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Five polypore species new to India

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In continuation of the exploration of the diversity of polyporoid fungi in north-west India, five polypores identified as *Antrodia leucaena*, *A. pulvinascens*, *Fomitiporia apiahyna*, *Inocutis ludoviciana* and *Inonotus venezuelicus* are presented as new to India. These species are reported based on material collected from localities in the Sirmaur District (Himachal Pradesh) and Patiala District (Punjab). Descriptions, photographs and line drawings of the new records from India are provided.

Key words: Agaricomycetes, *Polyporales*, *Hymenochaetales*, white-rot fungi, north-west Himalaya, Punjab.

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V rámci pokračujícího výzkumu diverzity chorošotvarých hub v severozápadní Indii bylo objeveno pět druhů, které jsou nové pro Indii: *Antrodia leucaena*, *A. pulvinascens*, *Fomitiporia apiahyna*, *Inocutis ludoviciana* a *Inonotus venezuelicus*. Jejich výskyt byl zaznamenán a materiál sebrán na lokalitách v okresu Sirmaur (stát Himáčalpradéš) a okresu Patiala (stat Paňdžáb). Popisy uvedených druhů jsou doplněny fotografiemi plodnic a kresbami mikroznaků.

INTRODUCTION

Polypores are characteristic in having a typical poroid hymenophore formed on resupinate, effused-reflexed to pileate or stipitate carpophores. These carpophores vary greatly in their nature, arrangement and morphology, and develop gymnocarpically with a unilateral hymenium lining the tubes. Polypores offer a great variation in their hyphal construction, basidia and basidiospores. These fungi have been placed in various orders of *Agaricomycetes* (Si & Dai 2016). The diversity of these fungi in India has been explored from time to time with some

prominent contributions by Bakshi (1971), Dhanda (1977), Singh (1987), Ranadive et al. (2011), Sharma (2012), Ranadive (2013) and Kaur et al. (2017).

Based on macro- and micro-morphological features and comparison with the literature, five species of four polypore genera were identified as new to India. The aim of the present study is to describe and illustrate these five species with remarks about their distribution.

MATERIAL AND METHODS

The polypore samples were collected during mycofloristic surveys conducted during the rainy season of the years 2015 and 2016 at localities of the Sirmaur District in Himachal Pradesh and Patiala District in Punjab (India). The carpophores were carefully isolated from their substrate using a chisel and a hammer. Data pertaining to habitat, host/substrate, carpophores texture, colour and type of hymenial/abhymenial surface and margins were noted carefully for each collected specimen. The specimens were dried either in the sun or using a portable electric drier. The dried specimens were packed following the standard protocols and were conserved with fumigants like 1,4-dichlorobenzene.

The macroscopic characters of the carpophores collected were studied by making crush mounts and free hand cut sections in water and 3%, 5% and 10% KOH solutions and stained in cotton blue (1% in lactophenol), Congo red (1% in distilled water), phloxine (1% in distilled water) and Melzer's reagent (0.5g iodine + 1.5g KI + 20g chloral hydrate + 20ml distilled water). The outlines of the microscopic structures were drawn in the form of line diagrams with a camera lucida at different magnifications (100×, 400× and 1000×) of the compound microscope.

The macro- and microscopic characters were compiled into descriptions which were compared with monographic compilations (Ryvarden 2002, Sharma 2012, Ryvarden & Melo 2014) for identification. The colour of the hymenial/abhymenial surface is cited according to Kornerup & Wanscher (1978). All the samples studied and described have been deposited into the Herbarium, Department of Botany, Punjabi University, Patiala (PUN).

