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Morphotaxonomic notes on the genus *Ganoderma* Karst. from Sirmaur district (Himachal Pradesh)

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The morphotaxonomy based account of twelve species of the polyporoid genus *Ganoderma* Karst. i.e. *Ganoderma applanatum, G. australe, G. brownii, G. carnosum,G. casuarinicola*, *G. chenghaiense, G. cochlear, G. curtisii, G. guinanense, G. lobatum, G. lucidum* and *G. triangulum* has been presented based on specimens collected from Sirmaur district of Himachal Pradesh. Among these species, *G. guinanense* is described as a new record for India while *G. chenghaiense* and *G. cochlear* are new to the state of Himachal Pradesh. All except *G. lucidum* are being described for the first time from the study area.

Keywords : Basidiomycota, diversity, fruit body, Himalaya, medicinal fungi

INTRODUCTION

Ganoderma Karst.(Polyporaceae, Polyporales, Agaricomycetes) is one of the most diverse and medicinally important genus of the polyporoid fungi. It is peculiar in having hard and woody macroscopic carpophores that are characterised by peculiar morphological attributes. The annual or perennial carpophores are distinctly pileate and stipitate in majority of the species. The shape of the pileus is quite variable and is generally represented by dimidiate, flabelliform, orbicular to suborbicular, reniform, applanate or spathulate forms that are born either solitary or in imbricate clusters. The genus is broadly divided into two morphological forms based on the nature of abhymenial surface of the pileus i.e. shiny or laccate forms and dull or non-laccate form. The hymenial side is distinctly poroid with round, angular, orbicular or suborbicular pores. The portion between the cuticle of the pileus and pore tubes, known as context, is either homogeneous or two layered (duplex) or rarely three layered. The nature of the pilear crust varies from hymenioderm to anamixoderm to trichoderm.Majority of the species are characterised by trimitic hyphal configuration with clamped generative hyphae, thick–walled, aseptate skeleto-binding hyphae with arboriform branching and thick-walled, aseptate and much branched binding hyphae. In the context region all three types of hyphae are oriented parallel to the substrate where as in the tramal zone the orientation becomes right-angled to the substrate. The subhymenial zone is generally dominated by the generative hyphae oriented at right angle to the tramal zone. The typical holobasidia are four sterigmate but are rarely observed. The most peculiar micro-morphological feature is the presence of truncate basidiospores with comparatively thinner, yellowish, smooth exine and thicker, brown intine with peculiar inter-wall pillars. As per Mycobank (2025) the genus has been placed in the family *Polyporaceae* with nearly two hundred legitimate taxa.

The studies on the diversity of the genus *Ganoderma* have been conducted from different parts of India and as many as 58 names have been described (Kaur *et al.* 2017). Some of the

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significant contributions from India include Bakshi (1971), Dhanda (1977), Singh (1987), Sharma (2012), Ranadive *et al*. (2011), Singh (2016), Kaur *et al*.(2017) and Kaur (2020). During the fungal forays conducted in different parts of Sirmaur district of Himachal Pradesh some interesting specimens of poroid fungi were collected in the monsoon months of 2015-2017. Based on the macro and microscopic characters and comparison with the literature these were identified as twelve species belonging to the genus *Ganoderma*. The aim of the present paper is to describe and illustrate these twelve species. Of these described members of the genus, ten species (*Ganoderma applanatum, G. australe, G. brownii, G. carnosum, G. casuarinicola*,*G. chenghaiense, G. cochlear, G. curtisii, G. guinanense, G. lobatum, G. lucidum* and *G. triangulum*) are reported for the first time from Sirmaur district. It is pertinent to mention here that *G. guinanense* is being described for the first time from India and two species namely, *G. chenghaiense* and *G. cochlear* are new records for the state of Himachal Pradesh.

MATERIALS AND METHODS

The carpophores were collected from the localities situated in the Sirmaur district of Himachal Pradesh during the humid months of 2015-2017. The sun dried specimens were packed and fumigated with the crystals of 1,4-dichlorobenzene so as to preserve the specimens.The macro-morphological characters of the carpophores were carefully recorded for the fresh as well as dried specimens. The micro-morphological characters of the carpophores were studied by making crush mounts and free hand cut sections in water and 3%, 5% and 10% KOH solutions, 1% cotton blue in lactophenol, 1% congo red, 1% phloxine and Melzer's reagent (0.5 gm iodine, 1.5 gm KI and 20 gm chloral hydrate in 20 ml distilled water). The outline of the microscopic structures was drawn in the form of line diagrams with a camera lucida at magnification of 100X, 400X and 1000X of the compound microscope. The macro and microscopic characters were compared with the published literature (Sharma, 2012; Ryvarden & Melo 2014) for identification. The colour standards used were as per Methuen's handbook of colours (Kornerup & Wanscher 1978). The voucher specimens were deposited at the internationally recognized Herbarium, Department of Botany, Punjabi University, Patiala (PUN).

RESULTS AND DISCUSSION

1. *Ganoderma applanatum* (Pers.) Pat., Bull. Soc. Mycol. France 5: 67, 1889. - *Boletus applanatus* Pers., Observations mycologicae 2: 2, 1800.

Carpophores perennial, pilei sessile, solitary, applanate, woody; abhymenial side non-laccate, sulcate, zonate, greyish orange to greyish brown to brown when collected, no prominent change on drying; hymenial side yellowish brown to greyish brown when collected, no prominent change on drying; pores round to angular, 4-6 per mm; dissepiments up to 80 µm thick, entire; context homogeneous, soft, brown, up to 7 mm thick; pore tubes up to 3 mm, brown; margins obtuse, irregular, concolorous on both sides, sterile up to 1.5 mm on hymenial side. Pilear crust trichoderm, fragile, cracks on pressing with nail. Generative hyphae subhyaline, up to 5 µm wide. Skeleto-binding hyphae, brown, up to 6 µm wide. Binding hyphae subhyaline, up to 4.4 µm wide. Basidia not observed. Basidiospores ellipsoid to broadly ellipsoid, truncate, 8.4–11 × 5–7.5 µm; exine thin, yellowish, smooth; intine thick, brown; two walls connected by inter-wall pillars; inter-wall pillars up to 0.7 µm long.

Remarks– *Ganoderma applanatum* is identified on the basis of sessile carpophores, non-laccate abhymenial side, trichoderm pilear crust and round to angular pores. It is being described for the first time from the study area. In addition to the present report, it is also documented from Chamba, Kangra, Kullu and Shimla districts of Himachal Pradesh (Dhanda 1977; Sharma 2000; 2012; Kaur 2013; Ritu 2019).

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, associated with roots of *Azadirachta indica*, Ramandeep 10919 (PUN), September 2, 2017.

