A new host for the parasitic macrofungus *Marasmius palmivorus* Sharples (Marasmiaceae)

The genus *Marasmius* Fr. (Basidiomycota, Marasmiaceae) is cosmopolitan in distribution with about 600 well-accepted epithets[1]. The characteristic features of the genus include an *in situ* reviving basidiomata; conic to convex pileus with striate to sulcate margin; adnexed to adnate attachment of lamellae; tough, filiform stipe, and dextrinoid tramal hyphae[2]. Recent advances in molecular phylogenetic protocols restrict the genus to a monophyletic lineage, including sections Globulares, Hygrometrici, Leveilleani, Marasmius, Neosessiles, Scotyphysini and Sicci[2]. Although most species of *Marasmius* are saprophytes, there are some parasitic species as well. *Marasmius palmivorus*, a notorious species, is responsible for causing various diseases like bunch rot of oil palm, post-harvest disease of coconut seedlings, etc.[3,4]. Based on our recent concept of the genus *Marasmius sensu stricto*, there are no corresponding sections for accommodating the present species because of its unique pileipellis morphology (cutis-type) and absence of tramal dextrinoid nature. So, at present, *Marasmius palmivorus* is of uncertain taxonomic placement, but it does belong to the Marasmiaceae and is neither related to the genus *Crinipellis* Pat. or *Moniliophthora* H.C. Evans *et al*. vide Wilson and Desjardin[5]. Though there are reports on the formal transfer of *M. palmivorus* to the genus *Marasmiellus*[6], the present taxon is not at all closely related to the type species of *Marasmiellus*, *M. juniperinus* Murrill and cannot be treated as a member in the Omphalotaceae. However, now it is best to retain the present taxon in '*Marasmius*' – where it was originally described[3], until more data from multiple genes and analyses in a large Marasmiaceae dataset provide enough information to clarify its taxonomic position.

The first instance of disease caused by *M. palmivorus* in India was reported from an oil-palm plantation of the Andaman and Nicobar Islands[7]. Later, Singh *et al*.[8] reported the occurrence of this fungus in the respiratory tract as a nonsporulating mould. However, the literature review indicates that throughout the world, there has been no published information on the occurrence of this fungal species on the *Lagerstroemia speciosa* tree. Besides, no information on the morphological features of this fungus has been reported thus far from India. During continuous investigation on the macrofungal flora of West Bengal over the last few decades, *M. palmivorus* was collected from the living stem of *L. speciosa* tree and is reported herein with morphological and molecular details. Genomic DNA of the collected macrofungus was extracted following Dutta *et al*.[9]. PCR amplification of the nuclear ribosomal internal transcribed spacer (nrITS) and large subunit (nrLSU) regions was done based on Dutta *et al*.[10]. The newly generated sequences have been deposited in GenBank (www.ncbi.nlm.nih.gov).

Taxonomy: *Marasmius palmivorus* Sharples, Malay. Agric. Journal 16 (nos 9-10): [1] (1928) Figures 1 and 2.

Pileus 12–26 mm diam., convex when young, becoming broadly convex to plano-convex or applanate in age, often with slightly revolute margin, with a shallow central depression, surface minutely fibrillose, overall white when young, becoming white with light orange (5A4) to grayish-orange (5B4) or pale orange (6A3) centre on maturity, translucent with KOH, shiny, margin striate to sulcate. Context white to cream, very thin, membranous. Lamellae ca. 2 mm broad, adnexed to adnate, distant (11–14) with 3–4 series of lamellulae, often intervenose, overall white when young, becoming white with light orange (5A4) to pale orange (6A3) towards attachment of stipe, turns translucent with KOH, concolorous, smooth, even to slightly eroded. Stipe rudimentary or small, 1.5–6.5 × 1–1.5 mm, eccentric, cylindrical, tapered at apex, white, minutely pruinose, shiny, insititious. Odour and taste not distinctive.

