**DOI: https://doi.org/10.36036/MR.32.1.2023.132825**
***Mushroom Research* 33 (1) : 1-8, 2024**

# Three new records of polyporoid mushrooms from Himachal Pradesh (India)

**Hardesh Kumar[1], Avneet Pal Singh[1*] and Gulshan Bansal[2]**

[1]*Department of Botany, Punjabi University, Patiala 147002, Punjab, India*
[2]*Department of Pharmaceutical Sciences and Drug Research, Punjabi University, Patiala 147002, Punjab, India.*
[*]*Corresponding author*, Email: avneet@pbi.ac.in; avneetbot@gamil.com

## ABSTRACT

**The manuscript describes an account of three polyporoid mushrooms viz. *Bresadolia cuticulata* (Y.C. Dai, Jing Si & Schigel) Audet, *Ganoderma fulvellum* Bres., and *Tyromyces fissilis* (Berk. & M.A Curtis) Donk,. Of these, *Bresadolia cuticulata* and *Tyromyces fissilis* are described for the first time from India while *Ganoderma fulvellum* in new for Himachal Pradesh.**

**Keywords:** *Basidiomycota,* polypore, medicinal mushrooms, diversity, taxonomy, Himachal Pradesh.

Polyporoid mushrooms are a large group of higher (*Basidiomycota*) macrofungi with resupinate to effused, reflexed to distinctly pileate basidiocarps characterized by the presence of poroid hymenophore. The basidiocarp texture is usually corky and leathery to sometimes woody hard (Chen, 2018). The nature of the basidiocarp depends upon hyphal construction, which varies from monomitic to dimitic to trimitic. The morphology based approach for classification followed the concept of order *Aphyllophorales* for these mushrooms and placed majority of polypores under the family *Polyporaceae* and *Hymenochaetaceae* (Ryvarden and Melo, 2014). The contributions of DNA sequence-based data have resulted in the proposal of more natural groups among fungi and as a result, polypores are currently distributed in 12 orders of *Agaricomycetes* (Hibbett *et al*., 2014, Zhao *et al*., 2015, Cui *et al*., 2019).

The polyporoid mushrooms are the key players involved in the degradation of lignin and cellulose. Majority of these mushrooms prefer lignin as the substrate hence cause white rot of both broad-leaved and conifer (Cui *et al*., 2019). Some of the polypores cause severe diseases of the trees and degrade timber and timber products (Tura *et al*., 2018). In addition to their role in ecology, some of the polyporoid mushrooms have been used for cure of many diseases for centuries in the traditional medicinal system. The ethnomycological compilation and the contemporary scientific research have established that these mushrooms produce diverse bioactive compounds, including polysaccharides, terpenoids and phenolics along with enzymes like proteolytic enzymes, which contribute to various therapeutic effects (Badalyan, 2015).

There are several significant studies have been reported on the taxonomy of polyporoid mushrooms from India (Bakshi, 1971; Roy and De, 1996; Leelavathy and Ganesh, 2000; Sharma, 2012; Prasher, 2015; Vinjusha and Kumar, 2022; Parihar *et al*.,

Recieved on 02-02-2023; Accepted on 31-07-2023
https://epubs.icar.org.in/index.php/MR/article/view/132825

2023). However, the review of the literature on the diversity of polyporoid fungi in Himachal Pradesh reveals relatively smaller number of taxa reported by earlier worker in this region so far. Hence, Himachal Pradesh was selected as the area of current study. It is a relatively smaller state with rich diversity of coniferous and broad-leaved tree species constituting tropical moist deciduous, tropical dry deciduous, subtropical pine, subtropical evergreen, Himalayan dry temperate, Himalayan moist temperate, moist alpine scrub, dry alpine scrub and sub-alpine forests (Champion and Seth, 1968). Exhaustive fungal forays were conducted in the various localities of the district Mandi and Kangra of Himachal Pradesh during the rainy months of the years 2021-2023 for the collection of polyporoid mushrooms. Some of these interesting specimens, identified on the basis of morphological characters, have been described as *Bresadolia cuticulata* (Y.C. Dai, Jing Si & Schigel) Audet, *Ganoderma fulvellum* Bres., and *Tyromyces fissilis* (Berk. & M.A Curtis) Donk. It is noteworthy to mention here that *Tyromyces fissilis* and *Bresadolia cuticulata* are being described as new to India while *Ganoderma fulvellum* is a new addition for Himachal Pradesh.

