
Additions to the genus *Leucoagaricus* from Kerala state, India

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Description of eight taxa of the genus *Leucoagaricus* viz., *L. melanotrichus* (Malence. & Bert.) Trimb., *L. melanotrichus* (Malence. & Bert.) Trimb. var. *fuligineobrunneus* Bon & Boiff., *L. melanotrichus* var., *septentrionalis* Reid, *L. pulverulentus* (Huijism.) Bon, *L. rubrotinctus* (Peck) Sing., *L. sublittoralis* (Kuhner ex Hora) Sing. and *L. sulphurellus* (Pegler) Akers and *L. tener* (Orton) Bon, are given based on collections from Western Ghats of Kerala. All the taxa except for *L. rubrotinctus* are reported for the first time from India. *L. rubrotinctus* is a new record for Kerala.

Key words: Mushrooms, systematics

INTRODUCTION

The genus *Leucoagaricus* is intermediate between *Macrolepiota* and *Leucocoprinus*. Most species entering the genus are either little known or not known at all from India even a very few years ago. As part of a long term investigation in to the mushroom flora of Western Ghats of Kerala, several interesting collections belonging to the genus *Leucoagaricus* have been made. Six species and two varieties of them are illustrated and described for their macroscopic and microscopic details.

MATERIALS AND METHODS

Macroscopic observations were based on fresh collections made by the authors. For microscopic study, free hand sections were mounted in 3% KOH solution stained with 1% cresyle blue, 1% congo red or melzer's reagent. Colour names were in accordance with Methuen (Kornerup and Wanscher, 1967). Specimens were deposited in the mycological herbarium of TBGRI (TBGT).

OBSERVATIONS

***Leucoagaricus melanotrichus* (Malenc. & Bert.) Trimb., *Docum. Mycol.* 5, 42, 1975.** (Fig. 1, A-E & Fig. 9A)

Pileus 1.8-2.5 cm diam., convex with an obtuse umbo; surface 'teak brown' (6F5), 'brown' (6E5), 'grey' (2F1) or 'raw sienna' (6D7) at the disc, which is smooth, sometimes granular, disrupting to form minute appressed 'gray' (2C1) to 'cinnamon' (6D6) squamules, paler towards the margin, dry; margin straight, entire, non-striate, sometimes becoming red on bruising. *Lamellae* free, creamy white, up to 2 mm, close with lamellulae of different lengths; edge concolourous to the sides, entire. *Stipe* 3-5 cm × 2.5-4 mm, central, cylindrical, often compressed, equal with a broad base; surface white turning yellow then dull red to brown on handling, smooth. *Annulus* superior, white, membranous, evanescent. *Context* white, thin, up to 1 mm, composed of thin walled, hyaline, interwoven hyphae, inflated to 23.2 μm. *Spore print* white. *Spores* 5.5-6.6 × 3.8-4.4 μm, Q = 1.53, ellipsoid with a round apex lacking a germ pore, hyaline, thick-walled, smooth, dextrinoid, metachromatic. *Basidia* 15.4-22 × 7.7-8.8 μm, clavate, 4-spored, sterigma up to 3.8 μm long. Lamella-edge sterile. *Cheilocystidia* 21-48 × 4.4-10 μm, clavate to elongate-clavate with an obtuse apex, thin-walled, hyaline. *Pleurocystidia* none. *Hymenophoral trama* regular, composed of thin-walled, hyaline hyphae, inflated to 20 μm. *Subhymenium* pseudoparenchymatous. *Pileal cuticle* a disrupted epicutis, composed of 2.2-6.6 μm wide hyphae with irregularly arranged, cylindrical,

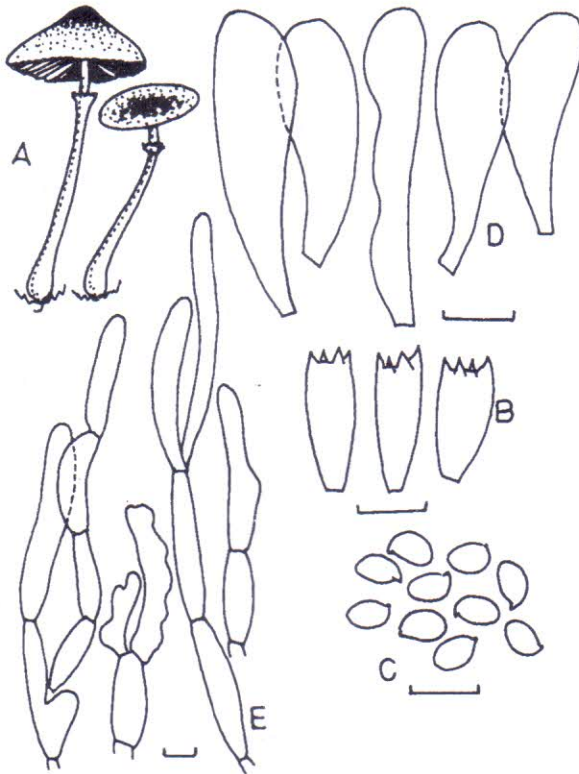


Fig. 1. A-E. *L. melanotrichus* A. habit x1; B. basidia; C. spores; D. cheilocystidia; E. pileal elements.

septate intertwined hyphae, sometimes with a greyish-yellow pigment, apical elements $14.4-40 \times 2.5-8.8 \mu\text{m}$, not inflated. *Stipe cuticle* composed of parallel arranged thin-walled, hyaline, $3.3-13.5 \mu\text{m}$ wide hyphae. *Caulocystidia* absent. All hyphae lacking clamp-connections.