Basidiospores (10–)11–12.5–13.5 (–14.5) × 5.5–6.5–6.9(–7.5) µm, Q = 1.5–1.8–2.1, ellipsoid, hyaline, IKI-, guttate when viewed with KOH, thin-walled. Basidia 32–37(–40) × 5.5–6(–7.5) µm, clavate, hyaline, thin-walled, four-spored; sterigmata 3.5–6.5 µm long, cylindrical. Basidioles 25–29(–43) × 6.5–7(–7.5) µm, cylindrical to clavate, hyaline, thin-walled. Pleurocystidia absent. Lamellae-edge sterile, with crowded cystidia. Cheilocystidia (14–)16–17(–19) × (5–)8–10(–14) µm, clavate with apical lobules, hyaline, inamyloid, thin- to moderately thick-walled; lobules (0.5–)1–2(–3) µm long, cylindrical, obtuse, sometimes apically bifurcate, thin- to thick-walled (Figure 2 *d*). Lamellae trama hyphae (3.5–)5–7(–8) µm broad, interwoven, cylindrical to irregularly cylindrical, non-gelatinous, hyaline, IKI-, moderately thick-walled (up to 0.9 µm). Pileipellis composed of radially arranged hyphae, 4–5(–7.5) µm broad, cylindrical, non-gelatinous, hyaline, IKI-, thin- to thick-walled (up to 1.1 µm). Pileus trama hyphae 3.5–7.5 µm broad, interwoven, cylindrical, hyaline, IKI-, thin-walled. Stipitipellis hyphae 2.5–3.5(–5.5) µm broad, subparallel, cylindrical, hyaline, inamyloid, thin- to slightly thick-walled. Stipe context hyphae 7–10(–13) µm broad, parallel to subparallel, cylindrical to irregularly cylindrical, non-gelatinous, hyaline, IKI-, wall 0.7–1.1 µm thick. Caulocystidia in the form of stipe hairs, in tufts, 3–4.5 µm broad, cylindrical, hyaline, thin-walled. Clamp connections present in all the tissues.

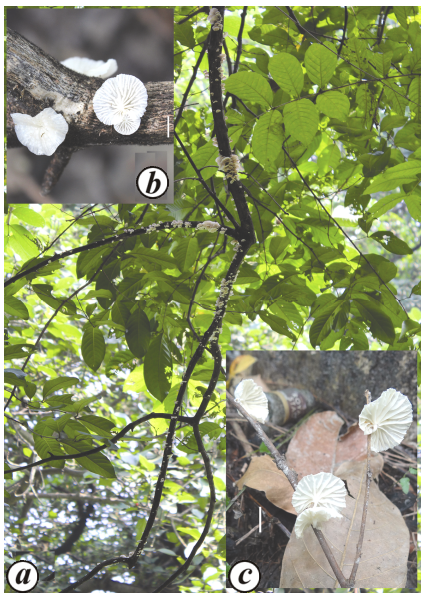

Figure 1. *Marasmius palmivorus*. ***a***, Habitat on living *Lagerstroemia* tree; ***b***, ***c***, Field photographs of basidiocarps showing pileus surface and lamellae side. Scale bar: ***b***, ***c*** = 10 mm.

