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## RESEARCH ARTICLE

ADDITIONS TO GENUS *HYMENOCHAETE* LÉV. FROM HIMACHAL PRADESH

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**Abstract**

Seven taxa of genus *Hymenochaete* Lév. (*H. carpatica*, *H. cinnamomea* subsp. *spretta*, *H. corrugata*, *H. cruenta*, *H. macrospora*, *H. minuscula* and *H. rubiginosa*) have been described, which are new additions to the earlier reported 6 taxa [Rattan (1977)-4 (*H. leonina*, *H. semistupposa*, *H. mougeotii*, *H. luteobadia*) and Sharma (2012)-2 (*H. cacao*, *H. tabacina*)] from Himachal Pradesh. Of these, 3 species (highlighted) are new records for India.

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## INTRODUCTION

Genus *Hymenochaete* Lév. is characterized by resupinate, effused-reflexed to pileate, annual to perennial, coriaceous to hard and corky basidiocarps; smooth hymenophore; monomitic hyphal system; simple septate generative hyphae; tissue becoming permanently dark in KOH solution; fusiform to subulate hymenial setae; narrowly clavate to subcylindrical to cylindrical, 4-sterigmate basidia and thin-walled, smooth, inamyloid, acyanophilous basidiospores. Earlier, from Himachal Pradesh, 6 species of this genus have been reported, 4 (*H. leonina*, *H. semistupposa*, *H. mougeotii* and *H. luteobadia*) by Rattan (1977) and Dhingra et al. (2014) and 2 (*H. cacao* and *H. tabacina*) by Sharma (2012).

## MATERIAL AND METHODS

**Collection of samples:** Collections have been made during the monsoon months of years 2013-14 from different localities of Himachal Pradesh. Field notes regarding the locality, host, texture of basidiocarp, colour and type of hymenial surface, abhymenial surface (in reflexed specimens), margins for all these have been recorded and deposited at the herbarium of the Department of Botany, Punjabi University, Patiala (PUN).

**Macroscopic and microscopic evaluation:** Crush mounts and free hand sections were made 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 for the evaluation of hyphae, setae, basidia and basidiospores and line diagrams made using light microscope in combination with camera lucida at different magnifications. Microphotography was also done using Olympus CX41.

## OBSERVATIONS

*Hymenochaete carpatica* Pilát, Hedwigia 70: 123, 1930.

Plate I, Figs. 1-7

**Basidiocarp** annual, resupinate, effused, adnate, up to 1.5 mm thick in section; hymenial surface smooth to somewhat cracked, brown to reddish brown, further cracking on drying; margins thinning, sterile, brownish red to pale orange or indeterminate. **Hyphal system** monomitic. Generative hyphae up to 5.7 µm wide, branched, simple septate; basal hyphae thick-walled, loosely interwoven, horizontal; subhymenial hyphae thin-walled, denser, vertical.

**Hymenial setae of two types: I.** 70–108 × 8.5–11.4 µm, abundant, brown, subfusiform to fusiform, thick-walled; projecting up to 40 µm out of hymenium. **II.** 31–44 × 5.7–7.4 µm, brown, fusiform, thick-walled, projecting up to 10 µm out of hymenium. **Basidia** 11.5–19.3 × 3.3–4.5 µm, cylindrical, 4-sterigmate; sterigmata up to 3 µm long. **Basidiospores** 4.4–5.8 × 2.5–3.3 µm, ellipsoid, smooth, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Shimla, about 2 km from Shimla towards Jakhu temple, on stump of *Quercus leucotrichophora*, Navpreet and Dhingra 7080 (PUN), August 1, 2013.

**Remarks:** This species is characteristic in having two types of hymenial setae based on the length, longer up to 108 µm and shorter up to 44 µm. Earlier, it has been reported from North America, Europe and Temperate Asia (www.mycobank.org). Here, it is being described as a new record for India.

*Hymenochaete cinnamomea* subsp. *spretta* (Peck) Parmasto, Folia Cryptogamica Estonica 37: 62, 2000. – *Hymenochaete spretta* Peck, Annual Report on the New York State Museum of Natural History 30: 47, 1878.

Plate I, Figs. 8-13

**Basidiocarp** resupinate, adnate, easily separable, up to 2 mm thick in section; hymenial surface smooth, grayish brown to brownish orange, irregularly cracked on drying; margins thinning, paler concolorous or indeterminate.