Habit and habitat: Solitary on soil

Specimens examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: 20 June 1996, No. 3324; Kollam District, Thenmala: 17 July 2003, No. 6157; Thiruvananthapuram District, TBGRI campus: Arboretum, 6 Aug 2003, No. 6427; No. 6443. *Leucoagaricus melanotrichus* was originally described by Malencon & Bertault (1970) from Morocco as *Lepiota melanotricha* Malenc. & Bert. *Leucoagaricus melanotrichus* (Malenc. & Bert.) Trimb. resembles *Leucocoprinus heinemannii* Migl. (Magliozzi *et al*, 1989a) in gross morphology and habitat, but differs microscopically. *L. heinemannii* has a sulcate-striate pileal margin, whereas the pileus is not striate in *Leucoagaricus melanotrichus*. The above description closely matches with that of Reid (1995). *L. melanotrichus* has been reported from Spain (Moreno, Manjon & Zugaza, 1986),

Sardinia (Candusso & Lanzoni, 1990), France (Trimback, 1975), Netherlands (Kuyper & Schreurs, 1983; Vellinga, 2001), Hungary and Finland (Babos, 1985).

***Leucoagaricus melanotrichus* (Malenc. & Bert.) Trimbach var. *fuligineobrunneus* Bon & Boiff. *Docum. Mycol.* 8(29) 33, 1978. (Fig. 2, A-E)**

Pileus 1-2 cm diam., convex becoming applanate with a broad obtuse umbo; surface 'mouse grey' (5E3), 'metal grey' (5E2) or 'brownish grey' (4D2) at the disc with 'dust' (5D2), 'marble white' (5B2) or 'birch grey' (5C2) appressed squamules, paler towards the margin; margin straight, entire to incised, non-striate. *Lamellae* free, up to 2 mm creamy white, crowded with lamellulae of many lengths; edge concolourous to the sides, entire. *Stipe* 1.5-3.5 cm \times 2-6 mm, central, cylindrical, hollow, equal or tapering upwards from a clavate base; surface white turning yellow then brown on handling, smooth and glabrous. *Annulus* superior, ascending, white, evanescent. Odour not characteristic. *Context*

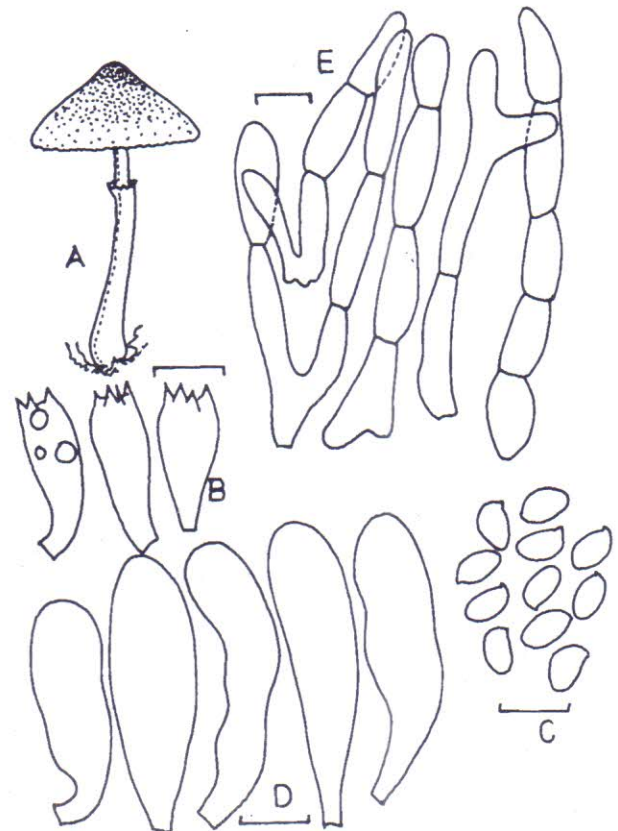


Fig. 2. A-E. *L. melanotrichus* var. *fuligineobrunneus*. A. habit x1; B. basidia; C. spores; D. cheilocystidia; E. pileal elements.

white up to 1 mm thick at the disc, composed of thin-walled, hyaline 3.3-3.7 μm wide hyphae. *Spore print* white. *Spores* 6.6-7.7 (8.5) \times 3.8-4.6 (5) μm , $Q = 1.65$, ellipsoid without a germ pore, thick-walled, smooth, hyaline, weakly dextrinoid, metachromatic. *Basidia* 18.7-25.5 \times 7.7-9.5 μm , clavate, 4-spored. Lamella-edge sterile. *Cheilocystidia* in tufts 21-45.5 \times 7.7-12 μm , clavate to elongate-clavate with an obtuse apex, thin-walled, hyaline. *Pleurocystidia* absent. *Hymenophoral trama* regular, composed of thin-walled, hyaline hyphae, inflated to 17.6 μm . *Subhymenium* pseudoparenchymatous. *Pileipellis*, a disrupted epicutis composed of thin-walled, hyaline, 3.3-12 μm wide hyphae with erect, sub-erect to adnate cylindrical elements, apical elements 16.5-60 \times 5.5-9.5 μm with obtuse or acute apex, thin-walled, mostly with a greyish brown intracellular pigment. *Stipitipellis* a narrow cutis, consisting of 3.3-38 μm wide hyphae thin-walled, hyaline. *Caulocystidia* absent. All hyphae lacking clamp-connections.

Habit and habitat : Solitary or scattered on soil.

Specimens examined : India, Kerala State : Thiruvananthapuram District, TBGRI campus: Palmatum, 19 Apr. 1996, No. 2924; Bamboosetum, 11 Nov. 2003, No. 6959; Palmatum, 11 Aug. 2004, No. 7719; 22 Nov. 2004, No. 8508; Agasthyamala project area, 16 June 2005, No. 8977.