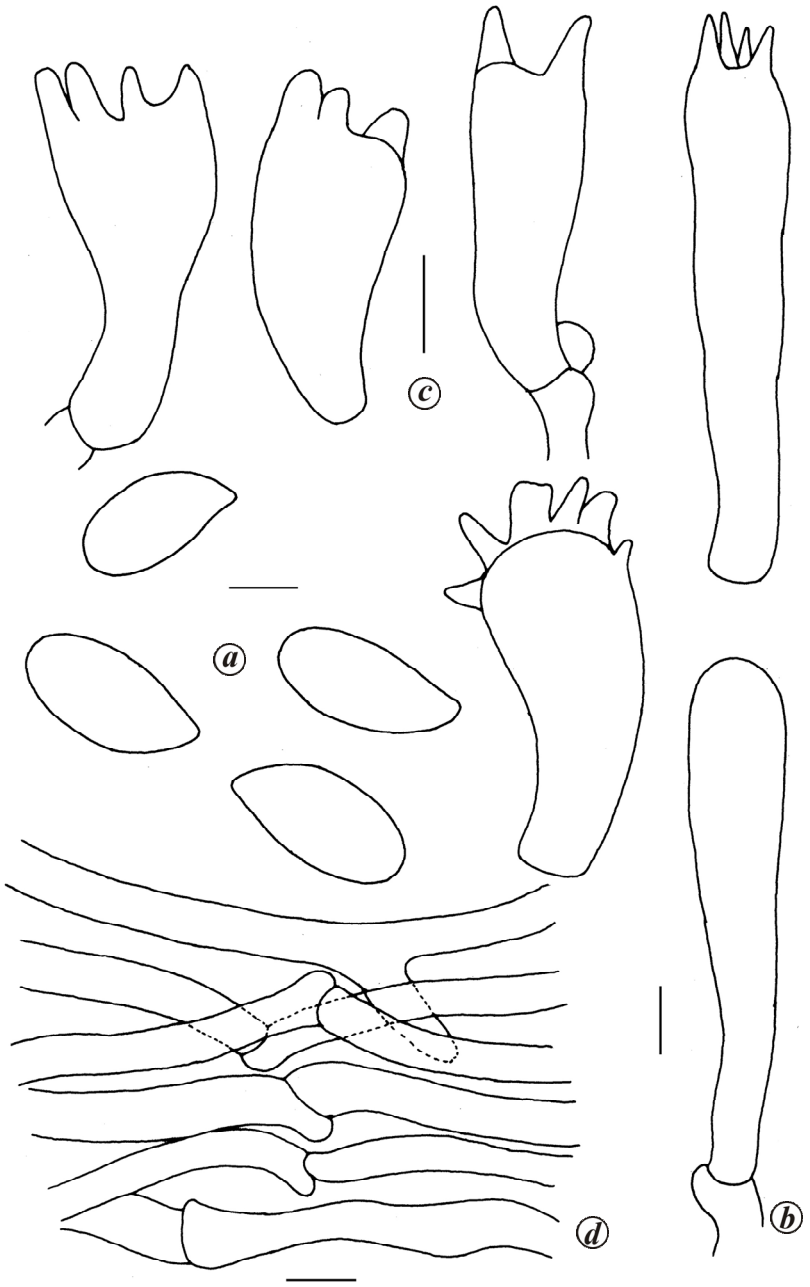

Figure 2. *M. palmivorus*. ***a***, Basidiospores; ***b***, basidium and basidiole; ***c***, cheilocystidia; ***d***, pileipellis hyphae. Scale bar: ***a–c*** = 5 µm; ***d*** = 10 µm.

Habit and habitat: Gregarious, parasitic, on living and fallen stems of *L. speciosa* (L.) Pers. tree.

Specimens examined: India: West Bengal, North-24-Parganas district, near Bibhutibhusan Wildlife Sanctuary, 23°11′15.9″N, 88°46′15.0″E, 14 m elev., K. Acharya & A.K. Dutta, 10 September 2017, AKD 52/2017 (CUH AM147); Howrah, AJC Bose Indian Botanic Garden, 22°33′37.1″N, 88°17′14.0″E, 13 m elev., 23 September 2015, A. K. Dutta & S. Paloi, AKD 112/2015 (CUH AM128).

Remarks: Based on the overall morphological features, the present Indian collection matches well with the description of *M. palmivorus*[11], except forming considerably larger basidiospores (10–14.5 × 5.5–7.5 µm versus 7–9 × 4.5–5.5 µm) and habitat on living *L. speciosa* tree. Previously, this fungus had been reported to be parasitic on oil palms[12], coconut palms and bananas[11]. The present finding expands the host range for this species.