## MATERIAL AND METHODS

The specimens of polyporoid fungi were collected from various localities of Mandi and Kangra district of Himachal Pradesh during the field surveys conducted in the monsoon season of years 2021-2023. Observation pertaining to macroscopic characteristics, such as type and nature of basidiocarp, colour and nature of abhymenial/hymenial surface and margin were noted in the field. The colour standards refereed are as per Kornerup and Wanscher (1978). Spore print of collected specimens was obtained from the fertile portion of the basidiocarp kept on a glass slide placed on a black chart paper. The collected specimens were dried either in sun or in an electric drier.

The microscopic analysis of the collected specimens was carried out by making crush mount or free hand cut section preparations in water, 3% / 5% / 10% KOH solution, 1% Congo red in distilled water, 1% cotton blue in lactophenol and Melzer's reagent (0.5 g iodine + 1.5 g potassium iodide + 20g chloral hydrate + 20 ml distilled water). Microscopic feature were observed with the help of a compound microscope under different magnifications (100X, 400X, and 1000X) and the outline of the various structures was drawn with the help of a camera lucida. The identified specimens were submitted in the Herbarium, Department of Botany, Punjabi University, Patiala (PUN).

## TAXONOMIC DESCRIPTIONS

**1.** ***Bresadolia cuticulata*** (Y.C. Dai, Jing Si & Schigel) Audet, Mushrooms nomenclatural novelties 10: 2 (2017).

*Polyporus cuticulatus* Y.C. Dai, Jing Si & Schigel, Mycosystema 35 (3): 275 **Fig. 1**

Basidiocarp annual, laterally shortly stipitate, solitary to imbricate, fleshy; pileus semicircular to flabelliform, up to 8 × 14 × 1 cm; abhymenial surface glabrous, indistinctly concentrically zonate, pale grey (1B1) to greyish brown (6F3) to brownish orange (6C8) with radial stripes when fresh, greyish orange (5B3), cinnamon (6D6) to fawn (7E4) when dry; hymenial surface poroid, white (1A1) to cream (4A3) when fresh, becoming cream (4A3) to brownish orange (5C6) upon drying; pores round to angular, 2-5 per mm; dissepiments thin, entire to lacerate; pore tubes up to 3 mm long, concolorous with pore surface; context up to 7 mm thick, buff and homogenous; margin sharp and straight when fresh and incurved when dry, concolorous on both abhymenial and hymenial surface; stipe short, lateral, cinnamon (6D6) to fawn (7E4), somewhat flattened, up to 0.7 cm × 1.1 cm.

