

***Leucocoprinus* Pat. (Agaricaceae, Agaricales, Basidiomycota) in Bengaluru, Karnataka State, India**

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Abstract: Four *Leucocoprinus* species [*Leucocoprinus birnbaumii* (Corda), *Leucocoprinus fragilissimus* (Rav.) *Leucocoprinus cepistipes* (Sowerby) *Leucocoprinus brebissonii* (Godey)] were recorded from Bengaluru, Karnataka State, India. A key to *Leucocoprinus* species collected during this study, description of macroscopic and microscopic characters, and the ecology of the species has been provided.

Key words: Agaricales • Bengaluru • Agaricaceae

INTRODUCTION

Leucocoprinus Pat. (Leucocoprineae Sing., Agaricaceae, Agaricales, Basidiomycota) is a genus distinct from other genera of the tribe Leucocoprineae [1]. It has been placed between Leucoagarics and Macrolepiota. It is differentiated from Macrolepiota by its small sized basidiocarp and by the absence of clamp-connection, while it can be distinguished from Leucoagaricus by its fragile, coprinoid, plicate-sulcate pileal margin. The basidiocarp of *Leucocoprinus* is small to medium, lepiotoid to coprinoid, often fragile. Pileus convex expanding to plane, membranous, floccoso-squamulose, radially sulcate, striate, often plicate, readily decaying. Lamellae free, crowded, whitish. Stipe central, equal, rarely with a bulbous base, hollow, cylindric. Annulus present, membranous. Context thin, hyphae lacking clamp connections. Spores medium large, hyaline, ellipsoid, dextrinoid, smooth, endosporium metachromatic with Cresyl blue, thick walled, apically truncated by a germ pore. Basidia clavate, tetrasporic, sometimes bisporic to monosporic. Lamella edge sterile with abundant cheilocystidia. Pleurocystidia absent. Hymenophoral trama regular. Pileal surface an epicutis rarely palisadic with sphaerocystes. Terrestrial on rotting debris. Development hemiangiocarpic. Reports reveal that they are cosmopolitan in distribution.

Singer [2] recognised 13 species in this genus. Wasser [3] mentioned 18 species. According to recent literature survey [4] which revealed 40 species in this

genus. Manjula [5] listed 5 species in India, Natarajan [6] listed 6 species, Kumar *et al.* [7,8] reported new species of *Leucocoprinus* from Kerala state [9]. Only one species of *Leucocoprinus* has been reported in Karnataka [10]. Hence the present investigation was done in order to fulfil the lacuna. During our studies on Taxonomy of Agaricales in and around Bangalore, four species of *Leucocoprinus* was identified out of which one in an addition to Indian Agaric flora. A key to *Leucocoprinus* species collected during this study, description of macroscopic and microscopic characters, and the ecology of the species has been provided.

MATERIAL AND METHODS

The collections of the mushrooms were made as per [11] between June 2007 to November 2010 in and around Bengaluru, Karnataka, India. Field characters such as habit, habitat, colour and size of the pileus, stipe and lamellae, presence or absence of annulus etc., were noted from the fresh material, spore-print was obtained, and photographs were taken in its natural habitat. The colour terminology used is that of Kornerup and Wanscher [12]. The specimens were dried for further microscopic examination in Hot air oven at 40-50°C and stored in air tight containers with some naphthalene balls. The dried specimens were revived with 10% potassium hydroxide solution; stains such as 1% aqueous Phloxine, Congo red solution were used. Reagent such as Melzer's reagent was used to study amyloidity of spores and various other

tissues. Cresyl blue solution was used to study the metachromatic reaction of the spores. Microscopic characters such as size and shape of basidia, basidiospores were noted, presence or absence of pluerocystidia, cheilocystidia, pileocystidia and caulocystidia with their size and shape were noted. The diameter of hyphae and the presence or absence of clamp-connection in different region of basidiocarp was also determined using trinocular microscope (Labomed CXL Plus) camera lucida diagrams were also made. In the present systematic study [13] classification concept was followed.

RESULT AND DISCUSSION

The collection was made in different localities in Bengaluru consistently for four years, June 2006-November 2010 with frequent visits during monsoon season. Four species of the genus *Leucocoprinus* was identified as *Leucocoprinus birnbaumii* (Corda) [14], *Leucocoprinus fragilissimus* (Rav.) [15] *Leucocoprinus cepistipes* (Sowerby) [16] *Leucocoprinus brebissonii* (Godey) [17]. *Leucocoprinus fragilissimus* was found on leaf litter, humus even on ground hence was found to be common through out the monsoon in all the collection especially in Jnanabharathi (Bangalore University campus), and hence it could be called as consistent in its occurrence. Were as *Leucocoprinus birnbaumii* found on rotting wood was collected from Jnanabharathi campus and in Savanadurga forest only in the year 2007 and 2009. *Leucocoprinus brebissonii* and *Leucocoprinus cepistipes* preferred to grow only on leaf litter and it was found during early and mid monsoon of 2007, 2008 and 2010, respectively.

