

Ectomycorrhizal mushrooms of Central India-II : *Lactarius*

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The paper deals with the description of eight ectomycorrhizal mushroom species of Central India, belonging to *Lactarius* and which were found to be ectomycorrhizal with sal (*Shorea robusta*).

Key words: Ectomycorrhizal mushrooms, Central India, *Lactarius*.

INTRODUCTION

The family Russulaceae, which includes the genera *Russula* and *Lactarius*, are distinguished from most other agarics by a structure consisting of heteromerous tissues. *Lactarius* is one of the common genera in temperate and tropical ecosystems. It is recognized in the field by the bright coloured fruiting bodies secreting latex. Currently, 200 species are recognized in the genus *Lactarius*. It has been reported that *Lactarius* forms ectomycorrhizal associations with several host tree species including *Abies*, *Quercus*, *Dipterocarp*, *kingiodendron*, *Humboldtia*, *Shorea*.

Madhya Pradesh being a central part of the country is rich in fungal flora. The ectomycorrhizal mushrooms are represented by wide range of forms and structures of fruiting bodies which have been neglected so far. The investigation of ectomycorrhizal mushrooms of Central India was a three year project initiated in January 2004 with a grant from the Department of Biotechnology, Ministry of Science and Technology, Government of India. Forest forays undertaken in the rainy season (2004-2007) yielded eight interesting mushrooms which are ectomycorrhizal with sal (*Shorea robusta*).

MATERIALS AND METHODS

Lactarius basidiomes were collected during rainy season (June-September) 2003-2007, from pure sal or mixed forests of Madhya Pradesh and Chhattisgarh. Conventional methods were used to

study the basidiomes and other characteristics. Microphotographs were taken with Nikon Eclipse E800 microscope with Nikon H-II camera attached to the microscope. The specimens have been deposited in the Mycological Research Laboratory, Department of Biological Sciences, R. D. University, Jabalpur. Authoritative monographs, papers and books were consulted/referred for correct identification. Literature consulted includes : Singer, (1986); Purkayastha and Chandra, (1985); Wilkinson and Buczaki, (1982); Findlay, (1977); Fluck, (2002); Jordan, (1999); Rayner, (1979); Mancinelli and Mancinelli, (1974); Lincoff, (1981); Keizer, (1988).

OBSERVATIONS

Basidiomes of 36 collections were examined (Fig. 1). These varied in size (pileus of fresh specimens ranged from 2 cm - 12 cm in diameter), colouring (ranged from white, yellow and brown) and surface (dry to viscid). Basidiospores of all collections were studied and although varying in size, in other aspects they appeared very similar, but were ornamented with well-developed spines. The taxonomy of ectomycorrhizal basidiomes of are as under.

***Lactarius angustifolia* Hesler & Smith, North American species of *Lactarius*, 190-191, (1979).**

Pileus 3-5 cm in diameter when young and 8 cm - 10 cm on maturity, depressed to infundibuliform, margin entire, sometimes splitting slightly involute, surface, moist, white with yellowish spots in the center, later milky, flesh creamy. *Gills* adnate to sub-

decurrent, narrow, crowded, white becomes yellowish on bruising, edges entire. *Stipe* 2-3 × 0.8-11.5 cm, white, solid, fleshy, equal to clavate, becomes yellow on bruising. *Spores* 6-8 × 4-6 cm,

sub-globose to ellipsoid, reticulate warty. *Basidia* 30-40 × 6-8 mm, sub-cylindrical to clavate and hyaline, 4-spored, sterigmata up to 4 mm. *Cystidia* 40-55 × 6-8 mm, hyaline.



Fig. 1. Sporocarps of ECM Mushrooms-*Lactarius*. : a. *Lactarius controversus*, b. *L. corrugis*, c. *L. deliciosus*, d. *L. piperatus*, e. *L. vellereus*, f. *Lactarius* sp. 1.

Habit & Habitat : terrestrial, solitary sandy soil mixture, **Ecology** : ECM with *shorea robusta* (sal). **Edibility** : edible, **Accession Number** : FGCCCL 3011, **Place of collection** : Mandha, Amarkantak. **Distribution** : Jammu and Kashmir (Saini and Atri, 1993), Jagdalpur, Chhattisgarh (Rajak *et al.*, 2003).

Lactarius camphoratus (Bull. ex Fr.) Fr., *Epicr. Syst. Mycol.* P. 346, 1838; *Hym. Eur.*, p. 437, 1938; *Sil. Fung.*, 5 : 451, 1887.