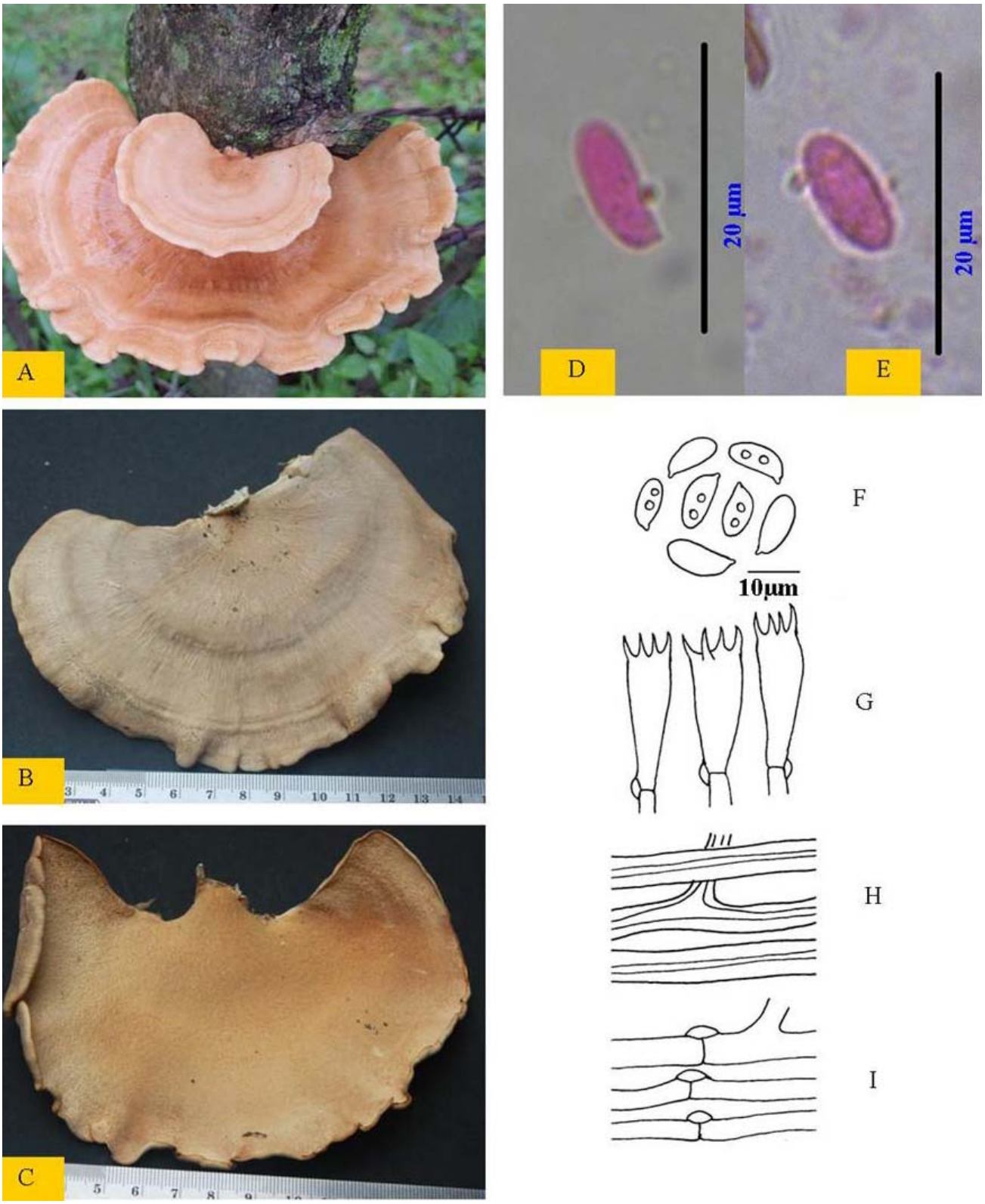


**Fig. 1.** *Bresadolia cuticulata* A) Basidiocarp attached with the substrate; B) Basidiocarp showing abhymenial surface; C) Basidiocarp showing hymenial surface; D,E) Photomicrograph showing basidiospores; F) Basidiospores; G) Basidia H) Skeletal hyphae; I) Generative hyphae

Hyphal system dimitic; generative hyphae up to 4.7 µm wide, hyaline, thin-walled, branched, septate, clamped; skeletal hyphae up to 5.3 µm wide, hyaline, aseptate, thick-walled with a distinct wide lumen, moderately branched. Basidia clavate, 18.5-21 × 6.5-8 µm, tetrasterigmate, with basal clamp; sterigmata up to 4.5 µm in length. Basidiospores 7.4-9.6 × 3.4-4.3 µm, cylindrical, thin-walled, smooth, usually with oil guttules, inamyloid, acyanophilous.

**Collection examined:** Himachal Pradesh, Kangra, Baijnath, Loat, on a fencing pole, Hardesh 12141 (PUN), 23 July, 2022.

**Remarks:** *Bresadolia cuticulata* is quite close to *Polyporus varius* but later differs in having a black stipe and distribution in temperate and boreal forests. This species has earlier been described from China (Cui et al., 2019).

**2. *Ganoderma fulvellum*** Bres., Bulletin de la Societe Mycologique de France 5: 69 (1889). **Fig. 2**

Basidiocarp annual, sessile, corky to woody, imbricate, pileus flabelliform or conchate, up to 7.5 × 7 × 1.5 cm; abhymenial surface laccate, indistinctly concentrically zonate, pale orange (5A3 ) to reddish brown (8E8) when fresh, reddish brown (8E8) to dark brown (8F4) after drying; hymenial surface poroid, Milk white (1A2) to pale yellow (2A3) when fresh, greyish brown (7D3) to dark brown (8F5) when dry; pores suborbicular, 4-6 per mm; dissepiments thin, entire; pore tubes up to 6 mm long, greyish brown (7D3); context up to 9 mm thick, brownish yellow (5C8) to dark brown (8F5), homogenous with black crustaceous layer; margin thin or obtuse, faintly brown (6D6) to yellow brown (5E8) on abhymenial side, greyish white (1B1) and sterile up to 5 mm on the hymenial side. Pilear crust irregular, composed of thin-walled generative hyphae and brown, thick-walled skeletal hyphae agglutinated almost parallel; cuticular elements 31-37.5 × 7.5-11.8 µm, thick-walled, yellowish brown to brown, mostly clavate.