RESULTS AND DISCUSSION

Antrodia leucaena Y.C. Dai & Niemelä, Annales Botanici Fennici 39(4): 259, 2002 Fig. 1

Description. Carpophores annual, resupinate, adnate, effused, up to 5 mm thick in cross section. Hymenial side poroid, reddish white to pale red to pastel

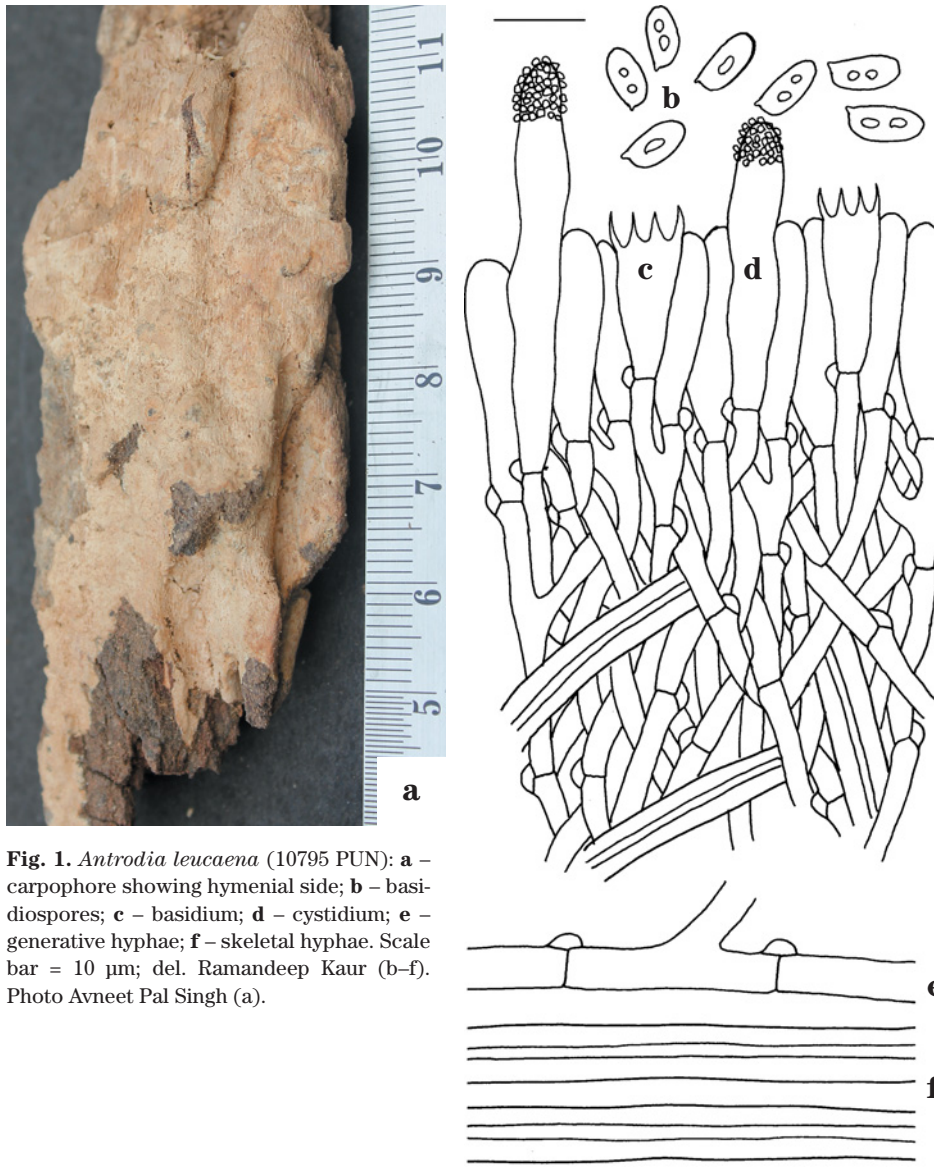

Fig. 1. *Antrodia leucaena* (10795 PUN): **a** – carpophore showing hymenial side; **b** – basidiospores; **c** – basidium; **d** – cystidium; **e** – generative hyphae; **f** – skeletal hyphae. Scale bar = 10 µm; del. Ramandeep Kaur (b–f). Photo Avneet Pal Singh (a).

red in fresh state, no prominent change on drying. Pores angular, 3–5 per mm; dissepiments up to 80 µm wide, lacerate. Subiculum up to 150 µm thick, pale orange; tubes up to 350 µm deep, pale orange. Margins somewhat fibrillose, paler than the colour of the hymenial side, occasionally indeterminate.