Pileus deep red brown to dark brown, at the centre, lighter along the margin, convex with umbo in the centre, then expanded 3-6 cm, when young and occasionally 9 cm and then depressed, but retaining the central umbo, lesh brown, leathery, margin rolled towards the gill, surface smooth, margin, milky unchanging latex present. **Gills** brown, close, bifid, near the stem, adnexed then decurrent, slightly reddish, finally of the same colour as the cap, covered with a cream coloured powder. **Stipe** 5 cm tall, 0.5-1.0 cm wide, central, glabrous, dry, dark brown, solid with abrupt base, milky white latex present. **Spores** 8-12 × 6-8 μm, hyaline, spherical to globose, apiculate, warty. **Basidia** 35-40 × 7-8 μm, 4-spored, clavate, sterigmata up to 0.2 μm long. **Pleurocystidia** 30-40 × 6-8 μm, hyaline, clavate. **Hymenophoral trama** heteromerous, hyaline 2-4 μm thick, sub-hymenium cellular.

Habit and Habitat : terrestrial, solitary, **Ecology** : ECM with *Shorea robusta* (sal), **Edibility** : edible, not very popular, **Accession Number** : FGCCCL 3012, **Place of collection** : Mandha. **Distribution** : Himachal Pradesh (Bhatt and Lakhanpal, 1990), Madhya Pradesh (Rajak *et al.*, 2003).

Lactarius controversus (Fr. ex Fr) Fr., *Epicr. Syst. Mycol.* p. 334, (1838).

Pileus 2-6 cm when young and up to 16 cm in diameter, surface viscid when moist but white on drying, margin inrolled, white, flesh thick, firm, brittle, latex white, margin inrolled when immature. **Gills** very close, crowded, white to pink, short, decurrent at maturity, edges entire. **Stipe** 2-5 cm long, 1-1.5 cm wide, central, narrowed downwards, with lateral root like outgrowths, white glabrous, flesh white. **Flesh** white, brittle, granular, yielding white milky latex from fleshy broken tissue. **Spores** 5-6.5 × 4-6 μm, warty, echinulate, apiculate, spherical to globose, spore print pinkish cream. **Basidia** 30-35 × 8-10 μm, clavate, swollen at the middle portion, 4-spored,

sterigmata up to 1.5 μm. **Cystidia** 35-40 × 8-10 μm, sub-cylindric, tapering towards base, hyaline. **Hyphae** septate, hyaline, 4-6 μm thick. **Hymenophoral trama** heteromerous, hyphae septate, hyaline.

Habit and Habitat : terrestrial, solitary or scattered, **Ecology** : form ECM with *Shorea robusta* (sal), **Edibility** : edible, very popular among tribals. **Accession Number** : FGCCCL 1008, **Place of collection** : Chada, Mawai, Baiyar, Achanakmar, **Distribution** : Kashmir, Jammu and Kashmir (Abraham *et al.* 1980), Madhya Pradesh (Rajak *et al.*, 2003), Fig. 1a.

Lactarius corrugis Peck., *N. Y. State Mus. Rept.*, 38 : 130, 1885.

Pileus 2-3 cm when young and extends up to 6 cm on full maturity, upper surface slightly depressed at the centre. Dry surface fleshy, produces milky latex, margin inrolled to incurved. **Gills** sub-decurrent to decurrent, close to crowded, yellowish brown. **Stipe** 2-6 cm long, 0.7-1.0 cm wide, cylindrical short, hollow, central, concolourous with pileus. **Spores** 6-8 × 4-6 μm, sub-globose to globose, warty, whitish. **Basidia** 25-30 × 6-8 μm, clavate, hyaline, 4-spored, sterigmata up to 2.5 μm. **Pleurocystidia** 35-40 × 4-8 μm, sub-fusoid, hyaline, thick-walled. **Hymenophoral trama** hyaline, 4 μm thick, septate.

Habit & Habitat : terrestrial, solitary, scattered, **Ecology** : ECM with *Shorea robusta* (sal), **Edibility** : edible by tribals, **Accession Number** : FGCCCL 1009, **Place of collection** : Chada, Gopalpur. **Distribution** : Himachal Pradesh (Bhatt and Lakhanpal, 1990), Fig. : 1b.

Lactarius deliciosus (Fries) S. F. Gray, *Nat. Arr. Brit.* 1 : 624, (1821).