Hyphal system trimitic; generative hyphae up to 4.3 µm, hyaline, thin-walled, branched, septate, clamped; skeletal hyphae up to 6.2 µm, aseptate, thick-walled to solid, light-brown to brown; binding hyphae up to 3.4 µm wide, thick walled, much branched and subhyaline. Basidia not observed. Basidiospores 8.5-10 × 6.5-7.1 µm, ovoid to subellipsoid, sometimes slightly truncate at apex, bitunicate; exospore thin, hyaline, smooth; endospore thick, brownish, echinulate with long and thick markings; inamyloid, acyanophilous.

**Collection examined:** Himachal Pradesh, Mandi, Padhar, Sudhar, Gallu forest, on the stump of *Quercus leucotrichophora,* Hardesh 12139 (PUN), 24 September 2023.

**Remarks:** *Ganoderma fulvellum* is characterised by ochraceous, brown to deep brown, firm context with a black crustaceous layer; non stratose tubes, bitunicate, distinctly echinulate spores. Earlier this species has been reported from Maharashtra (Ranadive et al. 2011) and Punjab (Kaur 2023).

***3. Tyromyces fissilis*** (Berk. & M.A Curtis) Donk, Mededelingen van het botanisch Museum en Herbarium van de Rijksuniversiteit Utrecht 9: 153 (1933).

*Polyporus fissilis* Berk & M.A. Curtis, Hooker's Journal of Botany and Kew Garden Miscellany 1: 234 (1849). **Fig. 3**

Basidiocarp annual, pileate, broadly attached, solitary, sappy to waxy, staining the paper in which they are wrapped and tough when fresh, drying slowly with considerable shrinking and becoming dense and hard with a pleasant and sweet smell; pileus applanate to semi-ungulate, triquetrous in section, up to 10.5 × 16 × 4 cm; abhymenial surface tomentose to pubescent, scrupose to tufted, uneven and undulating, chalky white (1A1) to orange (5A6) when fresh,