Hyphal system dimitic. Generative hyphae septate, with clamps, up to 5 µm wide, branched, thin-walled. Skeletal hyphae aseptate, up to 7 µm wide, occasionally branched, thick-walled. Cystidia subcylindrical, sinuous, 30–42 × 4–5 µm, smooth, thin-walled, with basal clamp, crystalline encrustation usually present in the apical part. Basidia clavate, sometimes constricted, 15–17 × 6–7 µm, tetrasterigmatic, with a basal clamp connection; sterigmata up to 3 µm long. Basidiospores ellipsoid, 7–9 × 4–5 µm, smooth, thin-walled, usually with oily contents, inamyloid, acyanophilous.

Remarks. Diagnostic characters of this species are the dimitic hyphal system and the presence of subcylindrical, sinuous, thin-walled cystidia. It was originally described from China (Dai & Niemelä 2002), and then recorded in Russia and Finland (Spirin et al. 2012, Ryvarden & Melo 2014, IMA on-line).

Specimens studied

India. Punjab, Patiala District, city of Patiala, Punjabi University, near Botany department, on base of trunk of *Lagerstroemia speciosa*, 13 July 2015, Gurpreet and Navpreet 8345 (PUN). – Himachal Pradesh, Sirmaur District, Ambwala near the town of Nahan, on trunk of *L. speciosa*, 23 August 2015, Ramandeep and Dhingra 10795 (PUN).

Antrodia pulvinascens (Pilát) Niemelä, Karstenia 25: 37, 1985 Fig. 2

≡ *Poria pulvinascens* Pilát, Acta Musei Nationalis Pragae 9B(2): 106, 1953
= *Antrodia plicata* Niemelä, Karstenia 18: 44, 1978

Description. Carpophores annual, resupinate, effused, adnate, up to 2.5 mm thick in cross section. Hymenial side poroid, pale orange to greyish orange in fresh state, no prominent change on drying. Pores angular, 2–7 per mm; dissepiments 80 µm thick, entire. Subiculum up to 0.5 mm thick, reddish white; tubes up to 2 mm long, greyish orange. Margins somewhat fibrillose, concolorous with the hymenial side, occasionally indeterminate.

Hyphal system dimitic. Generative hyphae septate, with clamps, up to 4.6 µm wide, branched, thin-walled. Skeletal hyphae aseptate, up to 5.9 µm wide, occasionally branched, thick-walled. Cystidia absent but cystidioles present. Cystidioles fusoid, 21–25 × 4.5–6 µm, smooth, thin-walled, with basal clamp. Basidia clavate, sinuous, 17–25 × 5.2–7.2 µm, tetrasterigmatic, with basal clamp connection; sterigmata up to 3.3 µm long. Basidiospores ellipsoid to subfusiform, 7.2–9.2 × 3.9–4.6 µm, smooth, thin-walled, inamyloid, acyanophilous.

Remarks. Diagnostic characters of this species are the dimitic hyphal system and presence of fusoid cystidioles. Former reports are from Russia, Finland, Sweden, Poland, Slovakia, Czech Republic, Austria, Germany, Switzerland, France, Spain, Italy, Bosnia and Herzegovina (Kotlaba 1984, Ryvarden & Melo 2014, IMA on-line; distribution in former Czechoslovakia and Yugoslavia clarified in pers. comm. with J. Kout and M. Karadelev).