**Hyphal system** monomitic. Generative hyphae up to 5 µm wide, branched, simple septate; basal hyphae thick-walled, loosely interwoven, horizontal; subhymenial hyphae thin- to thick-walled, denser, vertical. **Setae** 69–86 × 8–10 µm, abundant, subulate, sometimes rooted, thick-walled, dark brown, arising from the subhymenium, arranged in several alternating rows with hyphae; projecting up to 5 µm out of hymenium. **Basidia** 9.2–19 × 4.5–5.7 µm, clavate, subhyaline, 4-sterigmate; sterigmata up to 3.5 µm long. **Basidiospores** 4–6.3 × 2.2–3.4 µm, suballantoid, smooth, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Shimla, about 1 km from Kufri towards Chail, on log of *Rhododendron arboreum*, Navpreet and Avneet 7082 (PUN), August 1, 2013.

**Remarks:** This species is peculiar in having adnate, easily separable basidiocarp and presence of several alternating setal and hyphal layers. Earlier, from India it has been reported by Ranadive et al. (2011) from Western Ghats followed by Devi (2014) from Uttarakhand. However, it is the first report from the study area.

*Hymenochaete corrugata* (Fa.) Lév., Annales des Sciences Naturelles Botanique 5: 152, 1846. – *Thelephora corrugata* Fr., Observationes mycologicae 1: 134, 1815.

Plate I, Figs. 14-19

**Basidiocarp** annual, resupinate, adnate, up to 5 mm thick in section; hymenial surface cracked, tuberculate under lens, grayish brown; margins thinning, light yellow to brownish orange or indeterminate. **Hyphal system** monomitic. Generative hyphae up to 3.5 µm wide, frequently branched, simple septate; basal hyphae thick-walled, less branched, horizontal; subhymenial hyphae thin-walled, frequently branched, vertical. **Hymenial setae** 55–73 × 4.8–7.5 µm, dark brown, subfusiform, abundant, with crystalline encrustation at the apex, arising from the subhymenium; projecting up to 35 µm out of hymenium. **Basidia** 11.8–23 × 4.8–7.5 µm, narrowly clavate, 4-sterigmate; sterigmata up to 4 µm long. **Basidiospores** 2.3–4.5 × 2.2–2.9 µm, ellipsoid, smooth, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Shimla, about 2 km from Shimla towards Jakhu temple, on stump of *Quercus leucotrichophora*, Navpreet and Avneet 7084 (PUN), August 2, 2013.

**Remarks:** This species is characterized by grayish brown, irregularly cracked basidiocarp and abundant, blunt, encrusted hymenial setae. Earlier, it has been reported by Natarajan and Kolandavelu (1998) from Tamil Nadu followed by Devi (2014) from Uttarakhand. Here, it is being described for the first time from the study area.

*Hymenochaete cruenta* (Pers.) Donk, Persoonia 1 (1): 51, 1959. *Thelephora cruenta* Pers., Synopsis Methodica Fungorum 575, 1801.

Plate II, Figs. 20-27

**Basidiocarp** annual, resupinate, adnate, soft when fresh, hard and corky on drying, up to 2 mm thick in section; hymenial surface smooth to somewhat tuberculate, grayish red when fresh becoming brownish red on drying; margins thinning, dark brownish red. **Hyphal system** monomitic. Generative hyphae up to 3 µm wide, branched, simple septate; basal hyphae thick-walled, less branched, loosely interwoven, horizontal; subhymenial hyphae thin-walled, frequently branched, denser, vertical. **Hymenial setae** 57–73 × 7.4–9.7 µm, subulate to subfusiform, thick-walled, reddish brown, arising from the subhymenium; projecting up to 22 µm out of hymenium. **Dendrohyphidia** abundant, irregularly branched at the apex, present in the hymenium. **Basidia** 28–43 × 3.4–5.7 µm, subclavate, 4-sterigmate; sterigmata up to 5.7 µm long. **Basidiospores** 8.5–9.7 × 2.8–4 µm, subcylindrical to subellipsoid, smooth, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Dalhousie, Kalatop, on *Quercus leucotrichophora* sticks, Navpreet and Avneet 7086 (PUN), August 16, 2014.