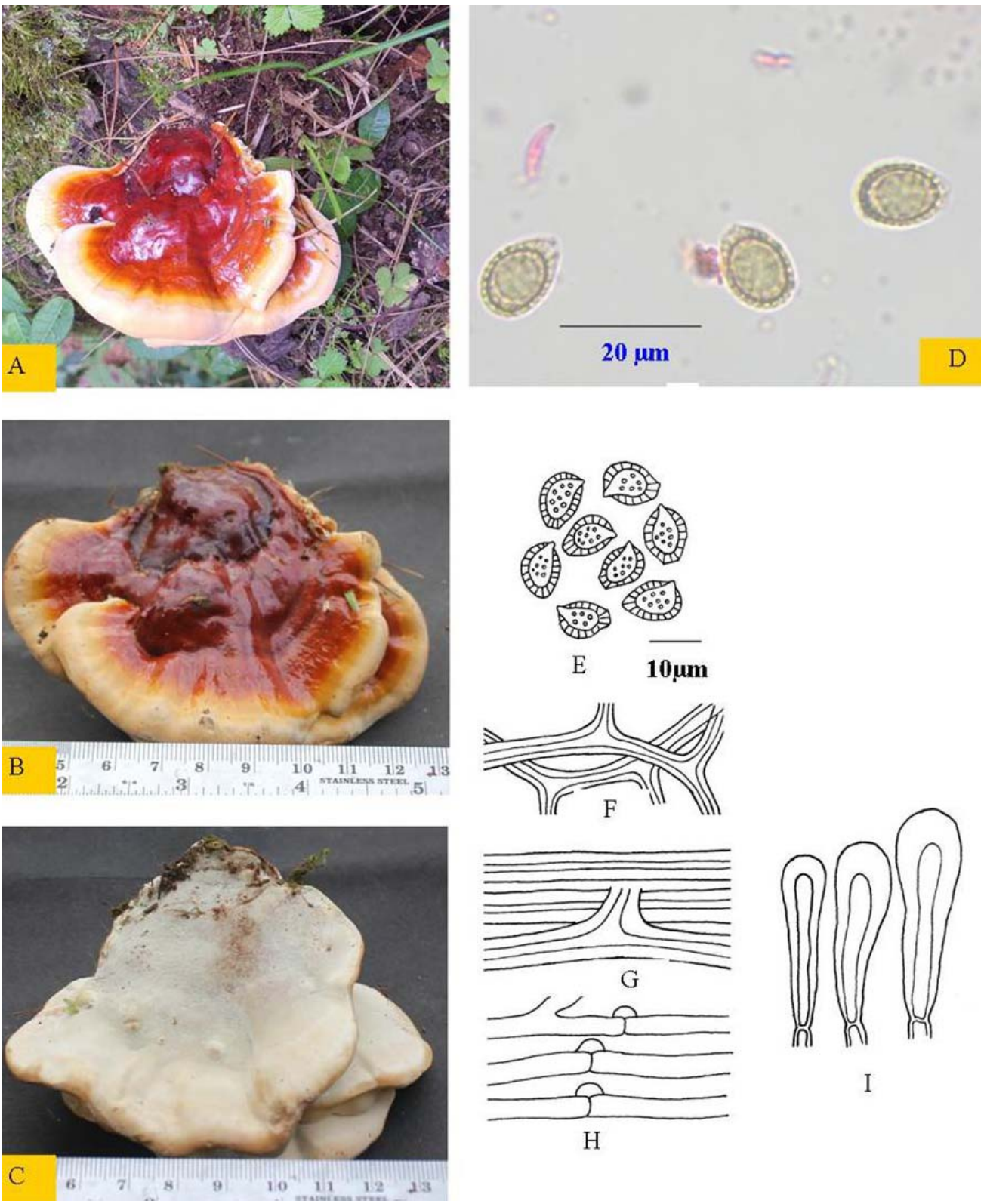


**Fig. 2.** *Ganoderma fulvellum* A) Basidiocarp attached with the substrate; B) Basidiocarp showing abhymenial surface; C) Basidiocarp showing hymenial surface; D) Photomicrograph showing basidiospores; E) Basidiospores; F) Binding hyphae; G) Skeletal hyphae; H) Generative hyphae; I) Cuticular elements