The species was originally described by Bon & Boiffard (1978). It is widely distributed in Western France (Bon, 1978), Northern France (Bon, 1988) and Netherlands (Bas, 1991; Vellinga, 2001). *Leucoagaricus melanotrichus* var. *fuligineobrunneus* differs from *L. melanotrichus* var. *melanotrichus* in having smaller basidiome and larger basidiospores. Smaller fruit body, metal grey to brownish grey scales on the pileus and the reddening of stipe on bruising characterize this variety.

***Leucoagaricus melanotrichus* var. *septentrionalis* Reid, Mycotaxon, 53: 325-336 1995 (Fig. 3, A-E & Fig. 9B)**

Pileus 1-1.5 cm diam., convex becoming applanate with a broad obtuse umbo; surface 'dust' (5D2) or 'grey' (6D1/7F1) at the disc, paler towards the margin, with concolourous appressed squamules, arranged on a white background, dry; margin

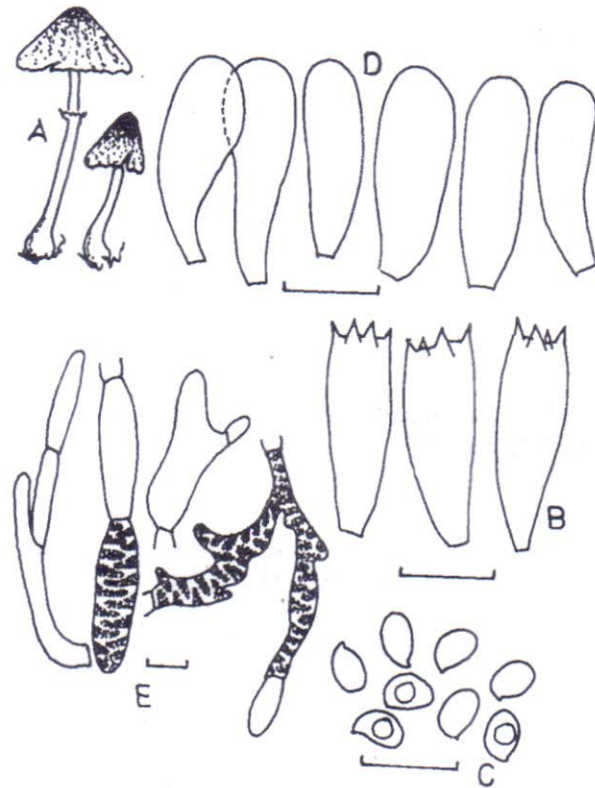


Fig. 3. A-E. *L. melanotrichus* var. *septentrionalis*. A. habit x 1; B. basidia; C. spores; D. cheilocystidia; E. pileal elements.

straight, entire, smooth; cap turning orange-red on bruising. *Lamellae* free, creamy white, on bruising reddish-orange, often without colour change, up to 2 mm, crowded with lamellulae of different lengths; edge concolourous to the sides, entire. *Stipe* 2-4 cm \times 1-2 mm, central, cylindrical hollow, equal or narrowly tapering up; surface off white, becoming red on bruising, appressed squamulose; stipe base with white mycelial codons. *Annulus* superior, ascending, white, evanescent. Odour agreeable. *Context* thin, up to 1 mm thick at the disc, white turning orange-red on bruising, composed of thin-walled, hyaline, 3.3-8.8 μm wide hyphae. *Spore print* white. *Spores* 5.5-6 \times 3.3-3.8 μm , $Q = 1.6$, ovo-ellipsoid, ellipsoid to sub-amygdaliform without a germ pore, smooth, hyaline with refractive guttule, dextrinoid, metachromatic. *Basidia* 16.5-25.7 \times 5.5-8.5 μm , clavate, 2-4 spored. Lamella-edge sterile with abundant cheilocystidia. *Cheilocystidia* 14.3-30.8 \times 5.5-11 μm , clavate to elongate-clavate with obtuse apex, thin-walled, hyaline. *Pleurocystidia* absent. *Hymenophoral trama* regular composed of thin-walled, hyaline 3.3-12 μm wide hyphae. *Subhymenium* pseudoparenchymatous. *Pileal cuticle* composed of radially arranged thin-walled, hyaline hyphae forming short chains, terminal

elements usually cylindrical, sometimes slightly clavate, up to 8.8 μm wide, elements with a brown intracellular pigment and with spiral encrustations. *Stipitipellis* a narrow cutis of thin-walled hyaline 2.2-7.7 μm wide hyphae, inflated to 17.6 μm , intermixed with tangled mass of cylindrical hyphae. All hyphae lacking clamp-connections.

Habit and habitat: Solitary on soil among leaf litter or in groups on soil.

Specimens examined: INDIA, KERALA STATE: Thiruvananthapuram District, TBGRI campus: FRLHT area, 23 July 1996, No. 3431; 30 July 1996, No. 3456; 31 July 1996, No. 3469; 5 Aug. 1996, No. 3486; Bamboosetum, 3 July 2003, No. 5948; Thannimoodu: 31 May 2006, No. 9693.

Reid (1995) created a new variety of *Leucoagaricus melanotrichus* viz, *Leucoagaricus melanotrichus* var. *septentrionalis* based on the size and shape of spores. Var. *septentrionalis* has smaller spores than viz. *L. nulanotrichus* var. *melanotrichus* and var. *fuligineobrunneus* Bon & Boiff. which are amygdaliform in shape. The above material closely matches with Reid's description in all aspects except for the slightly smaller cheilocystidia. Macroscopically it differs from the other two varieties in the smaller size of the fruit body.