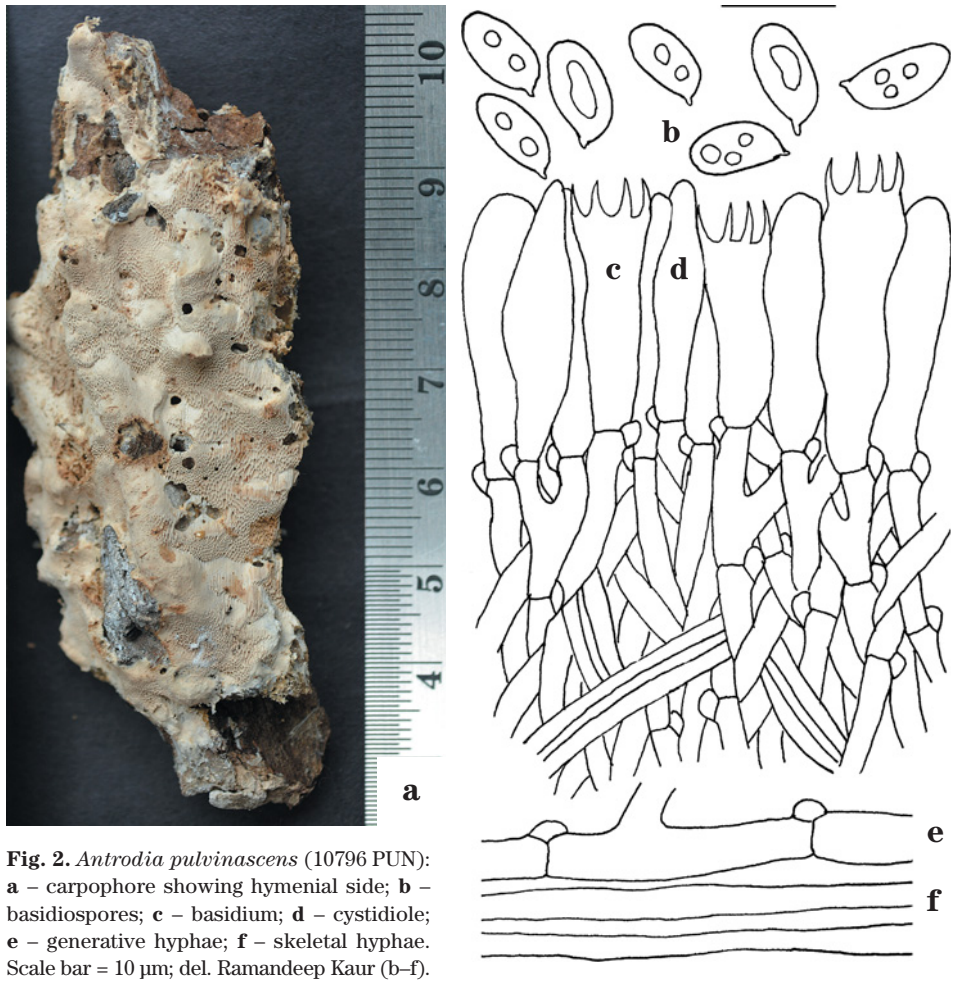

Fig. 2. *Antrodia pulvinascens* (10796 PUN): **a** – carpophore showing hymenial side; **b** – basidiospores; **c** – basidium; **d** – cystidiole; **e** – generative hyphae; **f** – skeletal hyphae. Scale bar = 10 µm; del. Ramandeep Kaur (b–f). Photo Avneet Pal Singh (a).

Specimens studied

India. Himachal Pradesh, Sirmaur District, Sainwala village, near the town of Nahan, on log of angiospermous tree, 23 August 2015, Ramandeep and Dhingra 10796 (PUN). – Punjab, Patiala District, city of Patiala, Punjabi University, backside of Kala Bhawan, on trunk of *Populus ciliata*, 10 September 2015, Gurpreet and Navpreet 8347 (PUN).

Fomitiporia apiahyna (Speg.) Robledo, Decock & Rajchenb., Mycologia 102(6): 1315, 2010 Fig. 3

≡ *Fomes apiahynus* Speg., Boletín de la Academia Nacional de Cienciasen Córdoba 11(4): 438, 1889

≡ *Phellinus apiahynus* (Speg.) Rajchenb. & J.E. Wright, Mycologia 79(2): 251, 1987