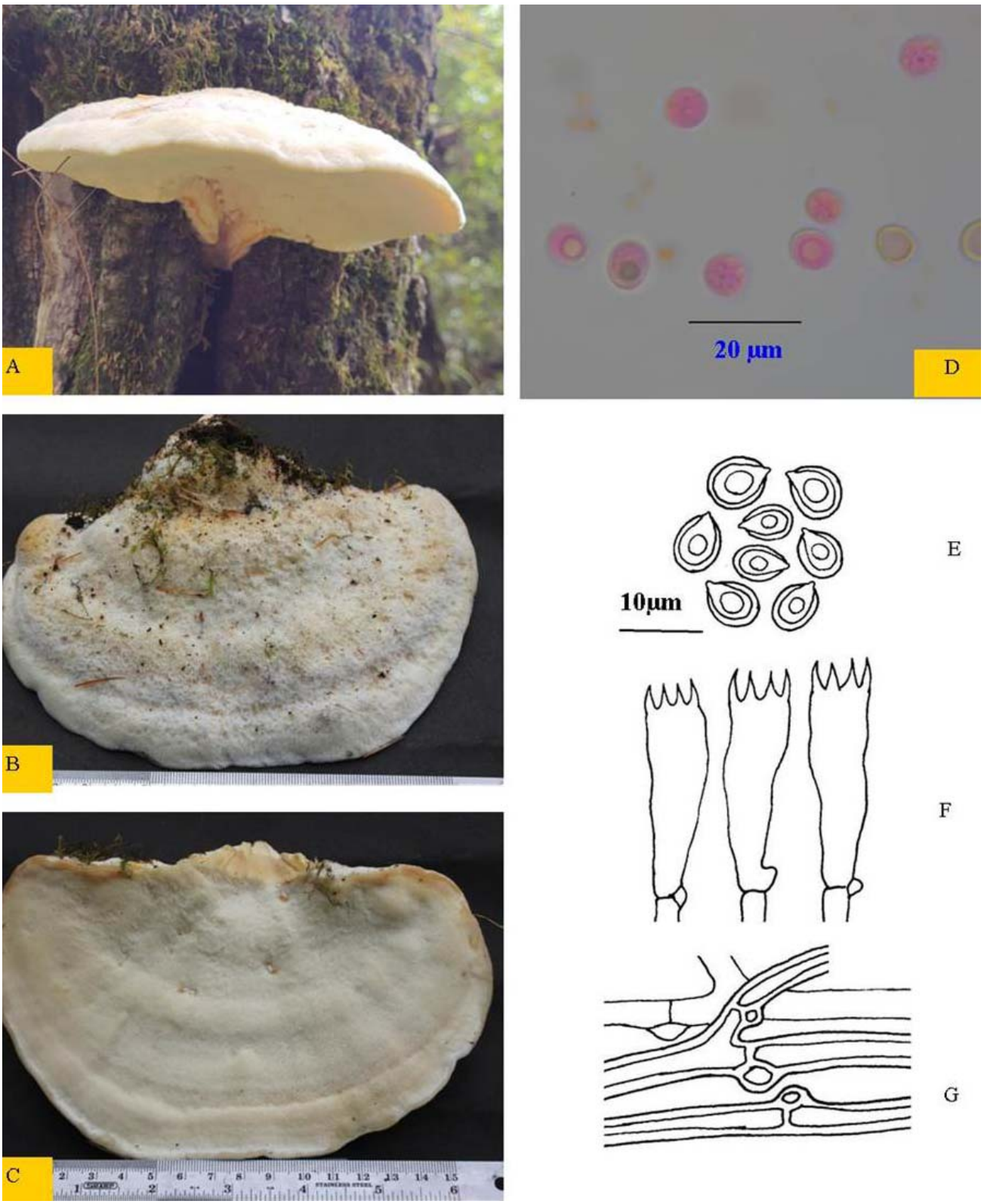


**Fig. 3.** *Tyromyces fissilis* A) Basidiocarp attached with the substrate; B) Basidiocarp showing abhymenial surface; C) Basidiocarp showing hymenial surface; D) Photomicrograph showing basidiospores; E) Basidiospores; F) Basidia G) Generative hyphae

cream (4A3) to brownish yellow (5C8) on drying; hymenial surface poroid, whitish (1A1) with pinkish tints (9A2) when fresh, cream (4A3) to brownish orange (6C8) when dry; pores circular to angular, 2-3 per mm, dissepiments thin, entire or slightly lacerate, pore tubes up to 1 cm long, brownish yellow (5C8) with pinkish tints (9A2); context up to 3 cm thick, homogenous, fibrous, light greyish brown (5E3) to pale yellow (3A3); margin thick to thin, rounded or sharp, concolorous on both abhymenial and hymenial surface, sterile up to 2 mm on hymenial surface.

Hyphal system monomitic, generative hyphae up to 4.3 µm wide, branched, septate, clamped, thick- to thin-walled, subhyaline. Basidia clavate, 22-23 × 6-7 µm, tetrasterigmate with basal clamp; sterigmata up to 3.5 µm in length. Basidiospores 5.6-6.8 × 4-6 µm, ellipsoid to subglobose, subhyaline, thick-walled, smooth, inamyloid, acyanophilous.

**Collection examined:** Himachal Pradesh, Mandi, Padhar, Sudhar, Gallu forest, on the stump of *Quercus leucotrichophora,* Hardesh 12140 (PUN), 24 September 2023.

**Remarks:** *Tyromyces fissilis* is characterised by the large sappy and partly waxy pilei that usually become shrunken with considerable drying, staining the paper in which they wrapped. It is generally a rarely species and is distributed from southern part of Fennoscandia south to Central Europe (Ryvarden and Melo 2014).

## ACKNOWLEDGEMENTS

The authors are thankful to Head, Department of Botany, Punjabi University, Patiala for providing necessary facilities. Mr. Hardesh Kumar is thankful to the Council of Scientific and Industrial Research, New Delhi for financial assistance under CSIR NET-JRF scheme (File No. 09/0140 (11107)/2021-EMR-I).

