West Bengal, India, based on morphological and molecular phylogenetic analyses (nuclear ITS sequence). *Pseudofomitopsis fusca* sp. nov. possesses perennial, triquetrous to ungulate, sessile basidiocarps with a shiny, glabrous, azonate, dark brown upper surface, a yellowish grey pore surface with angular pores (3–5 per mm), a dimitic type of hyphal system with clamped generative hyphae, fusoid cystidioles; ellipsoid, cotton blue positive, and basidiospores 3–5 × 1.5–3.5 µm. *Fomitopsis benghalensis* sp. nov. is characterized by its annual, resupinate basidiocarp with pilose, bluish white to orange-grey, warty, woody upper surface, bluish-white pore surface, circular to angular pores (5–7 per mm), a trimitic type of hyphal system with clamped generative hyphae, fusoid cystidioles, and cylindrical to elongate basidiospores (5.5–8 × 2.5–3.5 µm). The new taxa are compared to closely related taxa. Photomicrographs of the basidiocarps, along with detailed morphological descriptions and a molecular sequence-based phylogenetic tree, are provided.

Keywords. Fomitopsidaceae, India, ITS nrDNA, Polyporales, taxonomy.

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Introduction

Fomitopsidaceae Jülich (Jülich 1981), typified by *Fomitopsis* P. Karst., belongs to the order Polyporales Gäum. Notably, this family is notorious for hosting several species that exhibit parasitic tendencies towards woody plants, causing brown rot through wood decay (Liu et al. 2022, 2023). Currently, it includes 24 genera (Liu *et al.* 2023). Among them, certain species of *Fomitopsis*, such as *Fomitopsis betulina* (Bull.) B.K.Cui, M.L.Han & Y.C.Dai, are well acknowledged for their medicinal properties (Liu *et al.* 2022). Based on morphological and phylogenetic analyses, 32 species were recognized in *Fomitopsis* (type species: *Fomitopsis pinicola* (Sw.) P.Karst.) which was shown to be polyphyletic (Kirk *et al.* 2008; Justo & Hibbett 2011). Accordingly, Han *et al.* (2016) transferred some species which were previously placed in *Fomitopsis* to seven genera, *Fomitopsis* s.s., *Fragifomes* B.K.Cui, M.L.Han & Y.C.Dai, *Niveoporofomes* B.K.Cui, M.L.Han & Y.C.Dai, *Rhodofomes* Kotl. & Pouzar, *Rhodofomitopsis* B.K.Cui, M.L.Han & Y.C.Dai, *Rubellofomes* B.K.Cui, M.L.Han & Y.C.Dai, and *Ungulidaedalea* B.K.Cui, M.L.Han & Y.C.Dai. The genus *Pseudofomitopsis* was recently discovered from Vietnam in 2023 (Liu *et al.* 2023). It has close phylogenetic and morphological relationships with *Fomitopsis*. Morphologically, *Pseudofomitopsis* differs from *Fomitopsis* s.s. by a cream to olivaceous pore surface, and a dimitic type of hyphal system with clamped generative hyphae and thick-walled skeletal hyphae (Liu *et al.* 2023). The genus *Pseudofomitopsis*, typified by *P. microcarpa* B.K.Cui & Shun Liu (Liu *et al.* 2023), was up to now monotypic.

In the course of a broader study of Fomitopsidaceae in India, several specimens were encountered that could not be readily assigned to known species, based on both morphological and molecular phylogenetic criteria. These species belonged to *Pseudofomitopsis* B.K.Cui & Shun Liu and *Fomitopsis*. In this study, we introduce and illustrate *Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov. and *Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov. as novel species and discuss the taxonomic context.

Materials and methods

Collections and morphological analysis

Throughout the monsoon and post-monsoon seasons from May to October in the years 2018 to 2021, an extensive collection of more than 300 macrofungal specimens was performed. Field photographs were taken using a Nikon D300s camera. Macro-morphological features as well as habit and habitat were observed in the field using fresh basidiocarps. A tiny part of a fresh specimen was cut, and its reaction with chemical reagents was observed. Each collected specimen was kept apart in a box to avoid contamination. Subsequently, the collected specimens were dried in a hot air drier until the moisture was totally removed.

Micro-morphological features were obtained from the dried materials by mounting thin sections of basidiocarps in 10% KOH and staining with Congo red. Specimens were examined with a Carl Zeiss AX10 Imager A1 phase contrast microscope. For colour codes and terms, the Methuen Handbook of Colour (Kornerup & Wanscher 1978) was used, and specimens were identified using Liu *et al.* (2022, 2023) and Sharma (2012). Thirty basidiospores were measured from a sample to determine their morphometry. The length-to-breadth ratio signifies the Q value. The mean Q value (Q_m) was estimated by dividing the total sum of the Q value by the total number of spores noticed.

Hand drawings of various microscopic characteristics were acquired with the use of a camera lucida, and a 0.1 mm pen was used to trace the lines. The holotype and paratype collections have been preserved following Pradhan *et al.* (2015) and deposited in the Calcutta University Herbarium (CUH), Kolkata, India.

Table 1 (continued on next 2 pages). GenBank accession numbers of nrITS sequences of the taxa used for constructing the phylogenetic tree along with their geographical distributions. The new species described in this study are shown in bold.