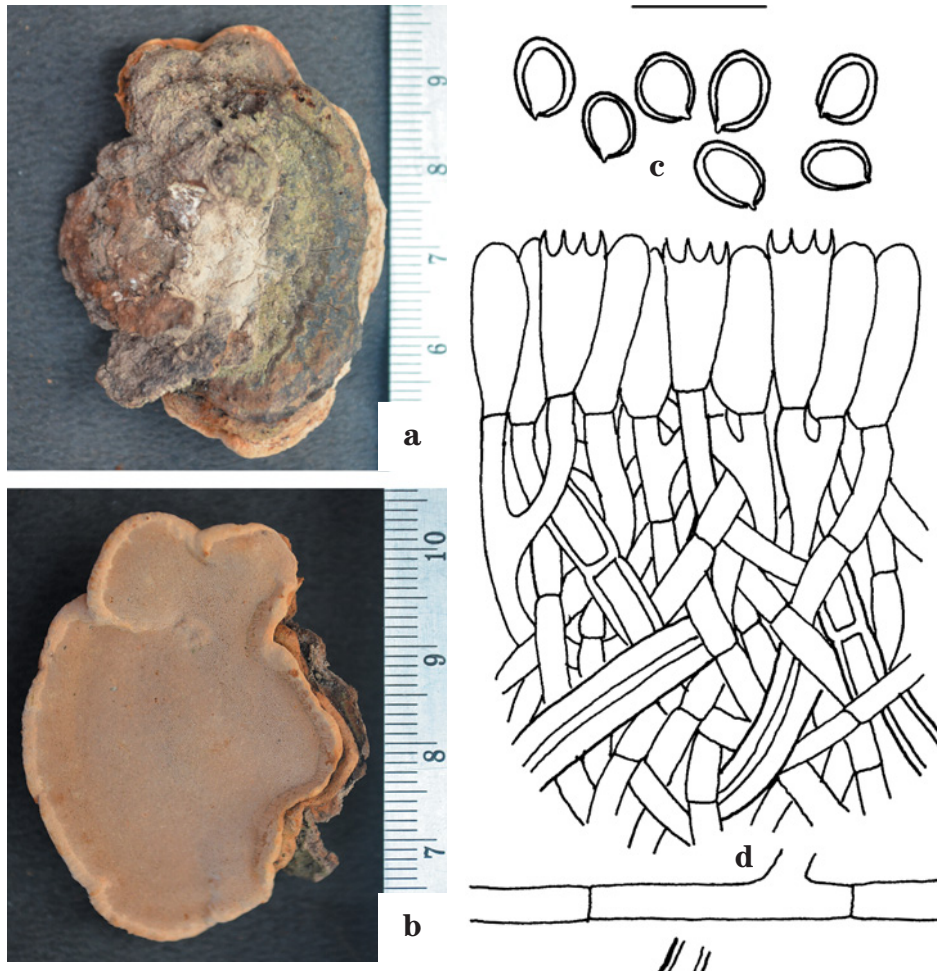

Fig. 3. *Fomitiporia apiahyna* (10804 PUN, 10805 PUN): **a** – carpophore showing abhymenial side; **b** – carpophore showing hymenial side; **c** – basidiospores; **d** – reconstruction of hymenium and subhymenium; **e** – generative hyphae; **f** – skeletal hyphae. Scale bar = 10 µm; del. Ramandeep Kaur (c–f). Photos Avneet Pal Singh (a, b).

Description. Carpophores perennial, effused, reflexed to pileate; pilei up to 4.7 × 3.8 × 1.1 cm, sessile, solitary to imbricately arranged, applanate. Abhymenial side tomentose to glabrous, zonate, sulcate, brown to reddish brown or black in fresh state, no prominent change on drying, crust up to 0.4 mm thick.

Hymenial side poroid, greyish brown to light brown or brown in fresh state, no prominent change on drying. Pores round to angular, 5–8 per mm; dissepiments up to 35 µm wide, entire. Context homogeneous, brownish orange to light brown, up to 2 mm thick; tubes greyish brown to light brown, up to 8 mm long, stratified, up to 4 mm in each layer, separated by very thin contextual layer. Margins acute, irregular, wavy, brownish orange to light brown on abhymenial side, paler concolorous on hymenial side, sterile up to 2 mm.