2. *Ganoderma australe* (Fries) Patouillard, Bulletin de la Société Mycologique de France 5:

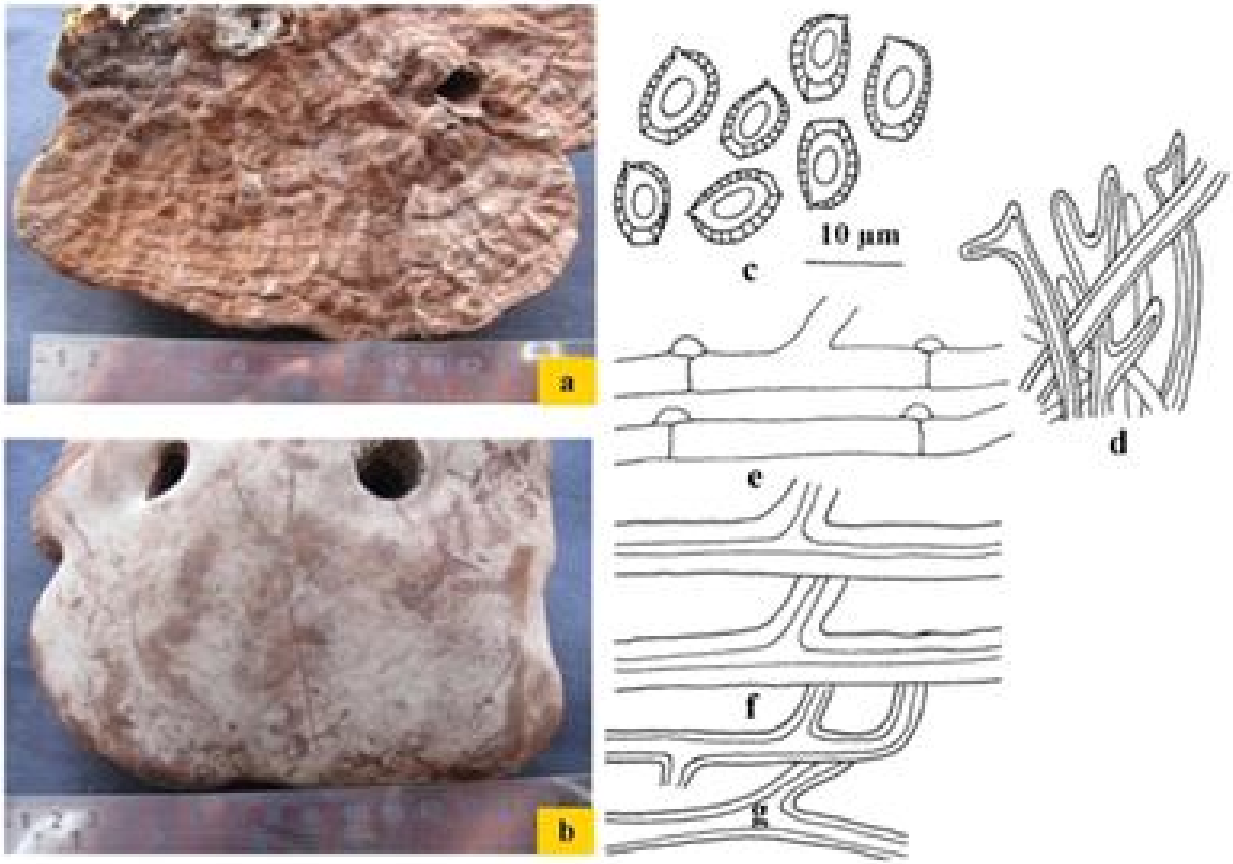

Fig 1: ***Ganoderma applanatum*****:** a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-g. Line diagrams showing outline of c. basidiospores, d. trichoderm type pilear crust, e. generative hyphae, f. skeleto-binding hyphae, g. binding hyphae.

71, 1889. – *Polyporus australis* Fries, Elenchus Fungorum 1: 108, 1828.

Carpophores perennial; pilei sessile, solitary, dimidiate, woody; abhymenial side non-laccate, sulcate, zonate, greyish orange to greyish brown to brown when collected, no prominent change on drying; hymenial sideyellowish brown to greyish brown to reddish brown when collected, no prominent change on drying; pores round to angular, 4-5 per mm; dissepiments up to 220 µm thick, entire; basal context homogeneous, soft, brown, up to 0.5 mm thick; pore tubes up to 3 cm long, stratified, each tube layer up to 1 cm long, separated by up to 0.5 mm thick, brown context layer; margins obtuse, irregular, concolorous on abhymenial side, reddish grey on hymenial side, sterile up to 5 mm on hymenial side. Pilear crust hard, dark reddish brown, anamixoderm, no cracks on pressing with nail.Generative hyphae sub-hyaline, up to 4 µm wide. Skeleto-binding hyphae brown, up to 7 µm wide. Binding hyphae light brown, up to 6.3 µm wide. Basidia clavate, 11-13 × 6-8 µm, four sterigmate, with basal clamp; sterigmata up to 3 µm long. Basidiospores ellipsoid to broadly ellipsoid, truncate, 8-10 × 5.5-7 µm, exine thin, yellowish, smooth; intine thick,

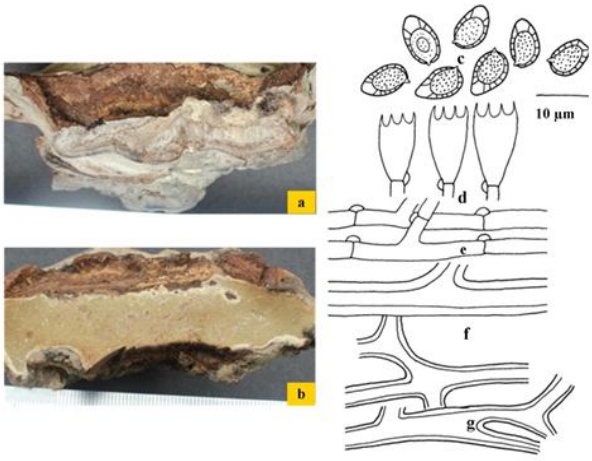

Fig. 2. ***Ganoderma australe*****:** a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side. c-g. Line diagrams showing outline of c. basidiospores, d. basidia, e. generative hyphae, f. skeleto-binding hyphae, g. binding hyphae.

brown; the two walls connected by inter–wall pillars; inter–wall pillars up to 1.7 µm long.

Remarks - Diagnostic characters of this species are sessile carpophores, anamixoderm pilear crust and round to angular pores. It is being described for the first time from the study area. As far as state of Himachal Pradesh is concerned it has been earlier reported from Shimla, Bilaspur and Kangra districts (Dhanda 1977; Kaur 2013; Ritu 2019).

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, Shamsherpur, on trunk of *Meliaa zedarach*, Ramandeep 10906 (PUN), September 4, 2017.

3. *Ganoderma brownii* (Murrill) Gilbertson, Mycologia 53(5): 505, 1962. – *Elfvingia brownii* Murrill, Western Polypores 5: 29, 1915.
Fig. 3

Carpophores perennial, pilei sessile, solitary, dimidiate to applanate, hard, woody; abhymenial side non–laccate, sulcate, zonate, greyish brown to brown when collected, no prominent change on drying; hymenial side poroid, greyish brown to brownish grey to light brown when collected, no prominent change on drying; pores round to angular, 4-5 per mm; dissepiments up to 90 µm thick, entire; context homogeneous, soft, brown, up to 5 mm thick; pore tubes up to 15 mm long, brown; margins obtuse, irregular, concolorous on both sides, sterile up to 1 mm on hymenial side. Pilear crust greyish brown anamixoderm, cracks on pressing with nail. Generative hyphae subhyaline, up to 4.3 µm wide. Skeleto-binding hyphae brown, up to 5.5 µm wide. Binding hyphae yellowish brown, up to 5.2 µm wide.Basidia not observed. Basidiospores ellipsoid, truncate, 8-10 × 5-6.2 µm; exine thin, yellowish, smooth; intine thick, brown; the two walls connected by inter–wall pillars; inter–wall pillars up to 0.7 µm long.