***Leucoagaricus pulverulentus* (Huijism.) Bon, Documents Mycologiques VIII, n^o, 30, p.70. 1978.** (Fig. 4, A-E & Fig. 9C)

Pileus 0.5-1.4 cm diam., convex becoming plano-convex and finally applanate with an obtuse or acute umbo; surface pure white, sometimes with 'topaz' (5CS), 'brownish orange' (6C3), 'birch bark' (6B2), 'yellowish white' (4A2) or 'greyish orange' (6B4) centre, entirely covered with pure white agglutinated floccose squamules, soon vanishing on handling, dry; margin straight, non-striate, appendiculate. *Lamellae* free, up to 2 mm, white turning 'greyish orange' (6B4), or 'red-haired' (6C4), close with lamellulae of many lengths; edge concolourous to the sides, entire. *Stipe* 1-1.8 cm \times 0.5-1 mm, central, cylindrical, hollow, equal; surface white becoming 'brownish orange' (6C3), 'Cafe-au-lait' (6D3) or 'camel' (6D4) on handling, entirely covered with white evanescent floccose squamules. *Annulus* none. *Context* thin, up to 1 mm, white, unchanging, composed of thin walled hyaline hyphae inflated to

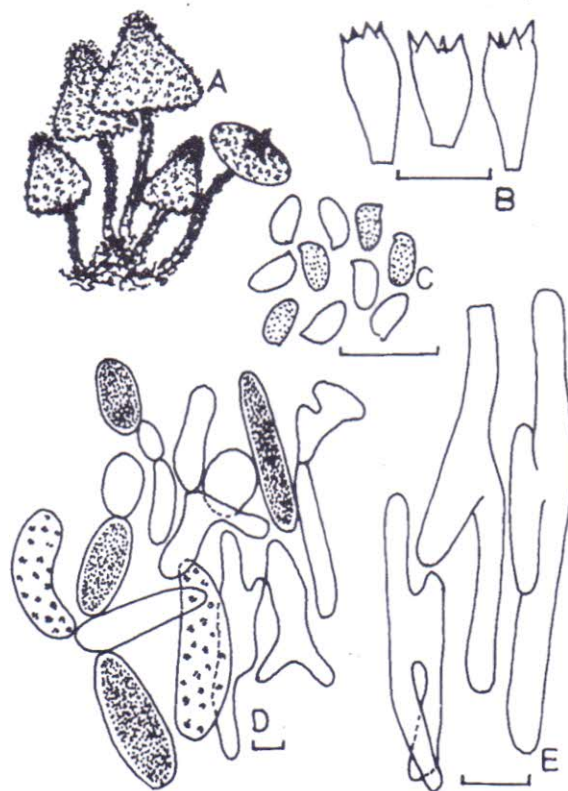


Fig. 4. A-E. *L. pulverulentus*. A. habit \times 1; B. basidia; C. spores; D. elements of pilei [pellis]; E. elements from the stipe cuticle.

23.2 μm . Spore print white. Spore 4.4-5.5 \times 2.2-3.3 μm . Q = 1.8. ellipsoid, without a germ pore, thin-walled with very fine ornamentation, visible only under a high power lens, not dextrinoid, metachromatic. Basidia 12.2-15.8 \times 4.4-6.5 μm , clavate, 4-spored, sterigma up to 3.8 μm long. Cheilocystidia and Pleurocystidia none. Hymenophoral trama regular, consisting of thin-walled, hyaline, 2.2-20 μm wide hyphae. Subhymenium pseudoparenchymatous. Pileipellis, an epicutis, composed of 3-11.6 μm wide hyphae, overtopped by loosely arranged detrusile elements 34.8-61 \times 7.25-23 μm , versiform, varying from ovate, clavate, cylindrical or bone shaped, sometimes with a yellow vacuolar pigment inside. Stipitipellis, a narrow cutis of thin-walled, hyaline hyphae, inflated to 14.3 μm ; scale cells abundant on the surface, elements, 27.5-51.7 \times 4.4-10 μm , versiform, cylindrical, H-shaped or bone shaped, thin-walled. All hyphae lacking clamp-connections.

Habit and habitat: Solitary or in tufts on mud wall or on soil; in large groups on decayed litter on the roof of a hut.

Specimens examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: Bamboosetum, 27 Oct. 2005, No. 9378; Central nursery, 2 Nov. 2005, No. 9410; DBT area: 11 Nov. 2005, No. 9505; Central nursery: 15 Nov. 2005; No. 9518; DBT area, 16 Nov. 2005, No. 9530; 22 Nov. 2005, No. 9560. Agasthyamala project area, 25 July 2006. No. 2251; Palmatum, 12 Oct. 2006, No. 2584; 17 Nov. 2006, No. 3316.

Bon (1978) transferred *Lepiota pulverulenta* Huijsman to the genus *Leucoagaricus* on account of the metachromatic reaction of the spores in Cresyle blue, the shape of the velar elements on the pileus and the absence of clamp-connections. He placed it in *Leucoagaricus* sect. *Pulverulenti* M. Bon. Later in 1989 Bon *et al.* recognized two forms namely *L. pulverulentus* (Huijsm) Bon f. *pulverulentus* and *L. pulverulentus* (Huijsm) Bon f. *minimus*, based on the size of the fruit body. Materials from Kerala agree in all respects with *L. Pulverulentus* (Huijsm.) Bon f. *minimus*. Vellinga (1992) placed this species in the genus *Cystolepiota* on account of the structure of the universal veil and the size, shape and chemical reaction of the spores. But considering the metachromatism of the spores, we prefer to follow Bas.

Caespitose habit, small basidiomè, pure white agglutinated floccose evanescent squamules, gill-edge without cheilocystidia and the small ellipsoid spores with fine ornamentations are the distinguishing characters of the species. The species is reported from Rome (Miggliozzi *et al.*, 1989b) and Europe (Candusso & Lanzoni, 1990).