Hyphal system dimitic. Generative hyphae hyaline to pale yellowish, septate, without clamps, up to 4.4 µm wide, branched, thin- to thick-walled. Skeletal hyphae yellowish brown to light brown, up to 5.5 µm wide, unbranched, thick-walled. Setal hyphae absent. Setae absent. Cystidia absent. Basidia broadly clavate, 10–12 × 4.4–4.9 µm, tetrasterigmatic, without basal clamp connection; sterigmata up to 2 µm long. Basidiospores broadly ellipsoid to subglobose, hyaline, 5.5–6 × 3.8–4.4 µm, smooth, thick-walled, dextrinoid, acyanophilous.

Remarks. This species is characterised by the absence of setae and cystidioles. It has been reported from the Neotropical region, i.e. from Argentina to Costa Rica and southern Florida (Loguercio-Leite & Wright 1995, Ryvarden 2004, Vlasák et al. 2011, IMA on-line).

Specimens studied

India. Himachal Pradesh, Sirmaur District, town of Paonta Sahib, on trunk of *Mallotus philippinensis*, 4 October 2015, Ramandeep 10804 (PUN). – Town of Renuka Ji, near Renuka Ji temple, on trunk of *M. philippinensis*, 8 October 2016, Ramandeep 10805 (PUN).

Inocutis ludoviciana (Pat.) T. Wagner & M. Fisch. [as '*ludovicianus*'], Mycologia 94(6): 1011, 2002 Fig. 4

≡ *Xanthochrous ludovicianus* Pat., Bulletin de la Société Mycologique de France 24(1): 6, 1908
≡ *Inonotus ludovicianus* (Pat.) Bondartsev & Singer, Annales Mycologici 39(1): 56, 1941

Description. Carpophores annual, pileate; pilei up to 12 × 6 × 2 cm, sessile, solitary; applanate to dimidiate, soft, corky in fresh state, no prominent change on drying. Abhymenial side tomentose to velutinous, azonate, yellowish brown to light brown in fresh state, no prominent change on drying. Hymenial side poroid, light brown to greyish brown in fresh state, no prominent change on drying. Pores round to angular, 4–6 per mm; dissepiments up to 50 µm wide, entire. Context homogeneous, up to 15 mm wide; tubes up to 5 mm deep, light brown. Margins obtuse, regular, wavy, yellowish brown on abhymenial side; paler concolorous on hymenial side, sterile up to 2 mm.

Hyphal system monomitic. Generative hyphae hyaline to yellowish brown, septate, without clamps, up to 2.8 µm wide, branched, thin- to thick-walled. Setal hyphae absent. Setae absent. Cystidia absent. Basidia clavate, 10–12 × 3.2–4.7 µm, tetrasterigmatic, without basal clamp; sterigmata up to 3.2 µm long. Basidiospores