Remarks- *Ganoderma brownii* is peculiar in having sessile carpophores, anamixoderm pilear crust and round to angular pores. It is being described for the first time from the study area. Formerly it has been reported from Kangra district of Himachal Pradesh (Kaur 2013) and Uttarakhand (Singh 2016).

Sample studied: Himachal Pradesh, Sirmaur, Nahan, about 2 km before Nahan from Sainwala, associated with roots of *Eucalyptusteraticornis*

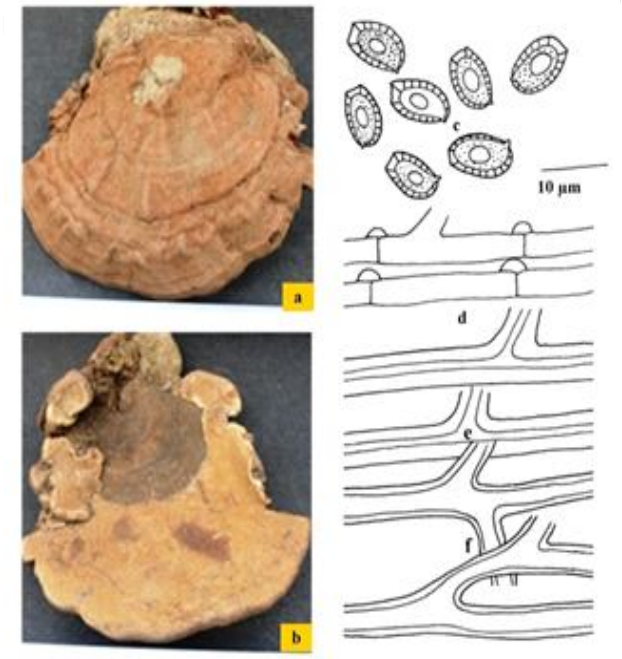

Fig. 3. *Ganoderma brownii*: a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-f. Line diagrams showing outline of c. basidiospores, d. generative hyphae, e. skeleto-binding hyphae, f. binding hyphae.

4. *Ganoderma carnosum* Patouillard, Bulletin de la Société Mycologique de France 5: 66, 1889.

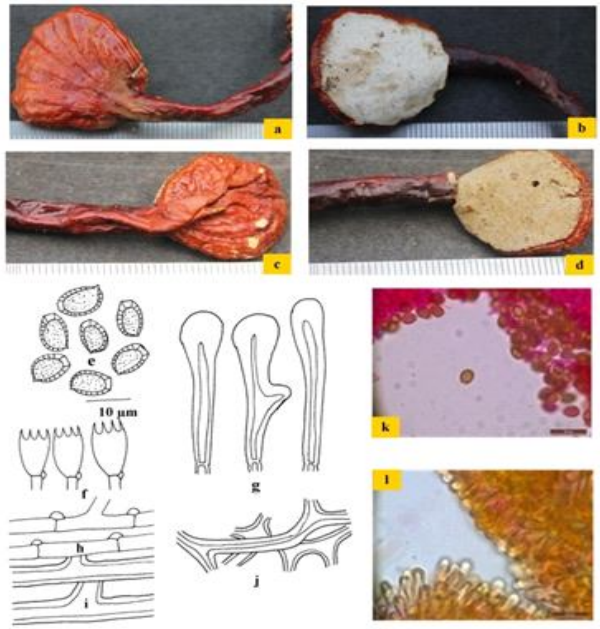

Fig. 4. *Ganoderma carnosum*: a. Carpophore showing abhymenial side (fresh), b. Carpophore showing hymenial side (fresh), c. Carpophore showing abhymenial side (dry), d. Carpophore showing hymenial side (dry), e-lj Line diagrams showing outline of e. basidiospores, f. basidia, g. cuticular elements, h. generative hyphae, i. skeleto-binding hyphae, j. binding hyphae, k. Photomicrograph showing basidiospores, l. photomicrograph showing cuticular elements

Carpophores annual; pilei stipitate, suborbicular to reniform, corky; abhymenial side laccate, sulcate, radially rugose, brownish red when fresh, violet brown on drying; hymenial side poroid, greyish yellow when fresh, greyish orange on drying; pores round to angular, 4–5 per mm; dissepiments up to 130 µm thick, entire; context homogeneous, soft, whitish to cream, up to 7 mm thick; pore tubes up to 10 mm deep, light brown to cream; margins obtuse, revolute, irregular, paler concolorous on the abhymenial side, incurved abhymenial portion on the hymenial side up to 5 mm, brownish red, masking the margins on the hymenial side. Stipe lateral, subcylindrical to flattened, solid, laccate, upper exposed portion smooth, brownish red, lower embedded portion roughly nodulose, somewhat discoloured. Pilear crust reddish brown hymenioderm, up to 0.7 mm thick, cracks on pressing with nail.Cuticular elements cylindrical with slightly inflated apex, 35-41 × 7-10 µm, smooth, thick-walled, yellowish brown, not stained in Melzer's reagent.

Generative hyphae subhyaline, up to 4.2 µm wide. Skeleto-binding hyphae brown, up to 6.6 µm. Binding hyphae subhyaline to yellowish, up to 4.2 µm wide. Basidia clavate, 9-11 × 7-8.3 µm, four sterigmate, with basal clamp; sterigmata up to 3.4 µm long. Basidiospores broadly ellipsoid, truncate, 8.5-11.2 × 6-8 µm; exine thin, subhyaline, smooth; intine thick, brown; connected by inter-wall pillars; inter-wall pillars up to 0.7 µm long.

Remarks - The identifying features of this species are stipitate carpophores with whitish to cream homogeneous context. It is being described for the first time from the study area. Kaur (2013) described it from Kangra and Shimla districts of Himachal Pradesh.

Samples studied: Himachal Pradesh, Sirmaur, Rajgarh, Batyuri, associated with roots of *Quercus leucotrichophora*, Ramandeep and Avneet 10908 (PUN), September 12, 2016.

5. *Ganoderma casuarinicola* Xing, Cui Dai with & Dai, Mycokeys 34: 100, 2018.