**Remarks:** This species is marked by the reddish hymenial surface, presence of dendrohyphidia and somewhat shorter hymenial setae. Earlier, from India, Sharma (2012) reported it from Uttarakhand. Here, it is being reported for the first time from Himachal Pradesh.

*Hymenochaete macrospora* Y.C. Dai, Mycotaxon 76: 446, 2000.

Plate II, Figs. 28-34

**Basidiocarp** resupinate, adnate, effused, up to 350  $\mu\text{m}$  thick in section; hymenial surface smooth, brownish orange to light brown; margins thinning, concolorous or indeterminate. **Hyphal system** monomitic. Generative hyphae up to 4.6  $\mu\text{m}$  wide, simple septate; basal hyphae thick-walled, less branched, parallel to the substrate; subhymenial hyphae thin-walled, frequently branched, vertical. **Hymenial setae** 76–103  $\times$  7.4–9.4  $\mu\text{m}$ , dark reddish brown, subfusiform to subulate, arising from the subhymenium; projecting up to 40  $\mu\text{m}$  out of hymenium. **Basidia** 17–21  $\times$  4–5.2  $\mu\text{m}$ , subclavate to clavate, 4-sterigmate; sterigmata up to 4.5  $\mu\text{m}$  long. **Basidiospores** 5.7–7.7  $\times$  3–4.8  $\mu\text{m}$ , broadly ellipsoid, smooth, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Solan, on way to Sanawar school from Dharampur, on stump of *Rhododendron arboreum*, Navpreet and Avneet 7078 (PUN), September 29, 2013.

**Remarks:** This species has earlier been described from its type locality in China by Dai (2010) and named on the basis of bigger, broadly ellipsoid basidiospores. Presently, it is being reported for the first time from India.

*Hymenochaete minuscula* G. Cunn., Transactions and Proceedings of the Royal Society of New Zealand 85 (1): 48, 1957.

Plate II, Figs. 35-40

**Basidiocarp** annual, resupinate, effused, adnate, easily separable, soft when fresh, not changing much on drying, up to 1 mm thick in section; hymenial surface smooth to somewhat tuberculate, grayish yellowish brown; margins thinning, indeterminate. **Hyphal system** monomitic. Generative hyphae up to 3  $\mu\text{m}$  wide, frequently branched, simple septate; basal hyphae thick-walled, loosely interwoven, less branched, horizontal; subhymenial hyphae thin-walled, denser, frequently branched, vertical. **Hymenial setae** 42–80  $\times$  5.7–6.8  $\mu\text{m}$ , brown, subfusiform, abundant, slightly curved at the apex, arising from the subhymenium; projecting up to 30  $\mu\text{m}$  out of hymenium. **Basidia** 15.6–19.4  $\times$  2.5–4  $\mu\text{m}$ , subclavate, 4-sterigmate; sterigmata up to 2.8  $\mu\text{m}$  long. **Basidiospores** 4.6–5.1  $\times$  2.8–3.4  $\mu\text{m}$ , ellipsoid to subballantoid, smooth, hyaline, thin-walled, inamyloid, acyanophilous.

**Collection examined**– Himachal Pradesh: Shimla, Tara Devi, on *Rhododendron arboreum* stump, Navpreet and Avneet 7085 (PUN), August 8, 2014.

**Remarks:** This species is characterized by resupinate basidiocarps with yellowish brown hymenial surface and slightly curved hymenial setae. Earlier, it has been reported from New Zealand, Africa, South America, Hawaii and China (www.mycobank.org). Presently, it is being reported for the first time from India.

*Hymenochaete rubiginosa* (Dicks.) Lév., Annales des Sciences Naturelles Botanique 5: 151, 1846. *Helvella rubiginosa* Dicks., Fasciculus plantarum cryptogamicarum Britanniae 1: 20, 1785.