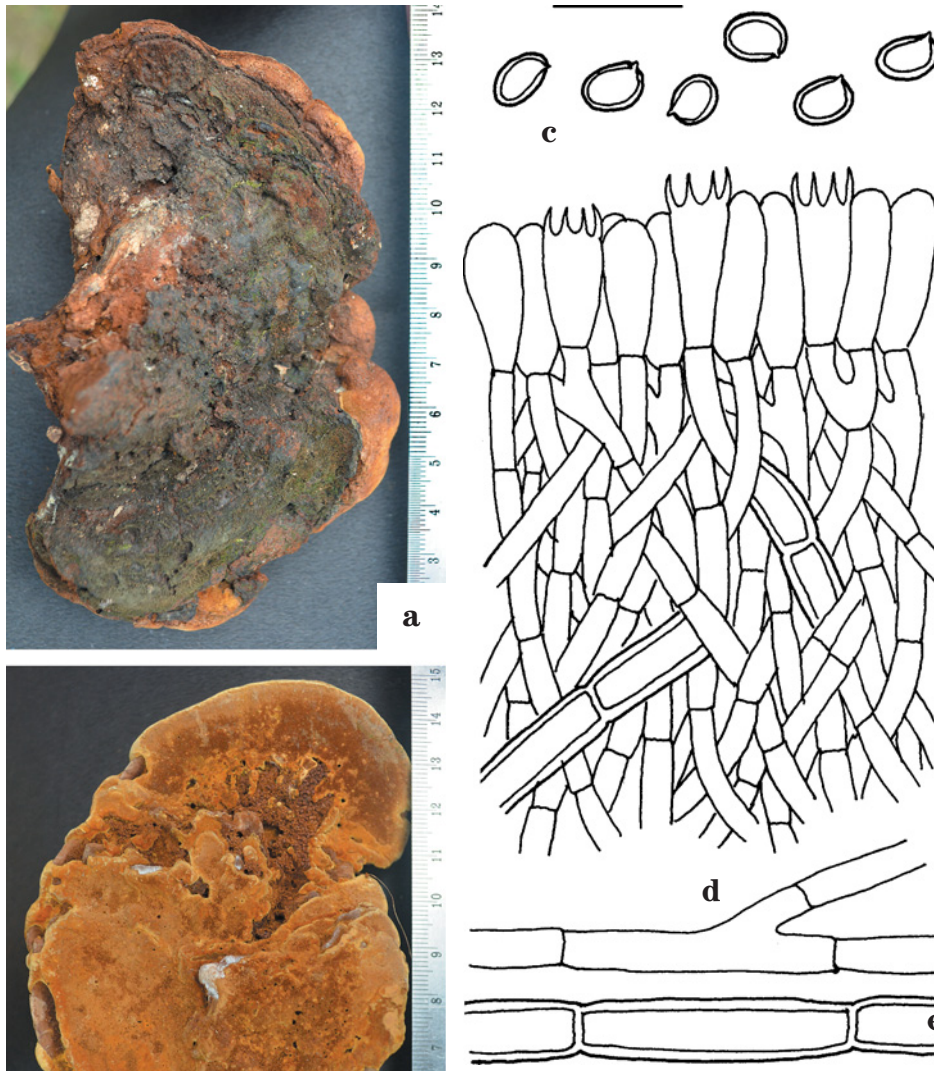

Fig. 4. *Inocutis ludoviciana* (10801 PUN, 10802 PUN): **a** – carpophore showing abhymenial side; **b** – carpophore showing hymenial side; **c** – basidiospores; **d** – reconstruction of hymenium and subhymenium; **e** – generative hyphae. Scale bar = 10 µm; del. Ramandeep Kaur (c–e). Photos Avneet Pal Singh (a, b).

ellipsoid to broadly ellipsoid, yellowish brown, 3.7–4.7 × 2.3–3.2 µm, smooth, thick-walled, inamyloid, acyanophilous.

Remarks. This species lacks both setae and cystidioles. Other reports are from the southeastern part of the United States, from North Carolina to Texas (IMA on-line), and China (Dai 2010).

Specimens studied

India. Himachal Pradesh, Sirmaur District, Batyuri village, near the town of Rajgarh, on trunk of *Morus alba*, 3 October 2015, Ramandeep 10801 (PUN). – Town of Paonta Sahib, on trunk of *M. alba*, 3 October 2015, Ramandeep 10802 (PUN).

Inonotus venezuelicus Ryvarden, Mycotaxon 28(2): 529, 1987 Fig. 5

Description. Carpophore annual, resupinate, effused, up to 3 mm thick in cross section, adnate, hard, brittle in fresh state, no prominent change on drying. Hymenial side poroid, glancing, reddish brown to brownish grey or brown in fresh state, no prominent change on drying. Pores angular to elongate, 4–5 per mm; dissepiments up to 62 µm wide, entire. Subiculum homogeneous, light brown, up to 1 mm thick; tubes up to 1 mm deep, light brown. Margins acute, irregular, lobed, paler concolorous, sterile up to 1 mm.

Hyphal system monomitic. Generative hyphae hyaline to rusty brown, septate, without clamps, up to 3.3 µm wide, branched, thin- to thick-walled. Setal hyphae absent. Setae absent. Basidia broadly clavate, 11–14 × 6–6.6 µm, tetrasterigmatic, without basal clamp; sterigmata up to 3.3 µm long. Basidiospores broadly ellipsoid to subglobose, rusty brown, 4.9–6 × 3.3–4.2 µm, smooth, thick-walled, inamyloid, acyanophilous.