Carpophores annual; pilei stipitate to substipitate, suborbicular, corky; abhymenial side laccate, sulcate, radially rugose, reddish brown when collected, no prominent change on drying; hymenial side brownish yellow when collected, no prominent change on drying; pores round to angular, 4-6 per mm; dissepiments upto 140 µm thick entire; context with; soft, light yellow towards pilear crust and reddish brown towards pore tubes, up to 5 mm thick; pore tubes up to 10 mm deep, light brown to cream; margins obtuse, revolute, irregular, paler concolorous on the abhymenial side, incurved abhymenial portion on the hymenial side up to 3 mm, reddish brown. Stipe lateral, subcylindrical to flattened, solid, smooth, brownish red, laccate, somewhat discoloured.Pilear crust reddish brown, hymenioderm, up to 0.4 mm thick, cracks on pressing with nail.Cuticular elements cylindrical with slightly inflated apex, 40-50 × 8-9.5 µm, smooth, thick-walled, yellowish brown, stained in Melzer's reagent. Generative hyphae subhyaline, up to 4.5 µm wide. Skeleto-binding hyphae brown, up to 5.4 µm. Binding hyphae subhyaline to yellowish, up to 5.5 µm wide. Basidia clavate, 11.5-17 × 8-10.5 µm, four sterigma, with basal clamp; sterigmata up to 4.5 µm long. Basidiospores broadly ellipsoid, truncate, 9-12 × 6-7 µm; exine thin, subhyaline, smooth; intine thick, brown; connected by inter-wall pillars; inter-wall pillars up to 0.7 µm long, wall stained in cotton blue.

Remarks– The identifying features of *Ganoderma casuarinicola* are stipitate carpophores, duplex

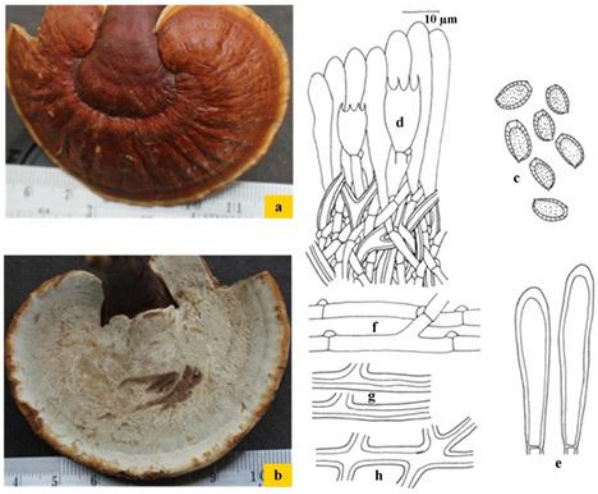

Fig 5 : *Ganoderma casuarinicola*: a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-h. Line diagrams showing outline of c. basidiospores, d. basidia, e. cuticular elements, f. generative hyphae, g. skeleto-binding hyphae, h. binding hyphae

context and basidiospore wall being stained in cotton blue. Xing *et al.* (2018) described it as a novel species growing in association with *Casuarina equisetifolia* from China. Recently the authors Kaur *et al.* (2025) documented it as a new record for India.

Sample studied: Himachal Pradesh, Sirmaur, Rajgarh, Batyuri, associated with roots of a dried gymnospermous tree, Ramandeep 10782 (PUN), September 12, 2016.

6. *Ganoderma chenghaiense* Zhao, Acta Mycologica Sinica 8(1): 31, 1989.

Carpophores annual; pilei substipitate to stipitate, suborbicular, corky; abhymenial side laccate, sulcate, concentrically zonate, greyish yellow to light orange to greyish orange to brownish orange to reddish brown when collected, no prominent change on drying; hymenial side greyish yellow to greyish orange to brownish orange when collected, no prominent change on drying; pores round to angular, 4-5 per mm; dissepiments up to 90 µm thick, entire; context homogeneous, soft, light brown to brown, up to 10 mm thick; pore tubes up to 5 mm deep, greyish brown; margins obtuse, revolute, irregular, yellowish white on the abhymenial side, concolorous on hymenial side, sterile up to 3 mm on hymenial side. Stipe lateral, subcylindrical to flattened, solid, brownish red, laccate. Pilear crust reddish brown to brown, hymenioderm, up to 2 mm thick, no cracks on pressing with nail. Cuticular elements cylindrical with slightly inflated apex, 24-37 × 5-6.5 µm, smooth, thick-walled, yellowish brown, not stained in Melzer's reagent. Generative hyphae hyaline, up to 4.5 µm wide. Skeleto–binding yellowish to pale brown, up to 5.7 µm wide. Binding hyphae subhyaline to yellowish, up to 6.3 µm wide. Basidia clavate, 19-24 × 7.5-10 µm, four sterigmate, with basal clamp; sterigmata up to 3.8 µm long.Basidiospores broadly ellipsoid to ovoid, truncate, 6.8-10 × 5.3-7 µm; exine thin, subhyaline, smooth; intine thick, brown; the two walls interconnected by inter–wall pillars; inter–wall pillars up to 1 µm long.

Remarks- The presence of substipitate to stipitate carpophores and light brown to brown context differentiate it from other species of the genus. It is being described for the first time from Himachal Pradesh as earlier it has been reported only from Uttarakhand by Singh (2016).

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, near Police station, associated with roots of *Dalbergia sissoo*, Ramandeep 10915 (PUN), September 2, 2017.

7. *Ganoderma cochlear* (Blume & Nees) Bresadola, Hedwigia 51 (4): 306–326, 1912. – *Polyporus cochlear* Blume & Nees, Nova Acta AcademiaeCaesareaeLeopoldino–Carolinae Germanicae Naturae Curiosorum 13: 20, 1826.

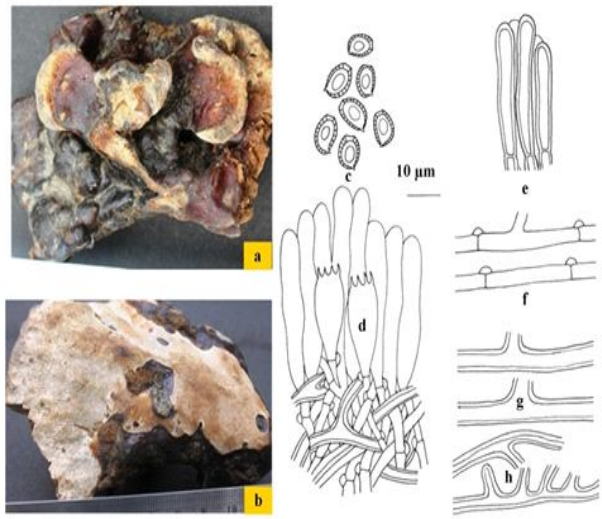

Fig : 6 *Ganoderma chenghaiense* : a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-h. Line diagrams depicting outline of c. basidiospores, d. basidia, e. cuticular elements, f. generative hyphae, g. skeleto-binding hyphae, h. binding hyphae

Carpophores annual; pilei stipitate, suborbicular to irregular, corky; abhymenial side laccate, sulcate, zonate, brownish orange when collected, reddish brown to dark brown to greyish red on drying; hymenial sidegreyish white when collected, greyish orange to greyish yellow on drying; pores orbicular to suborbicular, 4-6 per mm; dissepiments up to 90 µm thick, entire; context homogeneous, soft, fibrous, brown, up to 6 mm thick; pore tubes up to 4 mm deep, brown; margins obtuse, irregular, concolorous on both sides, sterile up to 3 mm on hymenial side. Stipe dorsolateral, subcylindrical to flattened, solid, brownish red, laccate.