***Leucoagaricus rubrotinctus* (Peck) Singer, *Sydowia* 2: 36 (1948). Fig. 5, A-F & Fig. 9D)**

Pileus 0.8-5.5 cm diam., convex becoming plano-convex, then appanate and finally uplifted, with or without an umbo, sometimes with a shallow depression at the centre; surface 'flame red' (7A8), 'tomato red' (8C8), 'cuba' (9E8), 'strawberry' (10D8), or 'violet brown' (10E8) at the disc, elsewhere 'pastel red' (7A5), 'reddish orange' (7A7/7B7/7B8) or 'shell pink' (8A3), paler towards the margin, smooth at the disc, disrupting elsewhere into appressed fibrillose squamules, dry; margin straight, becoming uplifted, exceeding the lamellae, entire to incised, appearing striate when the cuticle is peeled off. *Lamellae* free, creamy white, up to 4 mm, ventricose, crowded with lamellulae of many

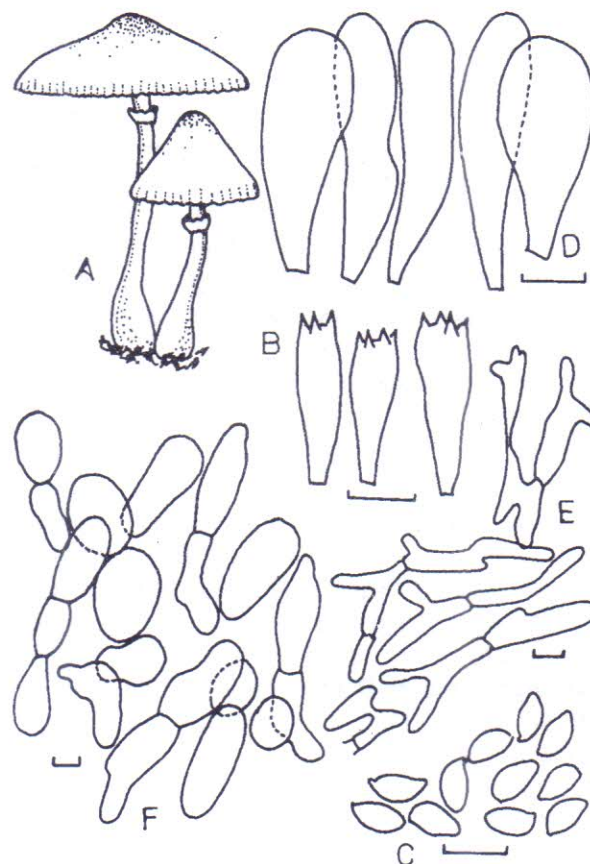


Fig. 5. A-F. *L. rubrotinctus*. A. habit x 1; B. basidia; C. spores; D. Cheilocystidia; E. elements of pileipellis; F. elements of sub-pellis.

lengths; edge concolourous to the sides, entire. *Stipe* 3.8-7.5 x 2-12 mm, central, cylindric, equal or narrowly tapering upwards from a clavate to clavate-bulbous base, hollow, surface creamy white turning yellowish, dry, smooth and glabrous. *Annulus* superior, rarely central, ring-like, white with a reddish-brown rim, evanescent. *Odour* not characteristic. *Context* white, up to 3.5 mm, unchanging, composed of thin-walled, hyaline hyphae inflated to 32 μ m. *Spore print* white. *Spores* (6) 6.6-8.8 (10) x (3.3) 3.8-4.6 μ m. Q = 1.78, ellipsoid to amygdaliform, mostly with a papillate apex, usually without a germ pore, but often with an inconspicuous germ pore, hyaline, smooth with a thick complex wall, dextrinoid, metachromatic. *Besidia* 22-28.6 x 5.5-9 μ m, clavate to elongate-clavate, 4-spored. *Lamella-edge* sterile. *Cheilocystidia* 22-44.5 x 8.8-16 μ m, clavate to elongate-clavate with an obtuse apex, hyaline. *Pleurocystidia* none. *Hymenophoral trama* regular composed of thin-walled hyaline hyphae inflated to 23 μ m. *Subhymenium* pseudoparenchymatous. *Pileipellis*, an interrupted epicutis with erect to sub-

erect closely septate, cylindric, irregularly branched elements, 6-26.4 μm wide, mostly with spiral bands of thickening. Sub-pellis composed of versiform elements, 17.6-98.6 \times 17.4-40.6 μm , globose, clavate, elongate-clavate to cylindric, thin-walled, hyaline. *Stipitipellis* a narrow cutis of thin-walled, hyaline hyphae, inflated to 32 μm , mostly with inconspicuous bands of thickening. *Caulocystidia* absent. All hyphae lacking clamp-connections.

Habit and habitat: Solitary or scattered in groups on soil.

Specimens examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: FRLHT area, 10 June 1996, No. 3165; 12 June 1996, No. 3201; 17 June 1996, No. 3259; 21 June 1996, No. 3337; Idukki District, Munnar: Aruvikkadu tea estate, 30 June 1998; No. 4331; Thiruvananthapuram District, TBGRI campus: 6 May 1999, No. 4648; 11 Oct. 1999, No. 4828; Kollam District, Achenkovil: 17 June 2004, No. 7281; Thiruvananthapuram District, TBGRI campus: FRLHT area, 26 July 2006, No. 9859.

This attractive species is characterized by the bright red cap, clavate-bulbous stipe base and relatively larger spores. It is reported from North America (Murrill, 1918), Trinidad (Dennis, 1952), and Venezuela (Dennis, 1970; as *Lepiota*). Yang (2000) reported this species from Vietnam. According to Murrill (1918) it more frequently occurs in the United States and the spores as well as the sporophore show considerable variations. A remarkable feature of the Trinidad material is the presence of minute granules in the tramal hyphae, which dissolve in Melzer's reagent (Dennis, 1952). No such granules were observed in the present collection.