The newly generated nrITS and nrLSU sequences of *M. palmivorus* were 760 and 593 bp respectively. These sequences for this study have been deposited in GenBank database with accession numbers MG251431 (for nrITS) and MG251441 (for nrLSU). Based on BLASTn searches in the NCBI database, these sequences had highest similarity to the same taxon previously reported from Malaysia [GenBank JQ653433; identities = 717/726(99%), gaps = 3/726(0%)] and Hawaii island of USA [GenBank AY639434; identities = 592/593(99%), gaps = 0/593(0%)].

Among morphologically similar taxa, *Collybia purpureogrisea* (Petch) Pegler, originally described as *Marasmius purpureo-griseus* Petch from Sri Lanka[13] and subsequently reported as *Marasmiellus purpureoalbus* (Petch) Singer from India[14] and Indonesia[15], differs by its non-striate pileus, longer stipe (up to 4 cm long) coloured brownish-white, subclose to crowded lamellae, and presence of Rameales structure in the pileipellis. However, the micro-morphological characters of *M. purpureoalbus* as mentioned by Retnowati[15] are similar to the collected specimen, but the pileus colouration of the Indonesian collection is greyish-purple to paler greyish-reddish purple. *Marasmiellus cocophilus* Pegler, originally described based on the collection made from Kenya, has its typical habitat on *Cocos nucifera* L., much smaller pileus (4–7 mm), presence of up to two series of lamellulae, less broad (3–4.5 µm broad), lacrymoid to elongate fusiform basidiospores, simple fusoid to sparsely nodulose cheilocystidia measuring 20–30 × 4–6 µm, and presence of typical Rameales structure in the pileipellis.

1. Wannathes, N., Desjardin, D. E., Hyde, K. D., Perry, B. A. and Lumyong, S., *Fungal Divers.*, 2009, **37**, 209–306.
2. Wilson, A. W. and Desjardin, D. E., *Mycologia*, 2005, **97**(3), 667–679.
3. Sharples, A., *Agric. J.*, 1928, **16**, 313–360.
4. Almaliky, B. S. A., *Plant Dis.*, 2013, **97**(1), 143.
5. Wilson, A. W., Desjardin, D. E. and Horak, E., *Sydowia*, 2004, **56**(1), 137–210.

6. Hemmes, D. E. and Desjardin, D. E., *Mushrooms of Hawaii*, Ten Speed Press, California, USA, 2002.
7. Reddy, O. R., Nair, R. R. and Majumdar, A., *FAO Plant Prot. Bull.*, 1987, **35**(1), 33–34.
8. Singh, P. K., Kathuria, S., Agarwal, K., Gaur, S. N., Meis, J. F. and Chowdhary, A., *J. Clin. Microbiol.*, 2013, **51**(10), 3331–3337.
9. Dutta, A. K., Chandra, S., Pradhan, P. and Acharya, K., *Mycotaxon*, 2014, **128**, 117–125.
10. Dutta, A. K., Wilson, A. W., Antonín, V. and Acharya, K., *Mycol. Prog.*, 2015, **14**, 79.
11. Corner, E. J. H., *Beih. Nova Hedwigia*, 1996, **111**, 1–175.
12. Pong, V. M., Ahmad, M., Abidin, Z., Almaliky, B. S. A., Kadir, J. and Wong, M. Y., *Pertanika J. Trop. Agric. Sci.*, 2012, **35**(S), 37–48.
13. Petch, T., *Trans. Br. Mycol. Soc.*, 1947, **31**(1), 19–44.
14. Manimohan, P. and Leelavathy, K. M., *Sydowia*, 1989, **41**, 200–208.
15. Retnowati, A., Ph D dissertation, Universitas Indonesia, Indonesia, 2012.

ACKNOWLEDGEMENTS. We thank DST-FIST and CAS (UGC) for providing the necessary facilities. A.K.D. thanks Prof. Dennis E. Desjardin (San Francisco State University, USA) for providing valuable suggestions on the specimen.