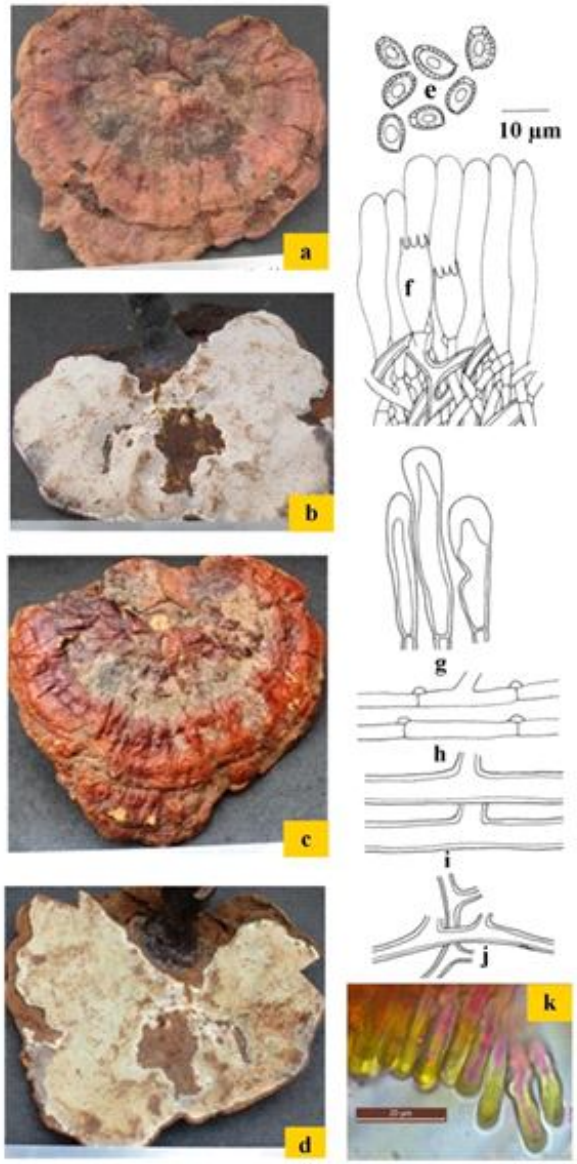

Fig : 7 ***Ganoderma cochlear***: a. Carpophore showing abhymenial side (fresh), b. Carpophore showing hymenial side (fresh), c. Carpophore showing abhymenial side (dry), d. Carpophore showing hymenial side (dry), e-j. Line diagrams showing outline of e. basidiospores, f. basidia, g. cuticular elements, h. generative hyphae, i. skeleto-binding hyphae, j. binding hyphae, k. Photomicrograph showing cuticular elements

Pilear crust reddish brown hymenioderm, up to 3 mm thick, cracks on pressing with nail. Cuticular elements clavate to cylindrical with slightly inflated apex, 38-43 × 5.5-7.5 µm, smooth, thick-walled, yellowish brown, not stained in Melzer's reagent. Generative hyphae subhyaline, up to 4.3 µm wide. Skeleto-binding hyphae brown, up to 7.5 µm wide. Binding hyphae subhyaline, up to 4.5 µm wide, branched. Basidia clavate, 13-19 × 6.5-8.7 µm, four sterigmate, with basal clamp; sterigmata up to 3.7 µm long. Basidiospores ellipsoid to broadly ellipsoid, truncate, 7-11.2 × 5-7 µm; exine thin, subhyaline, smooth; intine thick, brown; the two walls interconnected by inter-wall pillars; inter-wall pillars up to 0.9 µm long.

Remarks–The diagnostic characters of this species are laccate abhymeial side with dorsolateral stipe and brown homogeneous context. It is being described for the first time from the state of Himachal Pradesh. The only former report from India is by Singh (2016) from Uttarakhand.

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, Rajban, associated with roots of an angiospermous tree, Ramandeep 10916 (PUN), October 7, 2016.

8. ***Ganoderma curtisii*** (Berkeley) Murrill, North American Flora 9 (2): 120, 1908. – *Polyporus curtisii* Berkeley, Hooker's Journal of Botany and Kew Garden Miscellany 1: 101, 1849.

Carpophores annual; pilei stipitate, suborbicular to irregular, corky; abhymenial side laccate, sulcate, zonate, brownish orange when collected, reddish brown to dark brown to greyish red on drying; hymenial side greyish white when collected, greyish orange to greyish yellow on drying; pores orbicular to suborbicular, 4-6 per mm; dissepiments up to 90 µm thick, entire; context duplex dark brown zone near the pore tubes and pale brown towards the abhymenial side, soft, fibrous, up to 6 mm thick; pore tubes up to 9 mm deep, brown; margins obtuse, irregular, concolorous on the abhymenial side, incurved abhymenial portion on the hymenial side up to 4 mm, brownish red, masking the margins on the hymenial side. Stipe lateral, subcylindrical to flattened, solid, brownish red, laccate. Pilear crust brown, hymenioderm, up to 3 mm thick, cracks on pressing with nail.Cuticular elements clavate to cylindrical with slightly inflated apex, 24-43 × 4.5-8.5 µm, smooth, thick-walled, yellowish brown, not stained in Melzer's reagent.

Generative hyphae subhyaline, up to 4.5 µm wide. Skeleto-binding hyphae brown, up to 6.4 µm wide. Binding hyphae subhyaline, up to 5 µm. Basidia not observed. Basidiospores ellipsoid, truncate, 7.2-10.8 × 4.8-6.3 µm; exine thin, subhyaline,

smooth; intine thick, brown; two walls connected by inter-wall pillars; inter-wall pillars up to 0.9 µm long.

Remarks – *Ganoderma curtisii* is distinguished by laccate carpophores with dorsolateral stipe and duplex context. It is being described for the first time from the study area as the earlier reports from Himachal Pradesh are from Kangra and Una districts (Kaur 2013; Ritu 2019).

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, near Police station, associated with roots of *Dalbergia sissoo*, Ramandeep 10917 (PUN), September 2, 2017.

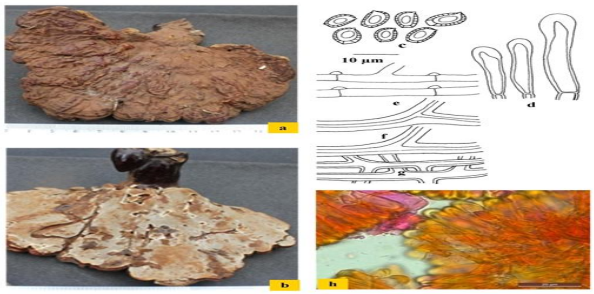

Fig 8. *Ganoderma curtisii*: a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-g. Line diagrams

9. *Ganoderma guinanense* Zhao & Zhang, Acta Mycologica Sinica 6 (1): 4, 1987.