***Leucoagaricus sublittoralis* (Kuhner ex Hora) Sing., Beih. Nova Hedwigia 29:163. 1969.** (Fig. 6, A-E & Fig. 9E)

Pileus 2-2.2 cm diam., convex becoming plano-convex to applanate, sometimes with a small umbo; surface 'brownish orange' (6C8) or 'raw sienna' (6D7) at the centre paler towards the margin, with concolourous fine appressed radially fibrillose squamules, smooth at the disc, disrupting towards the margin; margin exceeding the lamellae, straight becoming uplifted with age, entire to incised. *Lamellae* free, creamy white up to 2 mm, ventricose, crowded with lamellulae of many lengths; edge

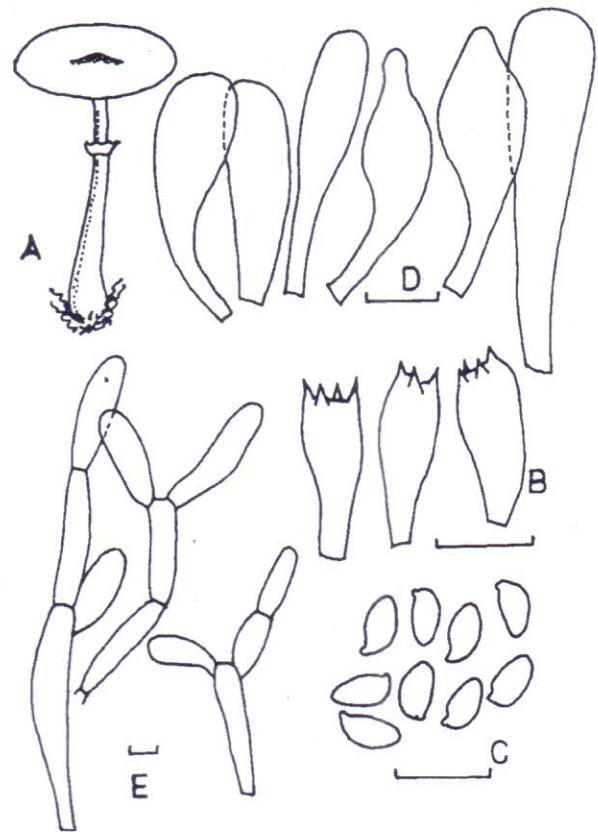


Fig. 6. A-E. *L. sublittoralis*. A. habit \times 1; B. basidia; C. spores; D. cheilocystidia; E. pileal elements.

concolourous to the sides, entire. *Stipe* 2.8-4.2 cm \times 3-4 mm, central, cylindric, equal with a broad base or narrowly tapering upwards from a sub bulbous base, up to 6 mm wide at the base, stuffed; surface white, sometimes slightly brownish at the base, unchanging on bruising, dry, brittle, smooth or with fine appressed fibrils on the surface, with white mycelial codons. *Annulus* superior, central or inferior, white with an orange-brown rim, ascending. Odour not characteristic. *Context* thin, up to 1 mm thick at the disc, unchanging, composed of thin-walled hyaline 5.5-18.7 μm wide hyphae. *Spore print* white. *Spores* 5.5-7 \times 3.2-3.8 μm , Q = 1.7, ellipsoid to amygdaliform, without a germ pore, often with an apical papilla, smooth, hyaline with one or two refractive guttule, dextrinoid, metachromatic. *Basidia* 13.4-20 \times 5.5-7.7 μm , clavate, 4-spored. Lamella-edge sterile with crowded cheilocystidia. *Cheilocystidia* 17.6-54 \times 6.6-13.6 μm , clavate, elongate-clavate or inflated clavate, with obtuse apex or with a small apical projection, thin-walled, hyaline. *Pleurocystidia* none. *Hymenophoral trama* regular, composed of thin-walled, hyaline 4-7 μm wide hyphae, inflated to 21 μm .

Subhymenium pseudoparenchymatous. *Pileipellis*, a disrupted epicutis of radially arranged 3-11 μm wide hyphae, interrupted by erect to sub-erect, septate, branched, cylindrical elements, apical elements 24-101.5 \times 5.8-29 μm , sometimes inflated, thin-walled, hyaline. Oleiferous hyphae present on the pileipellis. *stipitipellis*, a narrow cutis composed of parallelly arranged, thin-walled 6-34 μm wide hyphae. All hyphae lacking clamp-connections.

Habit and habitat: Solitary on soil or among decayed leaf litter.

Specimens examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: Arboretum, 5 Apr. 2005, No. 8539; DBT area. 21 Oct. 2005, No. 9336; Kollam District, Thenmala: 8 Nov. 2005, No. 9446.

Despite the smaller size of the spores, the above-described specimen closely agrees with the material from Netherlands described by Vellinga (2001). The spore size of the Nederland material is larger 6.5-10 \times 3.5-5 μm than those from Europe 6.7-7.2 \times 3.5-4.5 μm (Candusso & Lanzoni, 1990). South American material has spores in range 6.5-7.5 \times 4-4.5(5) μm (Singer, 1969). The above-described material has spores in the range 5.5-7 \times 3.3-3.8 μm , which is closer to the European material. Vellinga (2001) noted that cheilocystidia are often with crystals, any such crystals were not found in materials from Kerala. This was also not recorded by Singer or Candusso. *Leucoagaricus sublittoralis* can easily be distinguished from the field by the beautiful bright colour of the pileus, enlarged stipe base and the annulus with a brown rim. It is recorded from several European countries, Netherlands and southern Limburg (Vellinga, 2001).