Taxon	GenBank	Country
Amyloporia carbonica (Overh.) Vampola & Pouzar	KC585240	USA
Antrodia favescens (Schwein.) Vlasák & Spirin	KC543129	USA
Antrodia heteromorpha (Fr.) Donk	KP715306	USA
Antrodia macra (Sommerf.) Niemelä	KC543135	Finland
Antrodia mappa (Overh. & J.Lowe) Miettinen & Vlasák	KC543113	Finland
Antrodia serpens (Fr.) P.Karst.	MG787582	Poland
Antrodia subserpens B.K.Cui & Yuan Y.Chen	KP715310	China
Antrodia tanakae (Murrill) Spirin & Miettinen	KR605814	China
Antrodiopsis oleracea (R.W.Davidson & Lombard) Audet	KC585293	USA
Brunneoporus cyclopis (O.Miettinen & V.Spirin) Audet	KU866249	Indonesia
Brunneoporus kuzyanus (Pilát) Audet	KU866265	Russia
Brunneoporus kuzyanus (Pilát) Audet	KU866267	Czech Republic
Brunneoporus malicola (Berk. & M.A.Curtis) Audet	MG787586	China
Brunneoporus malicola (Berk. & M.A.Curtis) Audet	KC595896	China
Brunneoporus minutus (Spirin) Audet	KC595900	Russia
Cartilosoma ramentacea (Berk. & Broome) Donk	KC543138	Norway
Daedalea circularis B.K.Cui & Hai J.Li	JQ780411	China
Daedalea dickinsii Yasuda	KP171201	China
Daedalea modesta (Kunze ex Fr.) Aoshima	KR605791	China
Daedalea pseudodochmia (Corner) T.Hatt.	FJ403210	China
Daedalea quercina (L.) Pers.	KP171207	Czech Republic
Flavidoporia mellita (Niemelä & Penttilä) Audet	KC543140	Russia
Flavidoporia pulverulenta B.Rivoire	JQ700280	France
Flavidoporia pulvinascens (Pilát) Audet	JQ700286	Finland
Fomitopsis abieticola B.K.Cui, M.L.Han & Shun Liu	MN148230	China
Fomitopsis bambusae Y.C.Dai, Meng Zhou & Yuan Yuan	MW937874	China
***Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov.**	**OQ892247**	**India**
***Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov.**	**OQ892252**	**India**

DNA extraction, PCR, and sequencing

Genomic DNA was extracted as described in Dutta *et al.* (2014). ITS1 and ITS4 primers were used to amplify the entire nrITS region (White *et al.* 1990). The PCR and purification were done as described in Saha *et al.* (2022). DNA sequencing was outsourced to Agri Genome Labs Pvt. Ltd. in Kerala, India. BioEdit sequence alignment editor ver. 7.2.5 (Hall 1999) was used to check the quality of the freshly generated sequencing data and for editing the sequences where needed. The newly generated sequences were deposited in GenBank.

Phylogenetic analysis

Our molecular phylogenetic dataset included 98 nrITS sequences, of which 94 were procured from GenBank, and four sequences were newly generated. Two sequences of *Laetiporus* Murrill (Laetiporaceae

Table 1 (continued). GenBank accession numbers of nrITS sequences of the taxa used for constructing the phylogenetic tree along with their geographical distributions. The new species described in this study are shown in bold.

Taxon	GenBank	Country
Fomitopsis betulina (Bull.) B.K.Cui, M.L.Han & Y.C.Dai	OL621853	China
Fomitopsis bondartsevae (Spirin) A.M.S.Soares & Gibertoni	JQ700277	China
Fomitopsis cana B.K.Cui, Hai J.Li & M.L.Han	JX435776	China
Fomitopsis caribensis B.K.Cui & Shun Liu	MK852559	Puerto Rico
Fomitopsis durescens (Overh. ex J.Lowe) Gilb. & Ryvarden	KF937292	Venezuela
Fomitopsis eucalypticola B.K.Cui & Shun Liu	MK852560	Australia
Fomitopsis ginkgonis B.K.Cui & Shun Liu	MK852563	China
Fomitopsis hemitephra (Berk.) G.Cunn.	KR605770	Australia
Fomitopsis hengduanensis B.K.Cui & Shun Liu	MN148232	China
Fomitopsis iberica Melo & Ryvarden	KR605772	Italy
Fomitopsis kesiyae B.K.Cui & Shun Liu	MN148234	Vietnam
Fomitopsis massoniana B.K.Cui, M.L.Han & Shun Liu	MN148238	China
Fomitopsis meliae (Underw.) Gilb.	KR605775	UK
Fomitopsis mounceae Haight & Nakasone	KF169624	USA
Fomitopsis nivosa (Berk.) Gilb. & Ryvarden	MF589766	Brazil
Fomitopsis ochracea Ryvarden & Stokland	KF169609	Canada
Fomitopsis ostreiformis (Berk.) T.Hatt.	OL621855	Malaysia
Fomitopsis palustris (Berk. & M.A.Curtis) Gilb. & Ryvarden	KP171213	China
Fomitopsis pinicola (Sw.) P.Karst.	MK208852	Sweden
Fomitopsis resupinata B.K.Cui & Shun Liu	OL621842	China
Fomitopsis roseoalba A.M.S.Soares, Ryvarden & Gibertoni	KT189139	Brazil
Fomitopsis schrenkii Haight & Nakasone	MN148247	USA
Fomitopsis srilankensis B.K.Cui & Shun Liu	OL621844	Sri Lanka
Fomitopsis submeliae B.K.Cui & Shun Liu	OL621849	China
Fomitopsis submeliae B.K.Cui & Shun Liu	OL621848	Malaysia
Fomitopsis subpinicola B.K.Cui, M.L.Han & Shun Liu	MN148249	China
Fomitopsis subtropica B.K.Cui & Hai J.Li	KR605787	China
Fomitopsis tianshanensis B.K.Cui & Shun Liu	MN148258	China
Fomitopsis sp.	KC507160	China
Fomitopsis sp.	KC844848	China
Fomitopsis sp.	KU169365	USA
Fomitopsis yimengensis B.K.Cui & Shun Liu	OL621850	China
Fungal sp.	MZ437369	Malaysia
Fuscopostia fragilis (Fr.) B.K.Cui, L.L.Shen & Y.C.Dai	JF950573	Czech Republic
Laetiporus sulphureus (Bull.) Murrill	KR187105	China
Laetiporus zonatus B.K.Cui & J.Song	KF951283	China
Neoantrodia infirma (Renvall & Niemelä) Audet	KC595894	Finland
Neoantrodia leucaena (Y.C.Dai & Niemelä) Audet	JQ700278	Finland
Neoantrodia primaeva (Renvall & Niemelä) Audet	JQ700272	Russia
Neoantrodia primaeva (Renvall & Niemelä) Audet	MG787598	China
Neoantrodia serialiformis (Kout & Vlasák) Audet	JQ700290	USA