Pileus 5-10 cm, funnel shaped and with more or less explanate margin, smooth, viscid in humid weather, creamish-yellow-orange with darker concentric zones. **Stipe** cylindric, soon eroded and hollow, of the same colour that of pileus, tapering at base. **Flesh** hard, brittle, granular, white, pale orange at the periphery, may become green when exposed to air but soon it disappear. **Latex** white. **Gills** slightly paler than the cap, unequal, decurrent to free, close. **Spores** white-cream, globose-subglobose, ellipsoid, warty. **Basidia** 35-40 × 8-10 μm, 4-spored, clavate, hyaline, sterigmata 2.0 μm. **Pleurocystidia**

subcylindric-ventricose, tapers upward, hyaline. *Hymenophoral trama* hyphae septate, 6-8 μm thick. *Habit & Habitat* : terrestrial, solitary, scattered, *Ecology* : ECM with *Shorea robusta* (sal), *Edibility* : edible by tribals, *Accession Number* : FGCCCL 1010, *Place of collection* : Chada, Mawai, Baiyar, Saraigaun, *Distribution* : Madhya Pradesh (Rajak *et al.*, 2003), Fig. 1c.

***Lactarius piperatus* (Scop.) Fr., Epicr. p. 340, 1838; Hym. Eur., p. 430, 1874; Syll. Fung., 5 : 436, 1887.**

Pileus convex, then depressed and also funnel-shaped or infundibuliform, 6-12 cm, white then cream coloured, sometimes cracked in dry air, surface dry, margin irregular, latex white to transparent, flesh white, margin rolled toward the gill, then explanate and undulate, always white along the margin. *Gills* unequal, very close, thin, narrow, many are bifid, decurrent along the stem, white then pale cream, edges entire, spotted with light brown when bruised. *Stipe* white, 3-7 \times 2-5 cm, cylindrical or widening upwards, glabrous. *Spores* 7-8 \times 4-6 μm , ellipsoid to globose, echinulate, white. *Basidia* 35-45 \times 8-10 μm , clavate, hyaline. *Pleurocystidia* 40-50 \times 6-8 μm , hyaline. *Hymenophoral trama* hyphal.

Habit & Habitat : terrestrial, solitary, *Ecology* : ECM with *Shorea robusta* (sal), *Edibility* : edible, very popular among tribals, *Accession Number* : FGCCCL 2008, *Place of collection* : Amarkantak, Baiyar. *Distribution* : Himachal Pradesh (Bhatt and Lakhanpal, 1990), Madhya Pradesh (Rajak *et al.*, 2003), Fig. 1d.

***Lactarius vellereus* (Fr.) Fr., Fries 1838**

Pileus plano convex, with margin rolled toward the gills, then plane, 8-15 cm, depressed in the centre, finally fungal shaped with explanate and irregularly undulate margin, entirely covered with stiff membrane, more evident in dry weather, white then whitish or yellowish, with brownish spots. *Stipe* short, thick, hard, often misshapen, pointed at the base, white then with brownish spots, velvety like the cap. *Flesh* thick, hard, brittle, white then yellowish, with greenish stains. *Gills* somewhat apart, slightly decurrent along the stem, white with yellowish leaves, incomplete, margin entire. *Spores* white, warty, globose to sub-globose to slightly elliptical.

Habit & Habitat : terrestrial, solitary, *Ecology* : ECM with *Shorea robusta* (sal), *Edibility* : edible, very popular among tribals, *Accession Number* : FGCCCL 2009, *Place of collection* : Amarkantak, Chada, Mawai, Umaria, Mandha, Baiyer, Motinala, Pandutala, Saraigaun, Achanakmar, *Distribution* : Sikkim (Berkeley, 1856), Madhya Pradesh (Rajak *et al.*, 2003). Fig. 1e.

***Lactarius* sp. 1**

Pileus 5-8 cm, whitish, without real zones, viscid or glutinous, margin thin, glabrous. *Stipe* cylindrical, soon hollow, viscid, paler than the cap. *Flesh* tender, fragile, white tinged with yellowish. *Latex* white. *Gills* close, thin, decurrent, pinkish white, then yellowish. *Spores* white or cream.

Habit & Habitat : terrestrial, solitary, *Ecology* : ECM with *Shorea robusta* (sal), *Edibility* : edible, very popular among tribals, *Accession Number* : FGCCCL 3011, *Place of collection* : Mandha, Chilpi ghati, Fig. 1f.

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