***Leucoagaricus sulphurellus* (Pegler) Akers, Mycotaxon 76:39-50, 2000**
(Fig. 7, A-F & Fig. 9F)

Pileus 0.6-3.2 cm diam., parabolic in the bud, becoming conic, then convex and finally applanate with a more or less distinct umbo; surfaces uniformly 'sulphur yellow' (1A5), 'sun yellow' (2A5), 'linden green' (2C5), or 'wax yellow'

(3B5) often with 'ash grey' (1B2), 'greyish yellow' (1B5) or 'dark blonde' (5D4) centre, smooth, dry; margin straight, entire, non-striate or rarely weakly striate, turning dirty brown and then bluish-green on bruising. *Lamellae* free, up to 3 mm 'sulphur yellow' (1A5), 'prime rose yellow' (1A6) or 'pestel yellow' (2A4) turning dirty pinkish-brown and then bluish-green on bruising, sub-crowded with lamellulae of many lengths; edge concolourous to the sides, entire. *Stipe* 2-3.5 cm \times 2.5 mm, central, cylindrical, equal or tapering upwards from a clavate base, fistulose; surface concolourous to the pileus, sometimes with a grey colour at the base, turning dirty pinkish-brown and then bluish-green on bruising, dry, smooth and glabrous. *Annulus* superior, ascending, yellow, often with a grey rim, very thin, evanescent. *Context* thin, up to 2 mm, 'milk white' (1A2), or 'yellowish white' (2A2), composed of thin-walled, hyaline 5-22 μm wide hyphae. *Spores* 6-8.8 (10) \times 3.8-5 (5.5) μm , Q = 1.6, ellipsoid to amygdaliform, apically truncated by a small germ pore, hyaline, thick-walled, dextrinoid,

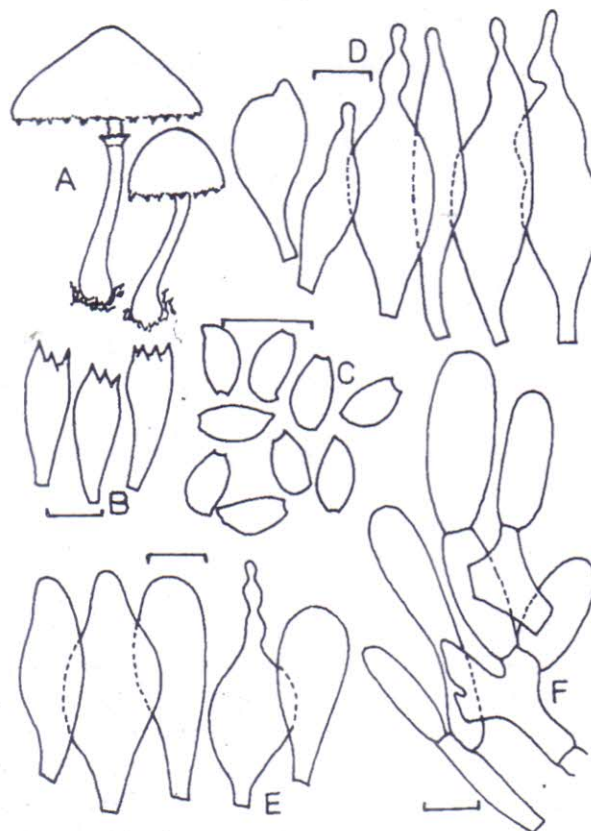


Fig. 7. A-F. *L. sulphurellus*. A. habit \times 1; B. basidia; C. spores; D. cheilocystidia; E. pleurocystidia; F. elements of pileipellis.

metachromatic. *Basidia* 19.8-27 × 6.6-9.2 μm, clavate, 4-spored, sterigma up to 4.4 μm long. Lamella-edge sterile with crowded cheilocystidia. *Cheilocystidia* 18.7-59.5 × 7.7-15.5 μm, clavate, elongate-clavate to lageniform, often with a pronounced mucronate apex, up to 20 μm long, thin-walled, hyaline. *Pleurocystidia* present, but not abundant, 27.5-44 × 10-17.4 μm, clavate to inflated clavate, often with a mucronate apex, up to 13.2 μm long, thin-walled, hyaline. *Hymenophoral trama* regular, composed of thin-walled, hyaline 3-6 μm wide hyphae, inflated to 23 μm. *Subhymenium pseudoparenchymatous*. *Pileipellis* a disrupted epicutis composed of 3.3-9 μm wide hyphae with tufts of erect to sub-erect, branched, septate, cylindrical elements, apical elements sometimes slightly inflated, measuring 18.7-45 × 4.5-11.6 μm, hyaline, thin walled. *Stipitipellis* a narrow cutis composed of thinwalled, Cylindric hyphae inflated to 24 μm. All hyphae lacking clamp-connections.

Habit and habitat: Solitary, scattered or in pairs on soil or among leaf litter.

Specimens examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: Medicinal garden, 24 June 2003, No. 5758; 18 July 2003, No. 6190; 5 Oct. 2004, No. 8119; Thannimoodu: 8 July 2005, No. 9069; TBGRI campus: DBT area, 21 Oct. 2005, No. 9334; Thannimoodu: 30 May 2006, No. 9672; 31 May 2006, No. 9686; TBGRI Campus: Palmatum, 2 June 2006, No. 1886; 19 Sept. 2006, No. 2432; 22 Sept. 2006, No. 2498.

This species is easily recognized in the field by the sulphur yellow pileus, which turns bluish-green on bruising. A unique feature of the species is the presence of pleurocystidia in the hymenium, even though it is usually absent in members of the tribe *Leucocoprineae*. Pegler (1983) described the species from Lesser Antilles as *Leucocoprinus sulphurellus* based on the porate spores and form of cheilocystidia. He noted the non-striate margin as an unusual feature for the species. But he did no mention anything about the presence of pseudoparaphysis in the hymenium. However Akers *et al.* (2000) placed this in the genus

Leucoagaricus due to its non-striate pileal margin and the presence of less abundant pseudoparaphysis. We follow Akers *et al.* (2000).