Carpophores annual; pilei stipitate, suborbicular, corky; abhymenial side laccate, sulcate, radially rugose, reddish brown to brown when collected, no prominent change on drying; hymenial side greyish brown to light brown when collected, no prominent change on drying; pores round to angular, 4-6 per mm; dissepiments up to 140 µm thick, entire; pore tubes up to 12 mm deep, light brown to cream; context homogeneous, soft, light brown, up to 8 mm thick; margins obtuse to irregular, concolorous on both sides, sterile up to 3 mm on hymenial side. Stipe up to 10 × 1.3 cm, lateral, subcylindrical to flattened, solid, smooth, brownish red, laccate, somewhat discoloured. Pilear crust reddish brown, hymenioderm, up to 0.4 mm thick, cracks on pressing with nail. Cuticular elements cylindrical to clavate, 22-39 × 4-9 µm, smooth, thick–walled, yellowish brown, not stained in Melzer's reagent. Generative hyphae subhyaline, up to 3.5 µm wide. Skeleto-binding hyphae brown, up to 6.6 µm. Binding hyphae subhyaline to yellowish, up to 5 µm wide. Basidia clavate, 12-17 × 5-6.7 µm, four sterigmate, with basal clamp; sterigmata up to 3 µm long. Basidiospores ellipsoid, truncate, 8-11 × 5.6-7.2 µm; exine thin, subhyaline, smooth; intine thick, brown; both walls connected by inter-wall pillars; inter-wall pillars up to 0.7 µm long, wall stained in cotton blue.

Remarks - The combination of stipitate carpophores, laccate abhymenial side and homogeneous context characterizes *Ganoderma guinanense*. It is being described for the first time from India. Formerly, it has been only reported from China (Zhao & Zhang 1987; Mycobank 2025).

Sample studied: Himachal Pradesh, Sirmaur, Rajgarh, Batyuri, associated with the roots of

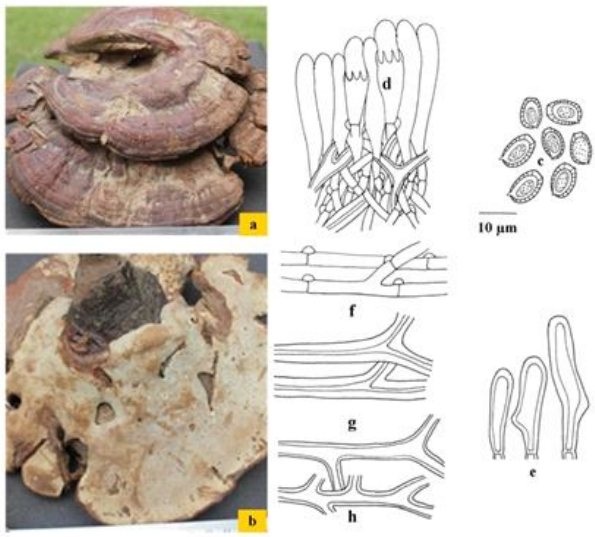

Fig:9 *Ganoderma guinanense* : a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-h. Line diagrams showing outline of c. basidiospores, d. basidia, e. cuticular elements, f. generative hyphae, g. skeleto-binding hyphae, h. binding hyphae

Quercus leucotrichophora, Ramandeep 10918 (PUN), September 12, 2016.

10. *Ganoderma lobatum* Steyaert, Bulletin du Jardin Botanique National de Belgique 50 (1–2): 168, 1980.

Carpophores perennial; pilei sessile, solitary, round to flabelliform, applanate, hard, woody; abhymenial side non-laccate, sulcate, zonate, greyish brown when collected, no prominent change on drying; hymenial side greyish white to

greyish yellow when collected, no prominent change on drying; pores orbicular to suborbicular, 4-5 per mm; dissepiments up to 90 µm thick, entire; context homogeneous, soft, brown, up to 2 cm thick; pore tubes up to 1 cm deep, light brown to brown; margins obtuse, regular, concolorous on both sides, sterile up to 4 mm on hymenial side. Pilear crust greyish brown, anamixoderm, hard, no cracks on pressing with nail. Generative hyphae subhyaline, up to 4.6 µm wide. Skeleto-binding hyphae brown, up to 6 µm wide. Binding hyphae subhyaline, up to 4.4 µm wide.Basidia not observed. Basidiospores ellipsoid, truncate, 7.7-

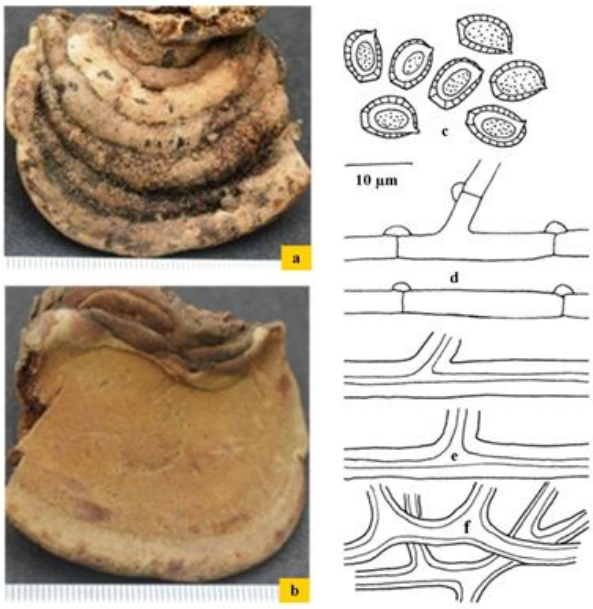

Fig.10. ***Ganoderma lobatum***: a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-f. Line diagrams showing outline of c. basidiospores, d. generative hyphae, e. skeleto-binding hyphae, f. binding hyphae

10 × 5.2-6.2 µm; exine thin, yellowish, smooth; intine thick, brown; the two walls interconnected by inter-wall pillars; inter-wall pillars up to 0.90 µm long.

Remarks – The salient features of *Ganoderma lobatum* are sessile carpophores, anamixoderm pilear crust and orbicular to suborbicular pores. It is being described for the first time from the study area. The earlier account from Himachal Pradesh is based on the specimens described from Mandi district of Himachal Pradesh (Kaur 2013).

Sample studied: Himachal Pradesh, Sirmaur, Paonta Sahib, near Himachal Pradesh and Uttarakhand state barrier, associated with roots of *Shorea robusta*, Ramandeep 10920 (PUN), October 7, 2016.