Table 1 (continued). GenBank accession numbers of nrITS sequences of the taxa used for constructing the phylogenetic tree along with their geographical distributions. The new species described in this study are shown in bold.

Taxon	GenBank	Country
Neoantrodia serialis (Fr.) Audet	KT995120	Czech Republic
Neoantrodia serialis (Fr.) Audet	JQ700271	Finland
Neoantrodia variiformis (Peck) Audet	KT995137	USA
Niveoporofomes spraguei (Berk. & M.A.Curtis) B.K.Cui, M.L.Han & Y.C.Dai	KR605784	France
Oligoporus lacteus (Fr.) Gilb. & Ryvarden	KC595938	Finland
Pseudoantrodia monomitica B.K.Cui, Yuan Y.Chen & Shun Liu	MG787602	China
***Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov.**	**OQ918741**	**India**
***Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov.**	**OQ918742**	**India**
Pseudofomitopsis microcarpa B.K.Cui & Shun Liu	NR_182869	Vietnam
Pseudofomitopsis microcarpa B.K.Cui & Shun Liu	MW377316	Vietnam
Pseudofomitopsis microcarpa B.K.Cui & Shun Liu	MW377317	Vietnam
Rhizoporia hyalina (Spirin, Miettinen & Kotir.) Audet	JQ700283	Russia
Rhodoantrodia tropica (B.K.Cui) B.K.Cui, Yuan Y.Chen & Shun Liu	JQ837939	China
Rhodofomes cajanderi (P.Karst.) B.K.Cui, M.L.Han & Y.C.Dai	KC507156	China
Rhodofomes roseus (Alb. & Schwein.) Kotl. & Pouzar	KC507162	China
Rhodofomitopsis africana (Mossebo & Ryvarden) B.K.Cui, M.L.Han & Y.C.Dai	ON417189	Vietnam
Rhodofomitopsis cupreorosea (Berk.) B.K.Cui, M.L.Han & Y.C.Dai	DQ491400	Costa Rica
Rhodofomitopsis feei (Fr.) B.K.Cui, M.L.Han & Y.C.Dai	KC844850	Venezuela
Rhodofomitopsis monomitica (Yuan Y.Chen) B.K.Cui, Yuan Y.Chen & Shun Liu	KY421733	China
Rhodofomitopsis lilacinogilva (Berk.) B.K.Cui, M.L.Han & Y.C.Dai	KR605773	Australia
Rhodofomitopsis oleracea (R.W.Davidson & Lombard) B.K.Cui, Yuan Y.Chen & Shun Liu	KC585296	USA
Rhodofomitopsis pseudofeei B.K.Cui & Shun Liu	MK461953	Australia
Rhodonia placenta (Fr.) Niemelä, K.H.Larss. & Schigel	JX109846	Finland
Rubellofomes cystidiatus (B.K.Cui & M.L.Han) B.K.Cui, M.L.Han & Y.C.Dai	KF937288	China
Rubellofomes minutisporus (Rajchenb.) B.K.Cui, M.L.Han & Y.C.Dai	KR605777	Argentina
Subantrodia juniperina (Murrill) Audet	KC585282	USA
Subantrodia juniperina (Murrill) Audet	MG787606	USA
Subantrodia uzbekistanica (Yuan Yuan, Gafforov & F.Wu) Audet	KX958182	Uzbekistan
Ungulidaedalea fragilis (B.K.Cui & M.L.Han) B.K.Cui, M.L.Han & Y.C.Dai	KF937286	China

Jülich) were chosen as the outgroup (Liu *et al.* 2022). The accession numbers of the newly generated sequences and of other GenBank sequences are displayed in Table 1 and Fig. 1.