***Leucoagaricus tener* P.D. (Orton) M. Bon in *Doc. mycol.* 7(27-28): 54. 1977. (Fig. 8, A-G)**

Pileus 2.5 cm diam., applanate, sub-umbonate; surface 'violet brown' (10E5) at the disc, 'greyish red' (10D5) elsewhere and paler towards the margin with appressed squamules, smooth at the disc, disrupting towards the margin, cap turning red, then brown and finally blackish-brown on bruising, dry; margin straight, entire. *Lamellae* free, up to 1.5 mm, white, becoming red, then brown and finally blackish-brown on bruising, ventricose, crowded with lamellulae of different lengths; edge concolourous to the sides, entire. *Stipe* 4 cm × 3 mm, central, cylindrical, hollow, narrowly tapering upwards from a broad base; surface creamy white, becoming red, then brown and finally blackish-brown on handling,

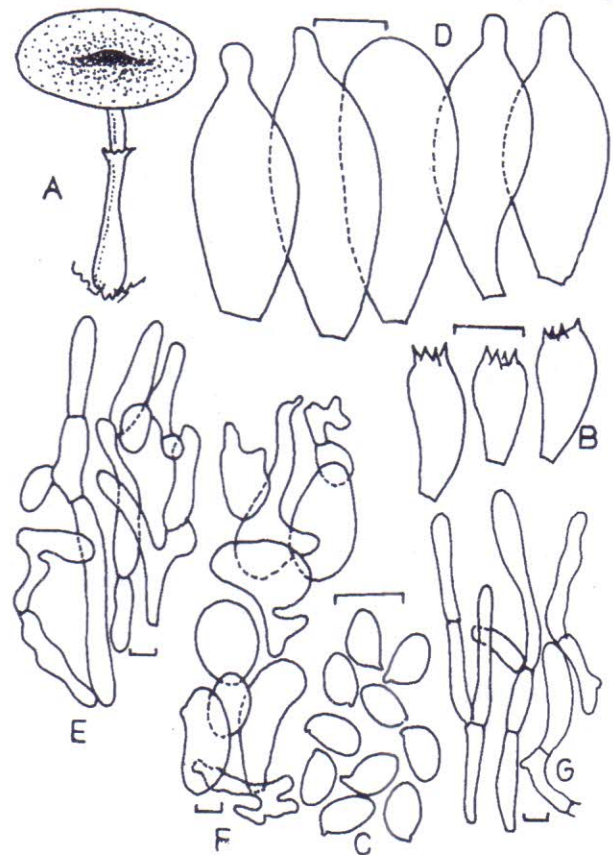


Fig. 8. A-G. *L. tener*. A. habit x 1; B. basidia; C. spores; D. cheilocystidia; E. elements of pileipellis; F. elements of sub-pellis; G. elements of Stipitipellis.



Fig. 9. A. *L. sulphurellus*; B. *L. sublittorales*; C. *L. melanotrichus* var *septantrionalis*; D. *L. rubrotinctus*; E. *L. pulverulentus*; and F. *L. melanotrichus*.

appressed squamulose. *Annulus* superior, ascending, white, evanescent. Odour not characteristic. *Context* up to 2 mm thick at the disc, white turning red, reddish-brown and finally blackish-brown on bruising, composed of thin-walled, hyaline, interwoven hyphae, inflated to 26 μm . *Spore print* white. *Spores* 5.5-6.6(7.7) \times (3.5) 3.8-4.4 mm, Q = 1.6, ellipsoid to sub-amygdaliform without a germ pore, occasionally with a very indistinct germ pore, smooth, hyaline with refractive guttule, dextrinoid, metachromatic. *Basidia* 16-23 \times 6.6-8.8 mm, clavate, 4 spored. Lamella-edge sterile with abundant cheilocystidia, 28.6-44.5 \times 12.19.8 mm, clavate to inflated clavate, mostly with a short apical appendage or with an obtuse apex, thin-walled, hyaline. *Pleurocystidia* absent. *Hymenophoral trama* regular composed of thin-walled, hyaline 5.5-20 μm wide hyphae. *Subhymenium* pseudoparenchymatous. *Pileipellis*, a disrupted epicutis with tufts of erect to sub-erect, closely septate, branched or unbranched, elements 18.5-101.5 \times 3-18.5 mm, thin-walled, hyaline or with a yellowish-brown pigment. Sub-pellis composed of versiform elements 29-111.8 \times 5.8-40.6 mm, thin-walled hyaline. *Stipitipellis* a narrow cutis of thin-walled, hyaline hyphae, inflated to 23.5 μm , often with spiral bands of thickenings, intermixed with cylindrical entangled mass of hyphae, apical elements 26-88 \times 3-13.5 μm , thin-walled, hyaline or with a yellowish brown intracellular pigment. All hyphae lacking clamp-connections.

Habit and habitat: Solitary on cow dung.

Specimen examined: India, Kerala State : Thiruvananthapuram District, TBGRI campus: Palmatum, 8 Oct. 2003, No. 6684.

The above description matches with the description of Reid (1995) from Eastern England. Material from Netherlands (Vellinga, 2001) differs from the European material in the larger spores and cylindrical cheilocystidia. According to Reid the species has varying forms of cheilocystidia (Reid, 1995). *L. melanotrichus* (Malenc. & Bert.) Trimb. (Reid, 1995) is a closely related species but differs in the colour of the fruit body and structure of cheilocystidia.

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