Plate III, Figs. 41-48

**Basidiocarps** annual, resupinate, effused, reflexed to pileate, imbricate, soft and leathery when fresh, hard and brittle on drying, up to 1 mm thick in section; abhymenial surface reddish brown to dark brown, tomentose, concentrically zonate and sulcate; hymenial surface smooth to somewhat tuberculate, brownish orange to light brown when fresh, grayish brown to reddish brown on drying; margins wavy to lobed, paler concolorous on both hymenial and abhymenial surfaces. **Hyphal system** monomitic. Generative hyphae up to 5  $\mu\text{m}$  wide, branched, simple septate; basal hyphae thick-walled, agglutinated, loosely interwoven, horizontal; subhymenial hyphae thin-walled, denser, vertical. **Hymenial setae** 74–83  $\times$  8.2–12.6  $\mu\text{m}$ , reddish brown, subfusiform, thick-walled, abundant, arising from the subhymenium; projecting up to 45  $\mu\text{m}$  out of hymenium. **Basidia** 15–24  $\times$  3.4–4  $\mu\text{m}$ , clavate to subclavate, 4-sterigmate; sterigmata up to 4  $\mu\text{m}$  long. **Basidiospores** 4–5  $\times$  2.3–3.4  $\mu\text{m}$ , ellipsoid, smooth, thin-walled, subhyaline, inamyloid, acyanophilous.

**Collections examined**– Himachal Pradesh: Shimla, about 1 km from Kufri towards Chail, on sticks of *Pinus roxburghii*, Navpreet 7079 (PUN), August 1, 2013; Baldeya, on branch of *Quercus leucotrichophora*, Dhingra 7081 (PUN), August 2, 2013; Chamba, Dalhousie, Kalatop on branch of *Q. leucotrichophora*, Avneet 7083 (PUN), August 17, 2014.

**Remarks:** This species is characterized by resupinate to effused, reflexed to pileate basidiocarps, concentrically zonate and sulcate abhymenial surface and abundant setae. Earlier, Bagchee et al. (1954) reported it from Uttarakhand followed by Chaudhary (1959) from West Bengal, Rattan (1977) and Sharma (2012) from Uttarakhand. But, it is being reported for the first time from the study area.

## DISCUSSION

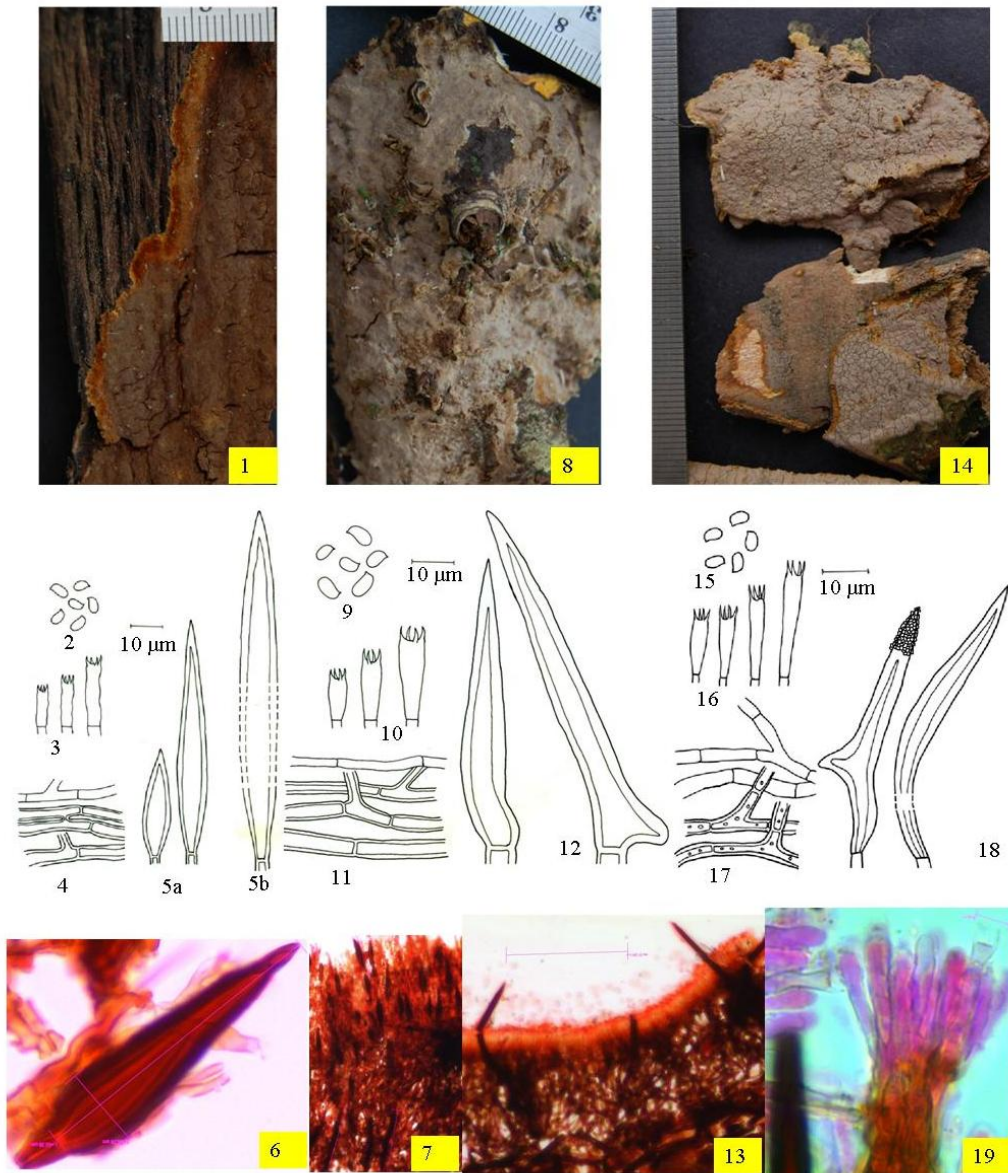
With addition of seven newly described taxa from the study area, the number has increased from 6 to 13. It is pertinent to mention here that 3 (*H. carpatica*, *H. macrospora* and *H. minuscula*) of these are being reported for the first time from India. Key to all the 13 species has been provided.