The nrITS dataset was aligned with MAFFT ver. 7.490 on XSEDE (Katoh *et al.* 2002) using default settings, and manually adjusted where needed using MEGA ver. 7.0 (Kumar *et al.* 2016). For maximum likelihood (ML) analyses, the statistically best-fit models of nucleotide substitution were determined by jModeltest ver. 2.1.6 (Darriba *et al.* 2012) using the XSEDE server on the Cyber Infrastructure for Phylogenetic Research (CIPRES) web portal (https://www.phylo.org/portal2/) (Miller *et al.* 2010). Based on the Bayesian information criterion (BIC), the GTR+I+G model was chosen as the most suitable model for further analysis. ML bootstrapping (MLBS) analyses were carried out using RAxML-HPC2 ver. 8.2.12 (Stamatakis 2006) with bootstrap statistics worked out from 1000 rapid bootstrap replicates

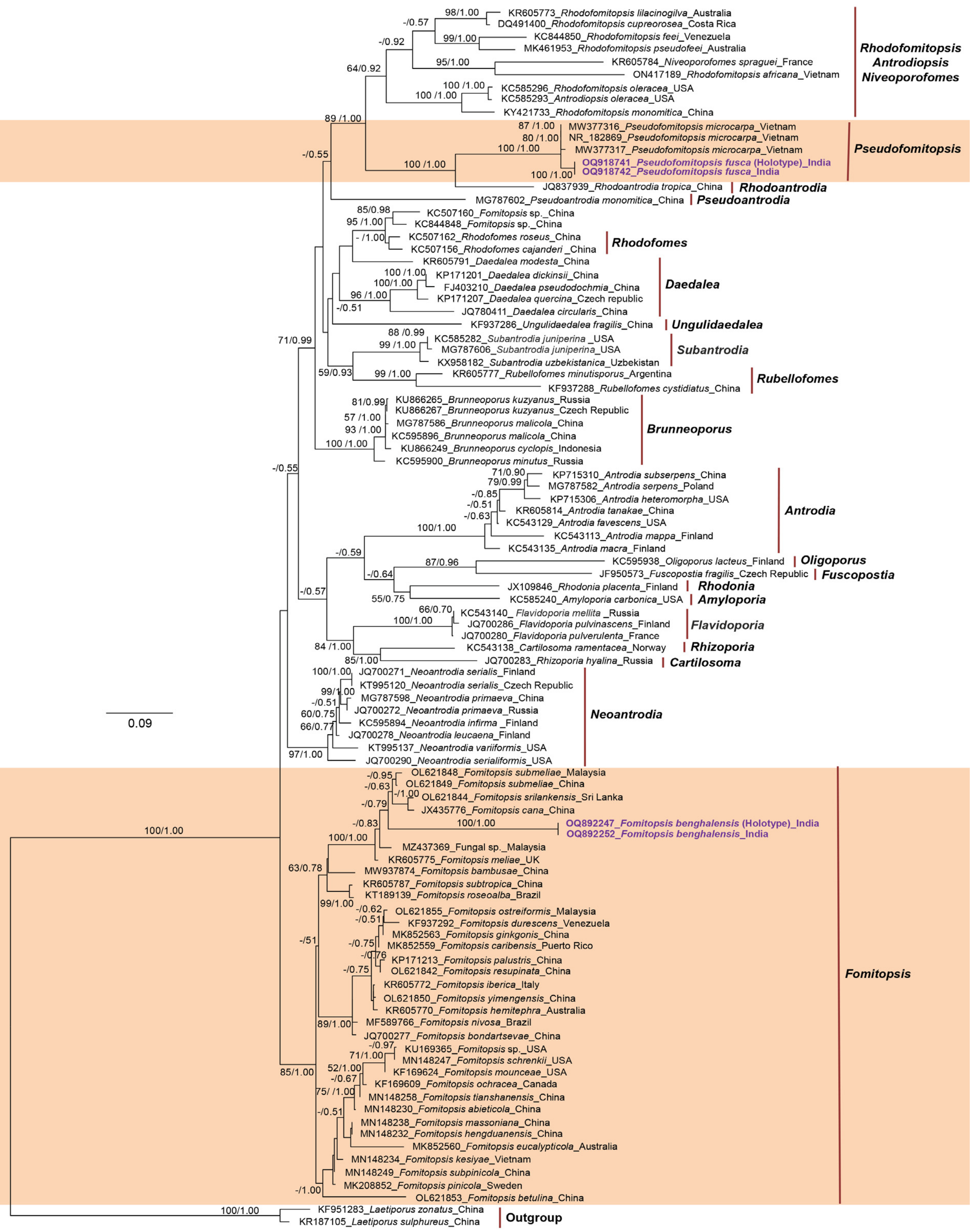

Fig. 1. Maximum likelihood (ML) tree constructed employing the GTR+I+G model of nucleotide evolution (-*lnL*= 12832.44796) based on the nrDNA ITS sequence data. Left side numbers of '/' are ML bootstrap support, and those to the right side show the Bayesian posterior probabilities (PP). MLBS ≥ 50% and PP ≥ 0.50 values are displayed above or below the branches and the scale bar indicate the expected changes per site. The newly described species are exhibited in deep violet bold font to highlight their positions in the phylogenetic tree.

on the CIPRES NSF XSEDE resource. Bayesian inference (BI) of the phylogeny was worked out with the application of MrBayes ver. 3.2.2 (Ronquist *et al.* 2012) using the selected model operating Markov chain analyses (Geyer 1991). Markov chains were enumerated for 10^6 generations, storing a tree every 100th generation. After a 25% preliminary burn in, MrBayes was used to figure out the remaining trees' 50% majority rule consensus phylogram to enumerate the posterior probabilities (PPs) of the groups. MLBS and PP values equal to or greater than 50% and 0.50 are displayed in the resulting phylogenetic tree.