Key To The Species Of The Genus *Leucocoprinus*

1 Basidiocarp uniformly bright yellow to sulphur yellow

L. birnbaumii

1 Basidiocarp white to creamy white

2. Basidiocarp very fragile, pileus with a yellow disk.

L. fragilissimus

2. Basidiocarp quite fleshy and pileus covered by fibrils especially at the disk.

3. Pileus surface covered by yellowish-brown to brown, fibrils basidiospores $5.6-8.52 \times 2.84-4.26 \mu\text{m}$

L. cepistipes

3. Pileus surface covered with greyish-brown fibrils, basidiospores $9.94-11.36 \times 5.68-7.10 \mu\text{m}$

L. brebissonii

Leucocoprinus birnbaumii (Corda) Singer, *Sydowia* 15(1-6): 67 (1962)

Agaricus birnbaumii Corda, *Icon. fung.* (Prague) 3: 48 (1839)

Bolbitius birnbaumii (Corda) Sacc. and Traverso, *Syll. fung.* (Abellini) 19: 151 (1910)

Agaricus cepistipes sensu Sowerby [Col. Fig. Engl. Fung. Vol., pl. 2 (796)] (yellow basidiomes); fide Checklist of Basidiomycota of Great Britain and Ireland (2005)

Agaricus cepistipes var. *luteus* Bolton, *Hist. fung. Halifax* (Huddersfield) 2: 50 (1788)

Lepiota cepistipes var. *lutea* (Bolton) Sacc., *Syll. fung.* (Abellini) 5: 44 (1887)

Lepiota lutea (Bolton) Matt., *Bull. Soc. mycol. Fr.* 13: 33 (1897)

Leucocoprinus luteus (Bolton) Locq., *Bull. mens. Soc. linn. Lyon* 14: 93 (1945)

Lepista lutea (With. ex Secr.) Godfrin

Lepiota lutea (With.) Quél.

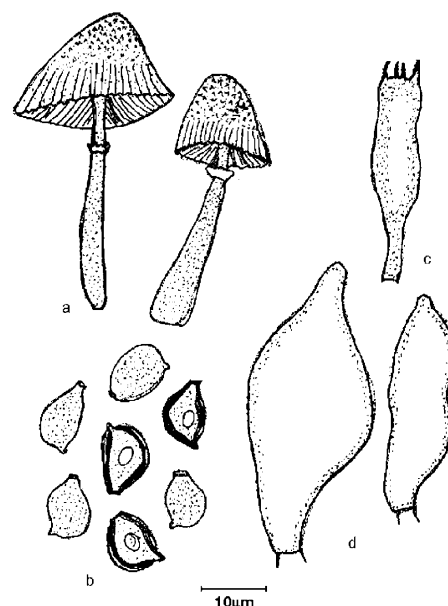
Agaricus luteus With., *Arr. Brit. Pl.*, Edn 3 (London) 4: 233 (1796)

Lepiota cepistipes var. *lutea* (With.) Quél., *Enchir. fung.* (Paris): 7 (1886)

Lepiota aurea Massee, *Bull. Misc. Inf.*, Kew: 189 (1912)

Agaricus aureus (Massee) F.M. Bailey, *Compr. Cat. Queensland Pl.*: 715 (1913)

Lepiota pseudolomicophora Rea, *Brit. basidiomyc.* (Cambridge): 74 (1922)



Leucocoprinus birnbaumii, a. habit, b. spores, c. basidia d. cheilocystidia

Fig. 1:

Pileus 1.5-3.0 cm in diameter, conical becoming campanulate with age, membranous; surface yellow (3A7) becoming greyish yellow (4B4), floccose squamulose; margin thin, plicate-striate, appendiculate with velar remnants. Lamellae free, concolorous with pileus surface, thin, crowded, with lamellulae. Stipe central, 4-6 × 1.5 cm, cylindrical with a swollen base, hollow; surface light yellow (3A5), minutely floccose towards base; annulus fragmentary to evanescent. Spore print white. Basidiospores ovoid-ellipsoid, 8.52-12.78 × 7.10-8.52 µm, hyaline, dextrinoid, metachromatic with Cresyl blue, thick-walled, truncated apex with distinct germ-pore. Basidia clavate, 36.17-42.60 × 7.10-9.94 µm, tetrasporic; sterigmata up to 2.84 µm long. Cheilocystidia clavate to lageniform, 28.84-42.60 × 12.78-19.88 µm, hyaline, thin-walled. Pleurocystidia absent. Gill trama regular, hyphae 2.84-18.46 µm in diameter. Context thin, light yellow, hyphae 2.84-12.78 µm in diameter, inflated up to 31.68 µm in diameter. Pileus surfaces an epicutis of loose chains of hyphal elements, 30.26-49.70 µm, hyaline, thin-walled. Clamp-connections absent.

In groups on decayed wood, Janabharathi, Bangalore, Karnataka, on 2nd August 2007 and 27th August 2009.

This mushroom is characterised by its bright yellow pileus, white spore print, spores metachromatic, dextrinoid, thick-walled, truncated with distinct germ-pore and presence of cheilocystidia. Dennis [18] reported this species from Trinidad. [19, 20] has reported this species from East Africa and Lesser Antilles. This species was earlier reported from India [21] in Orissa.

Leucocoprinus fragilissimus (Rav.) Pat., Essai Taxon.:171 (1990)

Hiatula fragilissima Rav. apud Berk. and Curt. In Ann Mag.Nat.Hist.ser.2,12:422 (1853)

Agaricus licmophorus Berk. and Br.in Journr.Linn.Soc.,Bot.11:500(1871).

Lepiota licmophora (Berk. and Br.) Sacc., Syll.Fung.5:44 (1871).

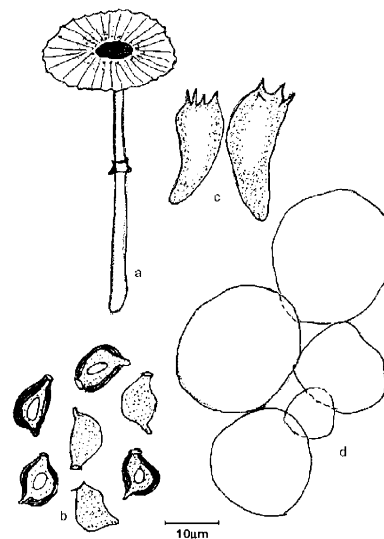
Mastocephalus licmophorus (Berk. and Br.) Kuntze, Rev. Gen.Pl.2:860 (1891)

A.fragilissima (Rav.) P.Henn.in Engl. and Prantl, Nat. Pfl.Fam.1,1:263(1900)

L.fragilissima (Rav.) Morgan in Journ.Mycol.13:5(1907)

H.licmophora (Berk. and Br.) Petch in Ann. Roy.Bot.Gard., Peradeniya 4:385 (1910).

Leucocoprinus licmophorus (Berk. and Br.) Pat. In Bull Soc. Mycol. Fr, 29: 216 (1913)



Leucocoprinus fragilissimus, a. habit, b. spores, c. basidia d. epicuticular sphaerocysts

Fig. 2:

Pileus 3-5 cm diameter, very thin and fragile, at first narrowly conical then plane or depressed; surface whitish when expanded, almost translucent, with a yellowish disk, plicate striate, covered by minute, yellow furfuraceous squamules along the radial ridges. Lamellae free, remote, pure white, narrow, up to 2 mm wide, moderately crowded but with a few lamellulae. Stipe 7-12 × 0.2-0.4 cm, cylindric, equal, hollow; surface dull yellow, glabrous. Annulus present attached to the mid-way region of the stipe. Context thin. Spore print white. Spores 8.82-11.36 × 5.68-7.10 µm, broadly ellipsoid, dextrinoid, thick walled, metachromatic, truncated by a broad germ-pore. Basidia 18.46-24.56 × 5.68-7.10 µm, clavate, tetrasporic, sterigma up to 2.84 µm Cheilocystidia and Pleurocystidia absent. Pileipellis an epicutis, with a mixture of loose, hyaline sphaerocysts of 14.42-35.95 µm, hyaline, thin-walled. All hyphae lacking clamp-connection.

On leaf litter, humus and terrestrial, Solitary, at Jnanabharathi, Bangalore, Karnataka, India, collected by Pushpa.H on 29-08-2007.

The distinguishing feature of this collected specimen is its white pileus, with yellow disk, fragile, translucent, plicate, long hollow stipe, spores white, metachromatic, thick walled, dextrinoid, with a germ pore. All the characters are similar to *Leucocoprinus fragilissimus* (Rav.) as described [20]. This species has been earlier reported [22] from Orissa, India..