Remarks. This is one of the few representatives of the genus with a resupinate carpophore. Other reports are from Panama and Venezuela (Ryvarden 2004 and IMA on-line).

Specimen studied

India. Himachal Pradesh, Sirmaur District, Batyuri village, near the town of Rajgarh, on stump of *Quercus leucotrichophora*, 12 September 2016, Ramandeep and Avneet 10803 (PUN).

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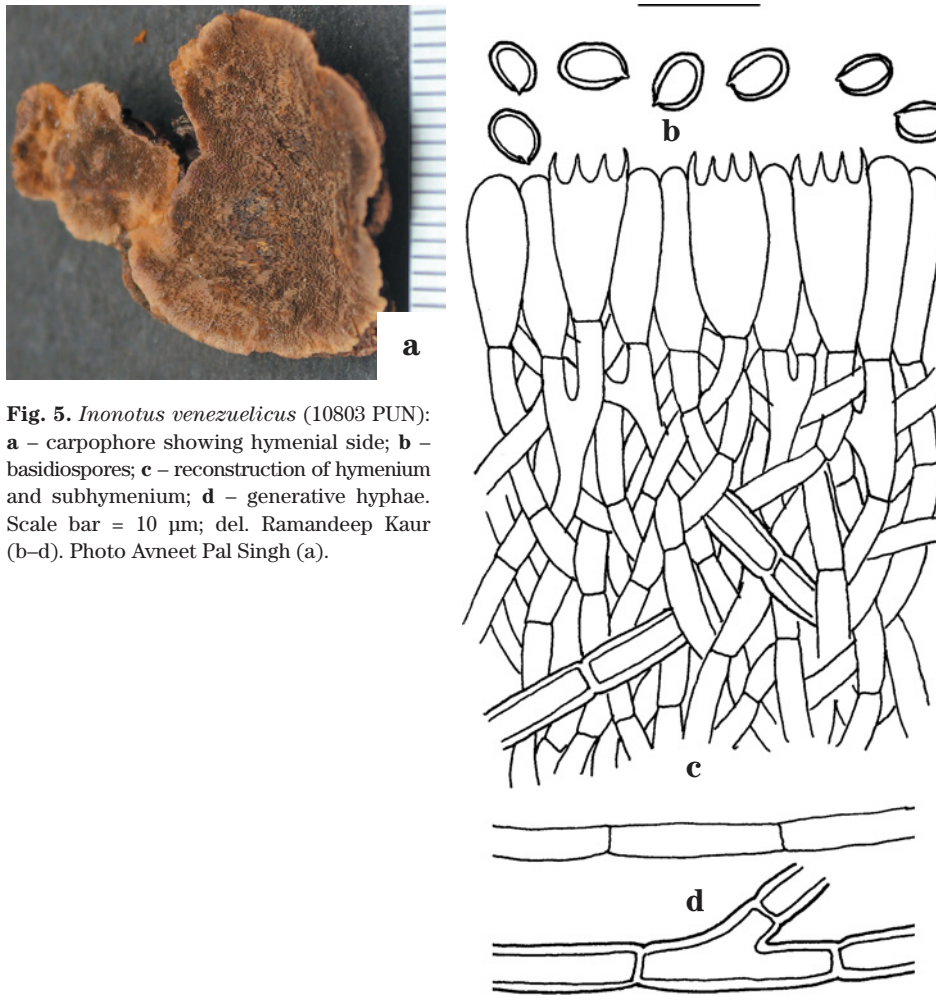

Fig. 5. *Inonotus venezuelicus* (10803 PUN): **a** – carpophore showing hymenial side; **b** – basidiospores; **c** – reconstruction of hymenium and subhymenium; **d** – generative hyphae. Scale bar = 10 µm; del. Ramandeep Kaur (b–d). Photo Avneet Pal Singh (a).

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