Results

Molecular phylogenetic analyses

ITS sequences of *Pseudofomitopsis fusca* sp. nov. and of *Fomitopsis benghalensis* sp. nov. ranged between 680–700 and 586–610 nucleotides, respectively. After trimming both ends, the aligned dataset contained 779 positions, including gaps. Bayesian analyses reached a standard deviation of split frequencies of 0.01 after 10^6 generations. The ML and Bayesian phylogenetic trees had the same in topology. Therefore, only the phylogenetic tree constructed using ML analysis is displayed in Fig. 1. The phylogenetic tree shows that our new sequences formed to distinct clades. One clade falls within *Pseudofomitopsis* s.s. (100% BS, 1.00 PP), while the other one is placed in a distinct long branch within the *Fomitopsis* s.s. clade (85% BS, 1.00 PP). These results, along with the morphological data presented below, warrants the recognition of two new species, *Pseudofomitopsis fusca* sp. nov. and *Fomitopsis benghalensis* sp. nov.

Taxonomy

Phylum Basidiomycota R.T.Moore
Class Agaricomycetes Doweld
Order Polyporales Gäum.
Family Fomitopsidaceae Jülich
Genus *Pseudofomitopsis* B.K.Cui & Shun Liu

Pseudofomitopsis fusca R.Saha, A.K.Dutta & K.Acharya sp. nov.
MycoBank: MB 848689
Figs 2–3

Diagnosis

Pseudofomitopsis fusca sp. nov. differs from *Pseudofomitopsis microcarpa* in having annual, pileate, glabrous, corky, straw yellow to honey yellow coloured, laterally stipitate to sub-stipitate basidiocarp, turning reddish brown to black towards base, 7–8 pores per mm, and cylindrical to oblong ellipsoid basidiospores that are non-reactive in cotton blue (CB).

Etymology

The epithet 'fusca' refers to the colour of the pileus upper surface.

Type material

Holotype

INDIA – **West Bengal** • Jalpaiguri district, Samsing forest, near Gorumara National Park; 26°84′82″ N, 88°60′22″ E; 102 m a.s.l.; 4 May 2018; *R. Saha, J. Tamang & K. Acharya RJK–01/2021*; on dead wood of an unidentified angiosperm; GenBank no.: OQ918741 (ITS); CUH [AM776].

Paratype

INDIA – **West Bengal** • Jalpaiguri district, Samsing forest, near Gorumara National Park; 26°84′82″ N, 88°60′22″ E; 914 m a.s.l.; 4 May 2018; *R. Saha, J. Tamang & K. Acharya RJK–09/2021*; on dead wood of an unidentified angiosperm; GenBank no.: OQ918742 (ITS); CUH [AM777].

Description

Basidiocarp pileate, perennial, triquetrous to ungulate, sessile, woody, hard, 20–35 mm wide, projecting 15–25 mm and 8–15 mm thick. Pileus upper surface applanate, shiny, glabrous, azonate, dark brown (9F4). Context 4–10 mm thick, brownish grey (7C2), woody, unchanged in KOH. Margin concolorous to the pileus upper surface, 0.8–1.5 mm thick. Pore surface yellowish grey (2C2), pores angular, 3–5 per mm. Tubes concolorous to the pore surface, 2–5 mm deep.

Hyphal system dimitic. Generative hyphae hyaline, thin-walled, branched, clamped, 1.65–3.5 µm wide. Skeletal hyphae thick-walled to solid, highly branched, hyaline, 1.5–5 µm wide. Basidia clavate, 4-sterigmate, hyaline, smooth, thin walled, 10–20 × 3.5–5.5 µm in diam. Cystidia absent. Cystidioles fusoid, thin-walled, hyaline, smooth, 9.5–16.5 × 3–3.5 µm in diam. Basidiospores thin-walled, hyaline, smooth, ellipsoid, aguttulate, reacting positive in cotton blue (CB), 3–$\underline{3.7}$–5 × 1.5–$\underline{2.9}$–3.5 µm in diam., Q = 1.09–1.99, Q_m = 1.34.

Remarks

The new species is quite exceptional. Characteristic features of *Pseudofomitopsis fusca* sp. nov. are: perennial, triquetrous to ungulate, sessile (20–30 × 15–20 × 8–15 mm) basidiocarp with glabrous,

Fig. 2. Field photographs of fresh basidiocarps of *Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov. in natural habitat, collected from West Bengal, India (CUH [AM776], holotype). Scale bar = 10 mm. Photograph by R. Saha.

dark brown upper surface; yellowish grey pore surface; dimitic type of hyphal system with clamped generative hyphae; fusoid cystidioles; ellipsoid, CB positive basidiospores measuring 3–5 × 1.5–3.5 µm with a mean Q value of 1.34.