11. ***Ganoderma lucidum*** Patouillard, Bulletin de la Société Mycologique de France 5: 66, 1889. Carpophores annual; pilei stipitate, reniform to dimidiate, corky; abhymenial side laccate, sulcate, concentrically zonate, greyish yellow to light orange to greyish orange to brownish orange to reddish brown when collected, no prominent change on drying; hymenial side greyish yellow to greyish orange to brownish orange whencollected, no prominent change on drying; pores round to angular, 4-6 per mm; dissepiments up to 174 µm thick, entire; context duplex, soft, light brown towards pilear crust and reddishbrown towards pore tubes, up to 13 mm thick; pore tubes up to 2 mm deep, greyish brown; margins obtuse,

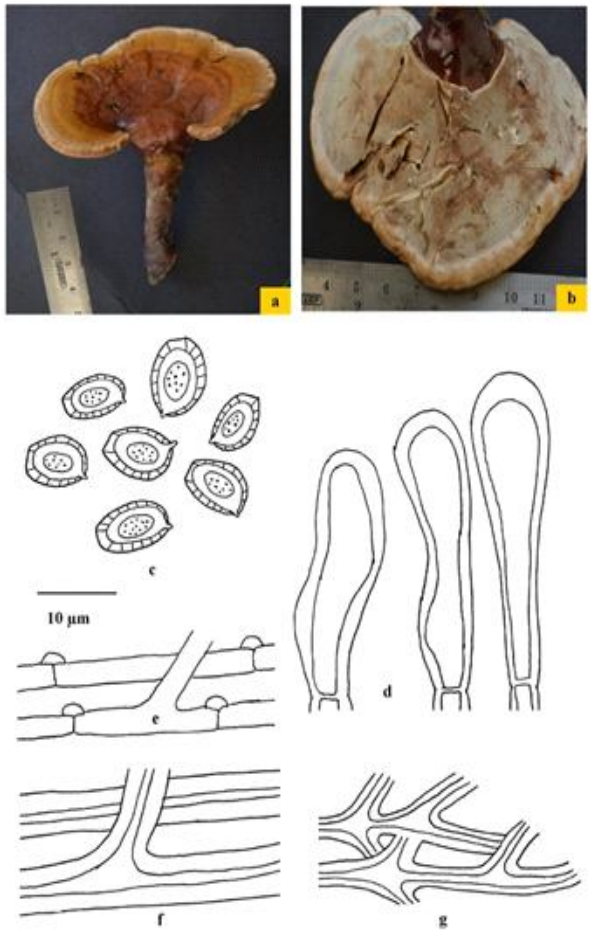

Fig. 11. ***Ganoderma lucidum***: a. Carpophore showing abhymenial side, b. Carpophore showing hymenial side, c-g. Line diagrams showing outline of c. basidiospores, d. cuticular elements, e. generative hyphae, f. skeleto-binding hyphae, g. binding hyphae

revolute, irregular, paler concolorous on both sides, sterile up to 5 µm on hymenial side. Stipe up to 7 × 1.5 cm, lateral, sub-cylindrical to flattened, solid, upperexposed portion smooth, brownish red, laccate. Pilear crust greyish yellow to reddish brown, hymenioderm, up to 2 mm thick, cracks on pressing with nail. Cuticular elements cylindrical with slightly inflated apex, 29-38 × 7.5-10.5 µm, smooth, thick-walled, yellowish brown, stained in Melzer's reagent.Generative hyphae hyaline, up to 3.6 µm wide. Skeleto-bindinghyphae yellowish to pale brown, up to 6.5 µm wide, thick-walled. Binding hyphaesubhyaline to yellowish, up to 3.5 µm wide. Basidia not observed. Basidiospores broadly ellipsoid, truncate, 7.8-10 × 5-7.2 µm; exine thin, subhyaline,smooth; intine thick, brown; the two walls interconnected by inter-wall pillars; inter-wallpillars up to 0.90 µm long.

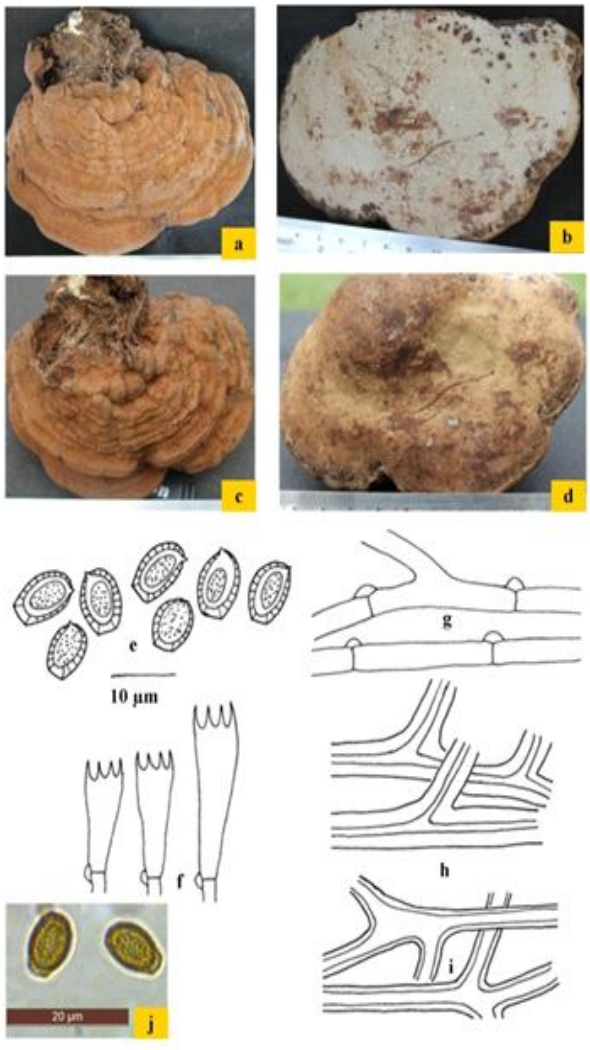

Fig 12: ***Ganodermatriangulum***: a. Carpophore showing abhymenial side (fresh), b. Carpophore showing hymenial side (fresh), c. Carpophore showing abhymenial side (dry), d. Carpophore showing hymenial side (dry), e-i. Line diagrams showing outline of e. basidiospores, f. basidia, g. generative hyphae, g. skeleto-binding hyphae, i. binding hyphae, h. Photomicrograph showing basidiospores

Remarks: The characteristic features of *Ganiderma lucidum* are stipitate, laccate carpophores with duplex context. It is a re-report from the study area with previous record by Kaur (2013).

Sample studied: Himachal Pradesh, Sirmaur, Rajgarh, Batyuri, associated with roots of *Quercus leucotrichophora*, Ramandeep and Avneet 10781 (PUN), September 12, 2016.

12. *Ganoderma triangulum* Zhao & Hsu, Acta Mycologica Sinica 3 (1):18, 1984.

Carpophores perennial; pilei sessile, solitary, ungulate, triangular in longitudinal section, hard, corky; abhymenial side non-laccate, sulcate, zonate, pale red to pale orange when collected, greyish brown to dark brown on drying; hymenial side greyish white when collected, brownish orange to light brown on drying; pores round to angular, 4-5 per mm; dissepiments up to 130 µm thick, entire; basal context homogeneous, soft, brown, up to 1cm thick; pore tubes up to 6 cm deep, stratified with 4 tube layers, each tube layer up to 1.5 cm thick, separated by up to 1 cm thick layer of homogeneous, brown context; margins obtuse, wavy to irregular, concolorous on both sides, sterile up to 5 mm on hymenial side. Pilear crust greyish brown to dark brown, hard, anamixoderm, not cracking on pressing with nail. Generative hyphae hyaline up to 4 µm wide. Skeleto-binding hyphae brown, up to 5.8 µm wide. Binding hyphae subhyaline up to 4 µm wide. Basidia clavate, 12.5-21 × 5-6.8 µm, four sterigmate, with basal clamp; sterigmata up to 4 µm long. Basidiospores broadly ellipsoid to ovoid, truncate, 7.5-9.5 × 4.6-6.6 µm; exine thin, subhyaline, smooth; intine thick, brown; the two walls interconnected by inter-wall pillars; inter-wall pillars up to 1.8 µm long.