Leucocoprinus cepistipes (Sowerby) Pat. [as 'cepaestipes'], J. Bot., Paris 3: 336 (1889)

Agaricus cepistipes Sowerby, Col. fig. Engl. Fung. Mushr. 1: pl. 2 (1797)

Coprinus cepistipes (Sowerby) Gray, Nat. Arr. Brit. Pl. (London) 1: 633 (1821)

Coprinus cepistipes (Sowerby) Gray, Nat. Arr. Brit. Pl. (London) 1: 633 (1821) var. *cepistipes*

Coprinus cepistipes (Sowerby) Gray, Nat. Arr. Brit. Pl. (London) 1: 633 (1821) var. *cepistipes*

Lepiota cepistipes (Sowerby) P. Kumm. [as 'cepestipes'], Führ. Pilzk. (Zwickau): 136 (1871)

Hiatula cepistipes (Sowerby) R. Heim and Romagn. [as 'cepaestipes'], Bull. trimest. Soc. mycol. Fr. 50: 181 (1934)

Agaricus rorulentus Panizzi, Comm. Soc. crittog. Ital. 1(no. 3): 172 (1862)

Lepiota rorulenta (Panizzi) Sacc., (1886)

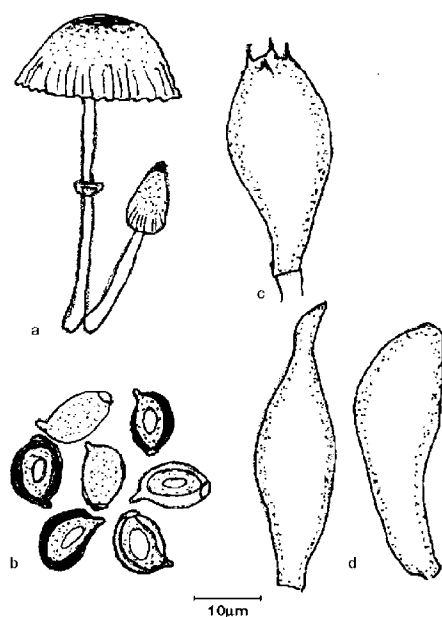
Lepiota cepistipes var. *rorulenta* (Panizzi) Rick, in Rambo (Ed.), Iheringia, Sér. Bot. 8: 314 (1961)

Leucocoprinus cepistipes var. *rorulentus* (Panizzi) Babos, Annls hist.-nat. Mus. natn. hung. 72: 87 (1980)

Agaricus cheimonoiceps Berk. and M.A. Curtis, J. Linn. Soc., Bot. 10(no. 45): 283 (1868)

Lepiota cheimonoiceps (Berk. and M.A. Curtis) Sacc., Syll. fung. (Abellini) 5: 66 (1887)

Lepiota cepistipes var. *cheimonoiceps* (Berk. and M.A. Curtis) Rick, in Rambo (Ed.), Iheringia, Sér. Bot. 8: 314 (1961).



Leucocoprinus cepistipes, a. habit, b. spores, c. basidia d. cheilocystidia

Fig. 3:

Pileus 2-2.3 cm diameter, at first ovoid then conical, finally campanulate or expanded at maturity; surface pure white (1A1) then cream with brownish (7E5) yellowish brown fibrils at the disk; margin plicate, striate towards the margin. Lamellae free, white, thin, crowded, with lamellulae of 2-3 lengths. Stipe 4-6 × 0.3-0.4 cm, central, equal, cylindrical, white (1A1), glabrous, hollow. Annulus present attached to the mid-way region of the stipe. Context thin. Spore print white. Spores 5.6-8.52 × 2.84-4.26 μm, ellipsoid, dextrinoid, thick walled, metachromatic, truncated by a broad germ-pore. Basidia 14.42-15.62 × 11.36-14.42 μm, clavate, bearing four sterigmata of 2.84 μm long. Cheilocystidia 28.40-32.66 × 8.56-μm 12.78 clavate.

Pleurocystidia absent. Hymenophoral trama regular, hyaline, Pileipellis an epicutis of loose chains of hyaline, thin-walled hyphae; individual elements 18.46-90 × 4.2-17.04 μm, hyaline, thin-walled. All hyphae lacking clamp-connection.

On leaf litter, Solitary, at Jnanabharathi, Bangalore, Karnataka, India, collected by Pushpa.H on 29-08-2007.