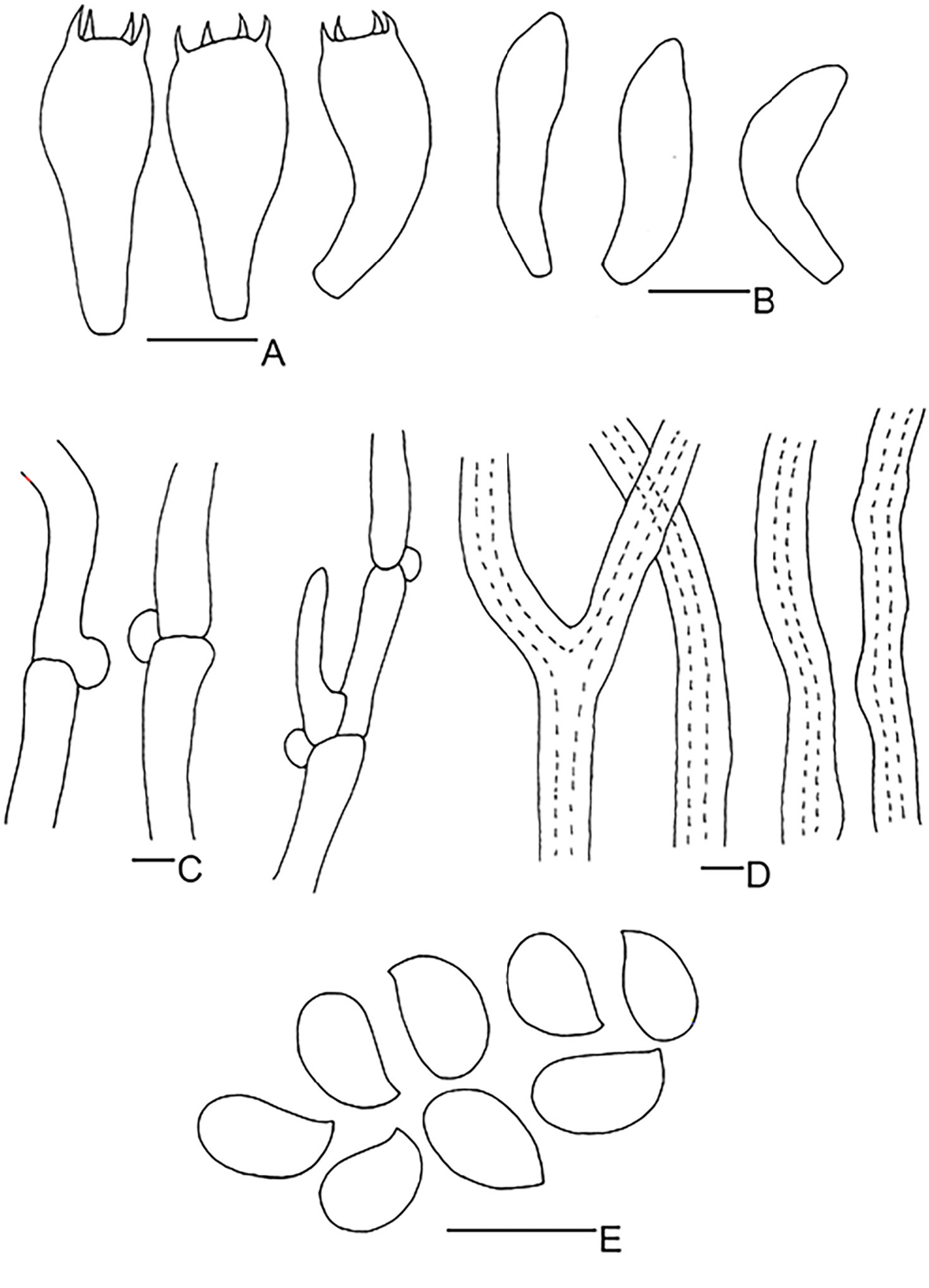

Fig. 3. Microscopic characteristics of *Pseudofomitopsis fusca* R.Saha, A.K.Dutta & K.Acharya sp. nov. (CUH [AM776], holotype). **A**. Basidia. **B**. Cystidioles. **C**. Generative hyphae. **D**. Skeletal hyphae. **E**. Basidiospores. Scale bars = 5 µm. Drawing by R. Saha.

Genus *Fomitopsis* P.Karst.

Fomitopsis benghalensis R.Saha, A.K.Dutta & K.Acharya sp. nov.
MycoBank: MB 848690
Figs 4–5

Diagnosis

Fomitopsis benghalensis sp. nov. differs from *Fomitopsis submeliae* B.K.Cui & Shun Liu due to the presence of effused-reflexed to imbricate, glabrous, mouse grey to greyish brown pilei and small-sized basidiospores (3.8–5.2 × 1.9–2.6 µm).

Etymology

The epithet 'benghalensis' refers to the type locality in West Bengal.

Type material

Holotype

INDIA – West Bengal • South 24 pargana, Hasim Nagar; 22°30′95″ N, 88°25′34″ E; 8 m a.s.l.; 2 Oct. 2021; *R. Saha & K. Acharya RK–36/2021*; on dead wood of an unidentified angiosperm; GenBank no.: OQ892247 (ITS); CUH [AM795].