Table 1: Comparative account of *Ganoderma* species morphology from Sirmaur district

Name of the taxon	Nature of carpophore	Nature of the pilear crust	Basidiospore shape & size	Remarks
Ganoderma applanatum	Non-laccate	Trichoderm	Ellipsoid to broadly ellipsoid; 8.4 –11 × 5 – 7.5 µm	New for Sirmaur district
G. australe	Non-laccate	Anamixoderm	Ellipsoid to broadly ellipsoid; 8 -10 × 5.5 -7 µm	New for Sirmaur district
G. brownii	Non-laccate	Anamixoderm	Ellipsoid; 8 -10 × 5 -6.2 µm	New for Sirmaur district
G. carnosum	Laccate	Hymenioderm	Broadly ellipsoid; 8.5 - 11.2 × 6-8 µm	New for Sirmaur district
G. casuarinicola	Laccate	Hymenioderm	Broadly ellipsoid; 9 -12 × 6-7 µm	Re-report for the study area
G. chenghaiense	Laccate	Hymenioderm	Broadly ellipsoid to ovoid; 6.8 -10 × 5.3 -7 µm	New for Himachal Pradesh
G. cochlear	Laccate	Hymenioderm	Ellipsoid to broadly ellipsoid; 7 -11.2 × 5 -7 µm	New for Himachal Pradesh
G. curtisii	Laccate	Hymenioderm	Ellipsoid; 7.2 -10.8 × 4.8-6.3 µm	New for Sirmaur district
G. guinanense	Laccate	Hymenioderm	Ellipsoid; 8-11 × 5.6-7.2 µm	New for India
G.lobatum	Non-laccate	Anamixoderm	Ellipsoid; 7.7-10 × 5.2 - 6.2 µm	New for Sirmaur district
G. lucidum	Laccate	Hymenioderm	Ellipsoid; 7.8-10 × 5-7.2 µm	Re-report for the study area
G. triangulum	Non-laccate	Anamixoderm	Broadly ellipsoid to ovoid; 7.5-9.5 × 4.6-6.6 µm	New for Sirmaur district

Remarks–The diagnostic characters of this species are sessile carpophores that appear triangular in longitudinal section, hard pilear crust and four stratified tube layers separated by context layers. It is being described for the first time from the study area. Formerly, it has been reported byKaur (2013) from Mandi district of Himachal Pradesh.

Sample studied: Himachal Pradesh, Sirmaur, Rajgarh, about 4 km before Phagu from Rajgarh, on trunk of *Pinus roxburghii*, Ramandeep and Avneet 10921 (PUN), September 13, 2016.

Key to the species

1. Carpophores non–laccate 2
1. Carpophores laccate 7
2. Carpophores triangular in longitudinal section .... G. triangulum
2. Carpophores not as above 3
3. Pilear crust trichodermis ..... G. applanatum
3. Pileaer crust anamixodermis 4
4. Pilear crust cracks on pressing with nail 5
4. Pilear crust not cracking on pressing with nail 6
5. Carpophore annual ..G. testaceum*
5. Carpophore perennial .. G. brownii
6. Pores round to angular .. G. australe
6. Pores orbicular to suborbicular ... G. lobatum
7. Basidiospores positive to Cotton Blue 8
7. Basidiospores negative to Cotton Blue 9
8. Cuticular elements positive to Melzer's reagent..... G. casuarinicola
8. Cuticular elements negative to Melzer's reagent..... G. guinanense
9. Context duplex 10
9. Context homogeneous 11
10. Pores round to angular ..... G. lucidum
10. Pores orbicular to suborbicular ..... G. curtisii
11. Stipe dorsolateral ..... G. cochlear
11. Stipe not as above 12
12. Pilear crust not cracking on pressing with nail ..... G. chenghaiense
12. Pilear crust cracks on pressing with nail 13
13. Abhymenial portion incurved on hymenial side, masking the margins on hymenial side ..... G. carnosum
14. Abhymenial portion not as above.....G. valesiacum*

[1] *Species previously reported from Sirmaur district but not encountered during present studies.

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DECLARATION

Conflict of Interest. Authors declare no conflict of interest.

REFERENCES

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

Dhanda, R.S.1977. Studies on Polyporaceae of North Western Himalayas. Ph.D. Thesis. Punjabi University, 500 pp

Kaur, H. 2013. Systematics of pileate poroid *Agaricomycetes* of Himachal Pradesh. Ph.D. Thesis. Punjabi University, Patiala. 371 pp.

Kaur, R. 2020. Taxonomic studies on poroid and resupinate non-poroid Agaricomycetous fungi form district Sirmaur (Himachal Pradesh). Ph.D. Thesis. Punjabi University, Patiala. 537 pp.

Kaur, G., Singh, A.P., Dhingra, G.S. 2017. Diversity of the genus *Ganoderma* in Punjab (India). *Mycobiota* **7:** 25-49. Doi10.12664/mycobiota.2017.07.05.

Kaur, A., Kaur, R., Joshi, T,, Singh, A.P., Arora, S., Dhingra, G.S., Singh, R. 2025. Taxonomic delineation and phylogenetic characterization of four species of *Ganoderma* Karst. from India. *Current Research in Environmental & Applied Mycology* (*Journal of Fungal Biology*) **15:** 287–299. Doi 10.5943/cream/15/1/19

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

MycoBank (2025). Fungal databases. Nomenclature and species banks. [Accessed: 03/05/2025].

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

Ritu. 2019. Taxonomic studies on poroid and resupinate non–poroid *Agaricomycetes* of district Kangra (Himachal Pradesh) Ph.D. Thesis Punjabi University, Patiala. 554pp.

Ryvarden, L., Melo, I. 2014. Poroid Fungi of Europe. *SynopsisFungorum* **31**: 1-455.

Sharma, J.R. 2000. Genera of Indian polypores. Botanical Survey of India, Ministry of Environment and Forest, Kolkata. 188 pp.

Sharma, J.R. 2012. Aphyllophorales of Himalaya (Auriscapiaceae – Tremellodendropsis). Botanical Survey of India, Ministry of Environment and Forests, Kolkata. 590 pp.

Singh, S. 1987. Studies on Polyporoid Fungi of Eastern Himalaya and adjoining areas. Ph.D. Thesis. Panjab University, Chandigarh. 500 pp.

Singh, R. 2016. Taxonomic studies, biochemical analysis and evaluation of CNS activities of some species of *Ganoderma* from Uttarakhand. Ph.D. Thesis. Punjabi University, Patiala. 294 pp.

Xing, J.H., Sun, Y.F., Han, Y.L., Cui, B.K. 2018. Morphological and molecular identification of two new *Ganoderma* species on *Casuarina equisetifolia* from China. *Mycokeys* **34** : 93-108.

Zhao, J.D., Zhang, X.Q. 1987. Studies on the taxonomy of Ganodermataceae in China VI. *Acta Mycologica Sinica* **6**1-7.