**Key to the species**

1. Hymenial surface greyish red to deep red.....2
1. Hymenial surface not as above.....3
2. Basidiospores <7 µm.....*H. cruenta*
2. Basidiospores >7 µm ..... *H. mougeotii*\*
3. Basidiocarp resupinate.....4
3. Basidiocarp resupinate to effused to reflexed to pileate.....11
4. Hymenial surface yellowish brown.....*H. minuscula*
4. Hymenial surface differently coloured.....5
5. Setae in several layers; setal layers alternating with hyphal layers .....  
.....*H. cinnamomea* subsp.*spreti*
5. Setae not as above.....6
6. Hymenial setae encrusted at apex..... *H. corrugata*
6. Hymenial setae not encrusted.....7
7. Context stratified..... *H. semistupposa*\*
7. Context not stratified.....8
8. Setae of two types longer up to 108 µm, shorter up to 44 µm..... *H. carpatica*
8. Setae not as above.....9
9. Basidiospores broadly ellipsoid..... *H. macrospora*
9. Basidiospores ellipsoid to subballantoid.....10
10. Basidiocarp densely tomentose, hymenial setae rare.....*H. luteobadia*\*
11. Cuticle present.....*H. rubiginosa*
11. Cuticle absent.....12
12. Hymenium cracked into radiating system.....*H. tabacina*\*
12. Hymenium not cracked.....*H. cacao*\*