## REFERENCES

1. Badalyan, S. M., A. V. Shnyreva, M. Iotti, and A. Zambonelli. 2015. Genetic resources and mycelial characteristics of several medicinal polypore mushrooms (*Polyporales*, *Basidiomycetes*). *International Journal of Medicinal Mushrooms*, **17(4):** 371-84. doi: 10.1615/intjmedmushrooms.v17.i4.60.

2. Bakshi, B.K. 1971. *Indian Polyporaceae (on trees and timber)*, 246 p, Indian Council of Agricultural Research, New Delhi.

3. Chen, C. C., S. H. Wu, and C. Y. Chen. 2018. Four species of polyporoid fungi newly recorded from Taiwan. *Mycotaxon* **133(1):** 45-54.

4. Cui, B.K., H.J. Li, X. Ji, J.L. Zhou, J. Song, J. Si, Z.L. Yang and Y.C. Dai. 2019. Species diversity, taxonomy and phylogeny of *Polyporaceae (Basidiomycota)* in China. *Fungal Diversity* **97:** 137-392.

5. Hibbett, D., R. Bauer, M. Binder, A. Giachini, K. Hosaka, Kentaro, A. Justo, E. Larsson, K-H. Larsson, J. Lawrey, O. Miettinen, G. Nagy, Laszlo, R.H. Nilsson, M. Weiss, and R.G. Thorn. 2014. Agaricomycetes. In: The Mycota vol. 7A: Systematics and Evolution. McLaughlin, DJ and JW Spatafora (eds), pp. 373-429, Springer. 10.1007/978-3-642-55318-9_14.

6. Kaur, A. 2023. *Systematic studies on polyporoid fungi from Punjab and evaluation of selected species for anticancer activity*. Ph.D. Thesis. Punjabi University, Patiala. 276p.

7. Kornerup, A. and J.H. Wanscher. 1978. *Metheun's Handbook of colours*, 3rd Ed., 252 p, Metheun and Co. Ltd., London.

8. Leelavathy, K.M., and P.N. Ganesh. 2000. *Polypores of Kerala,* 166 p, Daya Publishng House, Delhi.

9. Parihar, A., M. E. Hembrom, and K. Das. 2023. *Wood-Rotting Fungi of Koderma Wildlife Sanctuary, Jharkhand*, 219 p, Botanical Survey of India, Ministry of Environment, Forest and Climate Change, Govt. of India, Kolkata.

10. Prashar, I.B. 2015. *Wood-rotting non-gilled Agaricomycetes of Himalaya*. 635 p, Fungal Diversity Research Series, Springer, Dordrecht, Heidelberg, New York London.

11. Ranadive, K.R., J.G. Vaidya, P.K. Jite, V.D. Ranade, S.R. Bhosale, A.S. Rabba, M. Hakimi, G.S. Deshpande, M.M. Rathod, A. Forutan, M. Kaur, C.D. Naik-Vaidya, G.S. Bapat and P. Lamrood. 2011. Checklist of *Aphyllophorales* from the Western Ghats of Maharashtra State, India. *Mycosphere,* **2:** 91-114.

12. Roy, A. and A.B. De. 1996. *Polyporaceae of India*, 287 p, International Book Distributor. Dehradun. India.

13. Ryvarden, L., and I. Melo. 2014. Poroid fungi of Europe. *Synopsis Fungorum* **31:** 1-455. Fungiflora, Oslo.

14. Sharma, J.R. 2012. Aphyllophorales of Himalaya (Auriscalpiaceae–Tremellodendropsis), 590 p, Botanical Survey of India, Ministry of Environment and Forests, Govt. of India, Kolkatta.

15. Þura, D., S. P. Wasser, and I. V. Zmitrovich. 2018. Wood-inhabiting fungi: Applied aspects. In: Fungi: Applications and Management Strategies. Deshmukh, S.K., J.K. Misra, J.P. Tewari and T. Papp (eds). 245-292, CRC Press.

16. Vinjusha, N., and T.K. Arun Kumar. 2022. *The Polyporales of Kerala*. 229 p, Spore Print Books, Calicut, Kerala, India.

17. Zhao, C. L., B. K. Cui, J. Song, and Y. C. Dai. 2015. *Fragiliporiaceae*, a new family of *Polyporales (Basidiomycota). Fungal Diversity* **70:** 115-126.