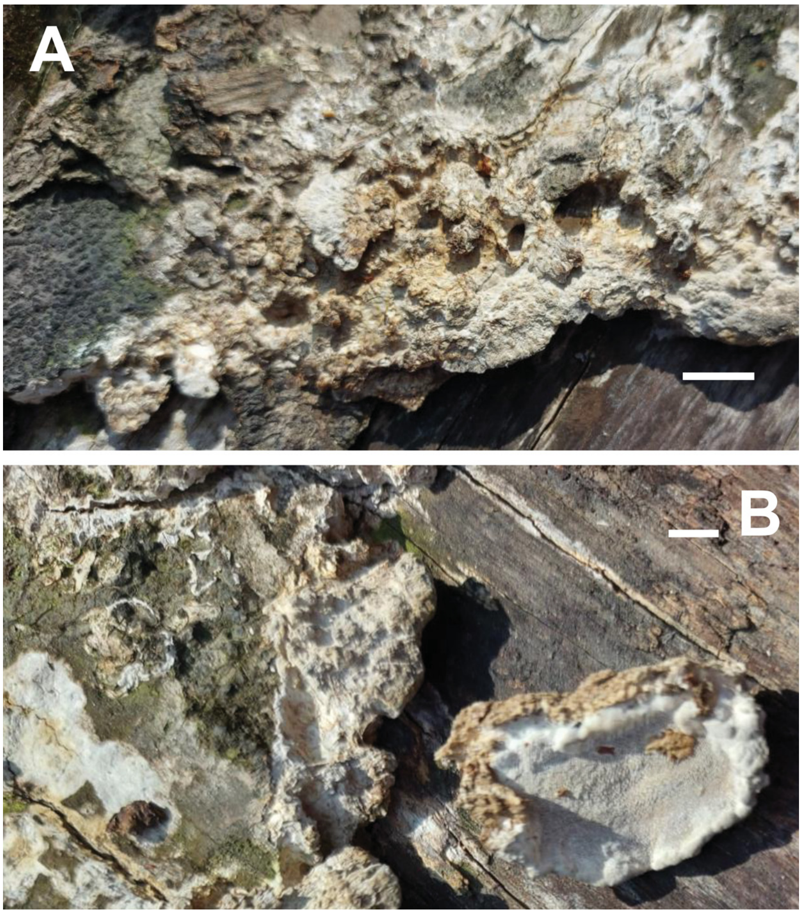

Fig. 4. A–B. Field photographs of fresh basidiocarps of *Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov. in natural habitat, collected from West Bengal, India (CUH [AM795], holotype). Scale bars = 10 mm. Photograph by R. Saha.

Paratype

INDIA – West Bengal • South 24 pargana, Hasim Nagar; 22°30′95″ N, 88°25′34″ E; 8 m a.s.l.; 2 Oct. 2021; *R. Saha & K. Acharya RK–39/2021*; on dead wood of an unidentified angiosperm; GenBank no.: OQ892252 (ITS); CUH [AM796].