## Plate— I



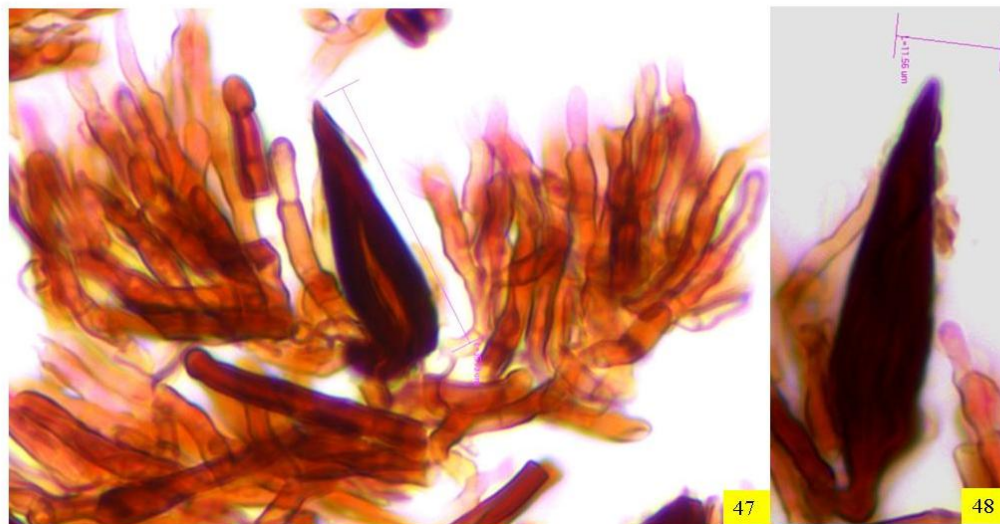
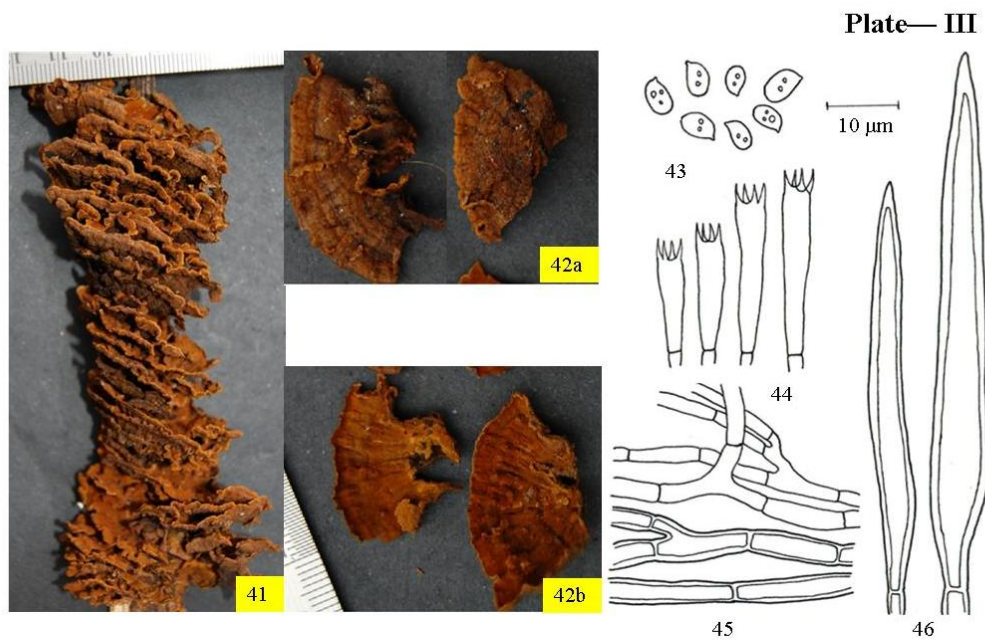
Figs. 1-7: *Hymenochaete carpatica*: 1. Basidiocarp showing hymenial surface. 2. Basidiospores. 3. Basidia. 4. Generative hyphae. 5a Short hymenial setae. 5b. Long hymenial setae. 6. Microphotograph of hymenial setae. 7. Vertical section through basidiocarp; Figs.8-13. *H. cinnamomea* subsp. *sprete*: 8. Basidiocarp showing hymenial surface. 9. Basidiospores. 10. Basidia. 11. Generative hyphae. 12. Hymenial setae. 13. Vertical section through basidiocarp; Figs. 14-19: *H. corrugata*: 14. Basidiocarp showing hymenial surface. 15. Basidiospores. 16. Basidia. 17. Generative hyphae. 18. Hymenial setae. 19. Microphotograph showing basidia.

## Plate— II



Figs. 20-27: *Hymenochaete cruenta*: 20. Basidiocarp showing hymenial surface. 21. Basidiospores. 22. Basidia. 23. Generative hyphae. 24. Dendrohyphidia. 25. Hymenial setae. 26. Microphotograph showing basidia. 27. Microphotograph showing dendrohyphidia; Figs. 28-34. *H. macrospora*: 28. Basidiocarp showing hymenial surface. 29. Basidiospores. 30. Basidia. 31. Generative hyphae. 32-33. Hymenial setae. 34. Microphotograph showing generative hyphae; Figs. 35-40. *H. minuscula*: 35. Basidiocarp showing hymenial surface. 36. Basidiospores. 37. Basidia. 38. Generative hyphae. 39-40. Hymenial setae.





Figs. 41-48: *Hymenochaete rubiginosa*: 41. Imbricate Basidiocarps. 42a. Basidiocarp showing ab-hymenial surface. 42b. Basidiocarp showing hymenial surface. 43. Basidiospores. 44. Basidia. 45. Generative hyphae. 46-48. Hymenial setae.

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