Received 26 October 2017; accepted 29 January 2018

ARUN KUMAR DUTTA
KRISHNENDU ACHARYA*

Molecular and Applied Mycology and Plant Pathology Laboratory,
Department of Botany,
University of Calcutta,
Kolkata 700 019, India
**For correspondence.*
e-mail: krish_paper@yahoo.com

Additional Quaternary faunal remains from the Middle–Late Pleistocene deposits of Purna Alluvial Basin, Maharashtra, Central India

One of the important fossiliferous localities being surveyed in recent years is the less known Purna Valley in Central India (Figure 1). However, the adjoining regions like the Central Narmada Valley have yielded numerous faunal remains in the past and these have been reported from time to time. In this context the Purna Valley assumes significant importance in the region. In fact, this area had remained less explored for a long time (Tables 1 and 2). Renewed efforts in this area have brought to light fossils from Bovidae, Equidae, Cervidae, Elephantidae and other groups like reptiles (turtles) and invertebrate fossils (molluscan shells) which are under study (Figure 2). In this study, the genus *Elephas* is reported from the Purna Basin. On the whole the material is well preserved and similar to that of the Narmada Valley. It throws enough light on the distribution pattern of these animals in Central and peninsular river valleys of India.

Geology of the area is characterized by silty clay, sandstone, gravels and calcretes. However, the most characteristic feature of the stratigraphy is the presence of tephra beds, palaeomagnetic and Ar–Ar dating. This has thrown light on the correlation of geological units with those of other Central Indian basins. Geologically, there are four formations in the valley – Vaghoi, Kodori, Kural and Purna, mostly comprising grey, silty clay, brown clay, calcretes and pockets of silty sand. Geochemistry of Gandhigram tephra relates the Purna Valley tephra to the Youngest Toba Tephra (YTT). Fission track date of the Gandhigram tephra is about 75,000 years BP. The Kodori Formation, *in situ* tephra, is early Upper Pleistocene in age[1–6]. Palaeomagnetic studies carried out by Gaonkar[7] show that the Vaghoi Formation has reverse magnetic polarity of Matuyama epoch (older than 0.7 Ma), whereas the Kodori and Kural formations are both in the normal magnetic polarity of Brunhes Normal (less than 0.7 Ma). Using the litho-stratigraphic and magnetic polarity criteria, the Vaghoi Formation is correlated with the Dhansi Formation of Narmada Valley[5,8]. Similarly, based on the fossil assemblage, the Kodori Formation and the overlying Kural Formation may belong to Upper Pleistocene. In fact, there appears to be a long erosional gap between the Vaghoi and Kodori formations, dating from Lower Pleistocene to early Upper Pleistocene respectively, and this is being examined. We are of the opinion that Middle Pleistocene should definitely be represented in the area, especially in parts of the Kural and Kodori formations pending its confirmation. The Kural Formation has yielded fossils of *Bos* sp., *Bos namadicus*, *Bubalus namadicus*, *Equus hemionus khur*, *Equus* sp. and *Antilope cervicapra* of Upper Pleistocene affinity. A few Palaeolithic implements were also discovered from this formation[9,10]. Recently, a rich and diverse assemblage of Quaternary fossils from Kapileshwar and adjoining localities of the Purna Basin has been discovered[11,12] and these collections are under study (Figure 3 *a* and *b*). The geomorphological and mineralogical data that are being studied may throw further light on the chronology and also on the depositional environment, fluvial geomorphology and types of palaeosols in the basin.

It is important to note that the alluvial fan deposits in the area form an important part of the geological formations and have an indirect bearing on the taphonomy of the fossils discovered in the region. The fans of the Upper Pleistocene occur as transverse depositional systems in northern region of the Purna Alluvial Basin. According to Chakrabarti and Roy[13], fans were formed by three main sedimentary processes – debris flow, sheet flood and stream flood.

More than 200 fossils have been retrieved so far during exploration and excavation in the area; most of them are well preserved and can be identified up to the species level. However, with more faunal materials being reported, it will be possible to identify the remaining materials up to the species levels. The materials are represented by parts of skulls, lower and upper jaws, isolated teeth, limb bones (complete and partial), vertebrae, girdles, digits, lamellibranchs, turtle shells and other parts. These were