It is characterized by having white pileus, covered with fibrils of brown to yellowish brown at the disk. Pileus margin plicate-striate and the basidiospores white, thick walled, dextrinoid, metachromatic, with a distinct germ pore. All the characters are similar to that of the *L. cepastipes* (Sow.ex Fr.) as described [21] but a variation in the size of the pileus. This species has been reported in Orissa, India by Dhancholia and Sinha [21]

Leucocoprinus brebissonii (Godey) Locq., Bull. mens. Soc. linn. Lyon 12: 95(1943)

Lepiota brebissonii Godey, Hymenomyc. eur. (Upsaliae): 64 (1874) *Armillaria subcava* sensu Cooke; fide Checklist of Basidiomycota of Great Britain and Ireland (2005)

Lepiota felina sensu Cooke; fide Checklist of Basidiomycota of Great Britain and Ireland (2005)

Lepiota cepistipes var. *cretacea* Grev., Scott. crypt. fl. (Edinburgh) 6: pl. 333 (1828)

Pileus 2-3 cm diameter, fragile, conico-campanulate, slightly umbonate; surface white (1A1) with dry surface covered by greyish-brown (5C2) fibrils at the centre of the disk. Margin plicate-sulcate half-way or more to the disk; Lamellae free, white, up to 3 mm wide, sub crowded with lamellulae of two lengths. Stipe 3-7.5 × 0.2-0.3 cm, cylindric, slightly bulbous at the base, hollow; surface white (1A1). Annulus membranous, persistent, white (1A1), attached half-way zone of the stipe of lower.

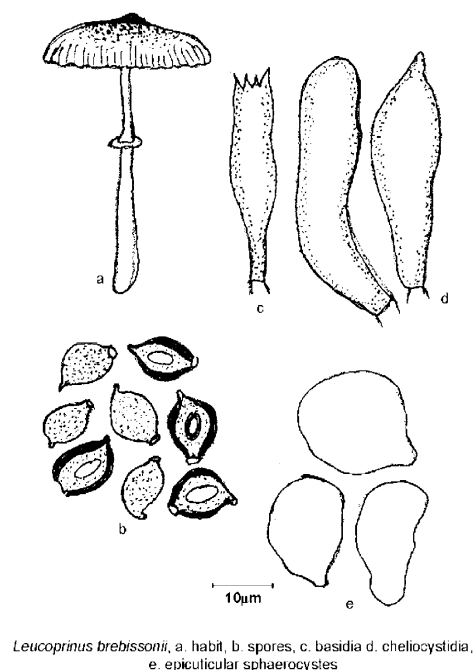


Fig. 4:

Context very thin up to 1mm thick at the disk, very thin elsewhere, made of thin-walled, hyaline hyphae of 2.84-9.94 μm diameters. Spore print white. Spores 9.94-11.36 \times 5.68-7.10 μm , ellipsoid, truncated by a apical germ-pore, hyaline, dextrinoid, with a complex wall. Basidia 25.9-28.84 \times 5.68-11.36 μm , clavate, bearing four sterigmata of 4.26 μm length. Lamella edge sterile with crowded cheilocystidia. Cheilocystidia 28.84-42.60 \times 12.78-14.42 μm , cylindric to clavate, hyaline, thin-walled. Pleurocystidia absent. Hymenophoral trama regular, consisting of hyaline, thin walled hyphae of 2.84-4.26 μm diameter. Subhymenial layer interwoven. Pileipellis an epicutis with spherical cells of 21.30-23.14 μm diameter, thin-walled. All hyphae with out clamp-connection.

On leaf litter, Solitary, at Jnanabharathi, Bangalore, Karnataka, India, collected by Pushpa.H on 29-08-2010.

It is characterized by having white pileus, covered with greyish-brown fibrils at the disk. Pileus margin plicate-striate, spore-print white, basidiospores thick walled, dextrinoid, metachromatic, with a distinct germ pore. All the characters are similar to that of the *L.brebissonii* (Godey) as described by [20]. This species has been reported for the first time in India.

In conclusion four species of *Leucocoprinus* was recorded in Bengaluru June 2006 - November 2010, *L.fragilissimus* was consistent in its occurrence, where as

L.brebissonii is a rare species in the study area. The maximum number of species of *Leucocoprinus* was recorded in the year 2007, their occurrence frequency decreased year after year this is due to the solid waste especially the non biodegradable plastic disposal, also due to the pollution caused by vehicles in the study area. Hence necessary action has to be taken in order to conserve the biodiversity of mushrooms in and around Bengaluru district of Karnataka, India.

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