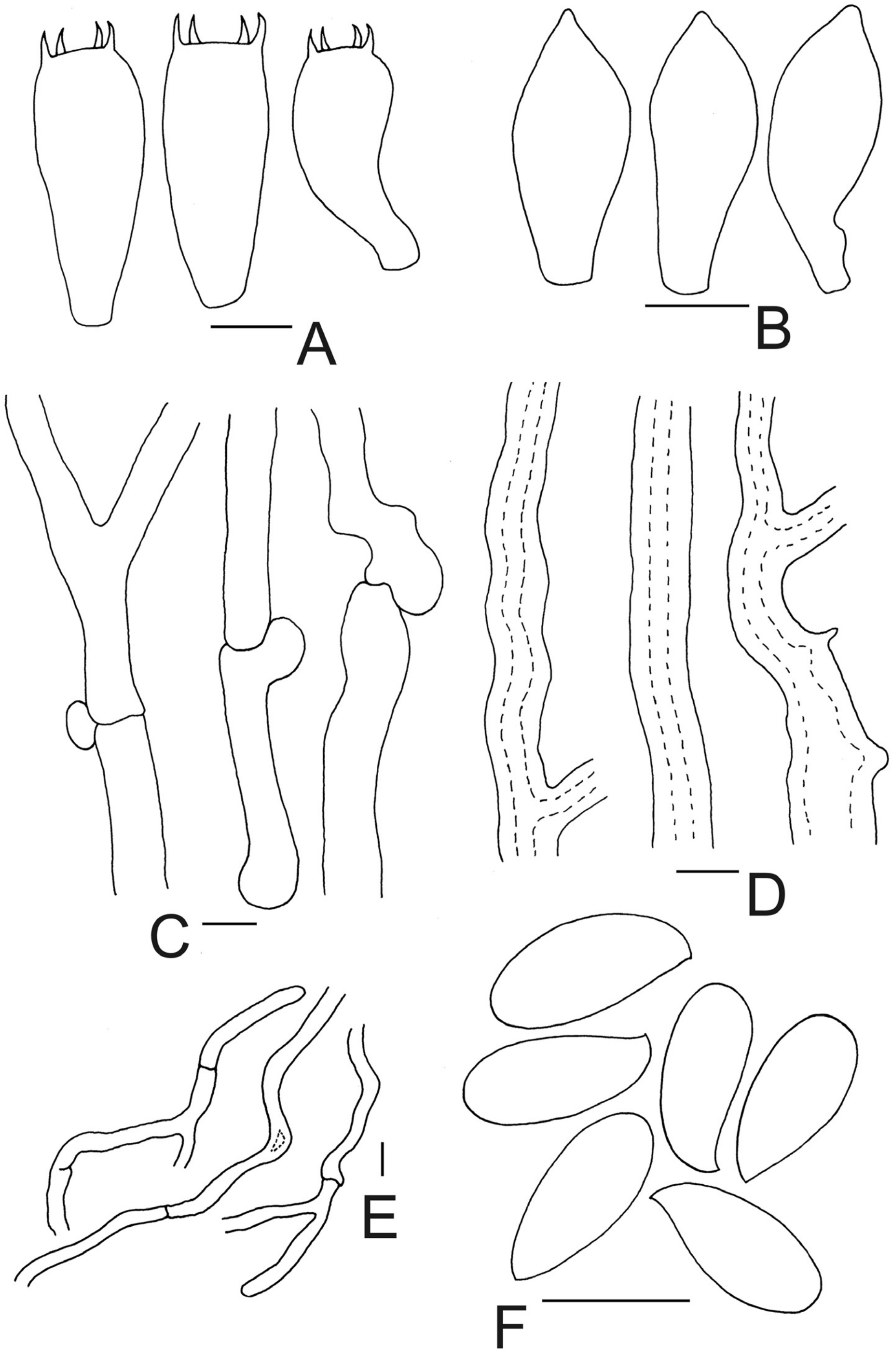

Fig. 5. Microscopic characteristics of *Fomitopsis benghalensis* R.Saha, A.K.Dutta & K.Acharya sp. nov. (CUH [AM795], holotype). **A**. Basidia. **B**. Cystidioles. **C**. Generative hyphae. **D**. Skeletal hyphae. **E**. Binding hyphae. **F**. Basidiospores. Scale bars = 5 µm. Drawing by R. Saha.

Description

Basidiocarp annual, resupinate to effused-reflexed, projecting 60–100 mm and 5–13 mm thick. Pileus surface pilose, azonate, bluish white (21A2) to orange grey (6B2), warty, woody. Margin bluish white (21A2) when fresh, up to 5 mm thick. Pore surface bluish white (21A2); pores circular to angular, 5–7 per mm. Context orange grey (6B2), 2–6 mm thick, hard, woody, colour unchanged in KOH. Tubes bluish white (21A2), not stratified, 2–7 mm deep.

Hyphal system trimitic. Generative hyphae clamped, hyaline, thin walled, branched, 2.5–6 µm wide. Skeletal hyphae hyaline, thick walled with narrow lumen, sometimes branched, 2.5–6.5 µm wide. Binding hyphae thin walled, solid, hyaline, branched, sometimes septate, 1.5–3.5 µm wide. Basidia clavate, thin walled, hyaline, 4-sterigmate, smooth, 11.5–20.5 × 5.5–7.5 µm in diam. Cystidioles fusoid, thin walled, hyaline, smooth, 11.5–15 × 5–5.5 µm in diam. Basidiospores thin walled, hyaline, smooth, cylindrical to elongate, aguttulate, negative in cotton blue (CB), 5.5–6.2–8.0 × 2.5–3.0–3.5 µm in diam., Q=1.67–2.7, Q_m= 2.05.

Remarks

Characteristic features of *Fomitopsis benghalensis* sp. nov. include an annual, resupinate basidiocarp with a pilose, bluish white to orange grey upper surface; bluish white pore surface; trimitic type of hyphal system with clamped generative hyphae; fusoid cystidioles; cylindrical to elongate basidiospores measuring 5.5–8 × 2.5–3.5 µm with a mean Q value of 2.05. The type species *Fomitopsis pinicola* differs from our novel species by having a perennial, ungulate, reddish brown basidiocarp, which is rarely effused-reflexed or resupinate, stratified tube layers, and hyphoid, often thick-walled cystidia (Ryvarden & Gilbertson 1993).

Discussion

Prior to this study, *Pseudofomitopsis* existed as a monotypic genus, represented by *P. microcarpa* B.K.Cui & Shun Liu. This species bears a close resemblance to the newly described *Pseudofomitopsis fusca* sp. nov., characterized by an annual, pileate, glabrous, azonate basidiocarp. It differs from the new species by having an applanate, corky, laterally stipitate to substipitate, straw yellow to honey yellow basidiocarp, turning reddish brown to black towards the base; smaller pores (7–8 per mm); and basidiospores reacting negative in CB (Liu *et al.* 2023). The phylogenetically related species *Pseudoantrodia monomitica* B.K. Cui, Yuan Y. Chen & Shun Liu differs from *P. fusca* by having a resupinate basidiocarp and monomitic types of hyphal systems (Liu *et al.* 2023). Another phylogenetically closely related species, *Rhodoantrodia tropica* (B.K.Cui) B.K.Cui, Y.Chen & Shun Liu, differs from *P. fusca* by having a resupinate basidiocarp difficult to separate from the substrate, absence of cystidioles, and larger, cylindrical to fusiform basidiospores (8–10 × 2.5–3 µm) (Cui 2013).

Fomitopsis benghalensis sp. nov. is phylogenetically closely related to an unidentified collection of Malaysia (GenBank no.: MZ437369), for which no morphological description is available. *Fomitopsis submeliae* is also closely related but it differs from *F. benghalensis* in having effused-reflexed to imbricate, glabrous, mouse grey to greyish brown pilei and small sized basidiospores (3.8–5.2 × 1.9–2.6 µm) (Liu *et al.* 2022). *Fomitopsis cana* B.K.Cui, Hai J.Li & M.L.Han differs by having effused-reflexed to imbricate, glabrous to slightly velutinate, mouse grey to dark grey coloured pilei (Li *et al.* 2013). *Fomitopsis srilankensis* B.K.Cui & Shun Liu differs from our new species by the presence of a glabrous pileus surface, a dimitic type of hyphal system with yellowish brown to cinnamon brown skeletal hyphae (Liu *et al.* 2022). *Fomitopsis meliae* (Underw.) Gilb. differs by having a pileate basidiocarp, pileus solitary and dimidiate (Gilbertson 1981).

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