

Mycena conicoalba, a new corticolous species from Spain

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Key words: *Agaricales*, *Tricholomataceae*, *Mycena*, *Mycena conicoalba*. - Systematics, taxonomy. Mycoflora of Spain.

Abstract: *Mycena conicoalba* is proposed as a new species belonging to sect. *Supinae*, growing on bark of *Quercus ilex* subsp. *ballota*, in evergreen, Mediterranean forest. It differs from similar species especially by its caulo- and cheilocystidia as well as its characteristic habitat.

Zusammenfassung: *Mycena conicoalba*, die auf der Rinde von *Quercus ilex* subsp. *ballota* im immergrünen mediterranen Wald wächst, wird als neue Art der Sektion *Supinae* vorgeschlagen. Sie unterscheidet sich von ähnlichen Arten besonders durch ihre Kaulo- und Cheilozystiden sowie durch ihr charakteristisches Habitat.

Small, corticolous species of *Mycena* are quite common growing on bark of living *Quercus* spp. after heavy rainfall. This new species reminded of *Mycena alba* (BRES. apud SACC.) KÜHNER when collected, owing to its white basidiomata; however, microscopic features revealed that it belongs to a different section. The conical pileus seems to be characteristic in the new species, as well as its completely pruinose basidiomata.

Mycena conicoalba VILLARREAL & ESTEVE-RAV., spec. nova. Fig. 1.

Diagnosis latina:

Basidiomata parva, solitaria vel sparsa. Pileus usque ad 3 mm latus, conicus, interdum papilla minutus, sulcatus, leviter striatus, omne pruinosis, albus. Lamellae c. 10 stipitem attingentes, adscendentes, late adnatae, dente decurrentes, albae, margine convexo, concolore. Stipes 7-10 x 0,2-0,4 mm, cylindraceus, aequalis vel subincrassatus ad basim, fragilis, dense albo-puberulus, albidus, basi fibrillis instructus. Caro tenuis, alba, odore saporeque indistinctis.

Sporae 9-10,08-11 x (8-)8,28-9,57-10,50 µm, globosae vel subglobosae, laeves, amyloideae. Basidia 28-34 x 10-13 µm, clavata, 4-sporigera, fibulata, sterigmatibus usque ad 9 µm longis. Cheilocystidia 19-30(-37) x 6,5-15 µm, clavata vel subirregularia, surculis cylindraceis 1,5-3(-6) x 1-1,5 µm obtecta. Pleurocystidia absentia. Trama lamellarum iodi ope brunneovinescens. Hyphae pileipellis 1,5-3 µm latae, surculis usque ad c. 25 x 1-2 µm, cylindraceis, simplicibus vel ramosis. Hyphae stipis corticalis

2-3,5 µm latae, diverticulatae. Caulocystidia 28-50 x 6,5-12 µm, claviformia vel subclaviformia, diverticulatae, descendencia ad basim.

Arboricola, ad corticem *Quercus ilex* subsp. *ballota* (DESF.) SAMP.

Etymology: referring to the shape and colour of the pileus.

Holotypus: Spain: Toledo, La Iglesuela, UTM 30TUK525575, 17. 12. 1996, leg. F. ESTEVE-RAVENTÓS, C. SÁNCHEZ, J. N. CAMPOAMOR & M. VILLARREAL, AH 22242.

Characters:

Basidiomata single to scattered. Pileus up to 3 mm in diam., conical, with small apical papilla, sulcate, slightly translucent-striate, dry, pruinose to white-puberulous, completely white except the yellowish papilla, margin plicate and concolorous. Lamellae (L: 7-10; I: 0-1), well developed, ascending, adnate, frequently with decurrent tooth, white, edge convex and concolorous. Stipe 7-10 x 0.2-0.4 mm, cylindrical, subbulbose at the base, fragile, pruinose all over, densely pubescent or strigose by white fibrils at the point of attachment, without basal disc. Flesh very thin, white. Odour and taste indistinctive.

Spores 9-10.08-11 x (8-)8.28-9.57-10.50 µm; Q = 1-1.05-1.11 (n = 23), globose to subglobose, smooth, amyloid. Basidia 28-34 x 10-13 µm, clavate, to broadly clavate, 4-spored, with clamp connections (clamp connections usually inconspicuous), with sterigmata up to 9 µm long. Cheilocystidia 19-30(-37) x 6.5-15 µm, clavate, sometimes eventually constricted, densely covered with simple to branched excrescences, 1.5-3 (-6) x 1-1.5 µm. Lamellar edge homogeneous. Pleurocystidia absent. Hymenophoral trama regular, made up of cylindrical hyphae 4-17 µm, not gelatinized, strongly dextrinoid. Hyphae of the pileipellis 1.5-3 µm wide, covered with simple to furcate or branched excrescences up to 25 x 1-2 µm which tend to form dense coralloid masses. Hypoderm made up of interwoven hyphae up to 35 µm wide. Hyphae of the cortical layer of the stipe 2-3.5 µm wide, covered with more or less scattered cylindrical excrescences 1-3 x 0.9-1.2 µm. Caulocystidia 28-50 x 6.5-12 µm, clavate to narrowly clavate, sometimes irregularly shaped, densely diverticulate, usually thick-walled.

Habitat: on bark of living *Quercus ilex* subsp. *ballota* (DESF.) SAMP.

Collection examined: see holotypus.

Observations: Following the key to sect. *Supinae* KONR. & MAUBL. (MAAS GEESTERANUS 1984), *Mycena conicoalba* comes close to *M. supina* (FR.) KUMM., which can be distinguished by the different shape and colour of pileus and stipe, but above all, by the hyphae of the pileipellis, which do not form coralloid masses; another clear difference is the presence of caulocystidia all over the stipe in the new species. Recently discovered in Norway, *Mycena juniperina* ARONSEN (ARONSEN 1996), another member of this section, differs from *M. conicoalba* in the brown or yellowish pileus, beige to pale brown stipe, cheilocystidia covered with long and furcate excrescences and its peculiar habitat, living on bark of *Juniperus communis* L. *Mycena cupressina* ANTONÍN & MAAS G. (ANTONÍN & MAAS GEESTERANUS 1998) differs from *M. conicoalba* in the smooth hyphae of the stipitipellis and its habitat on bark of *Cupressus sempervirens* L. and *Arbutus unedo* L. In Asia, *Mycena umeae* IMAI is, ac-

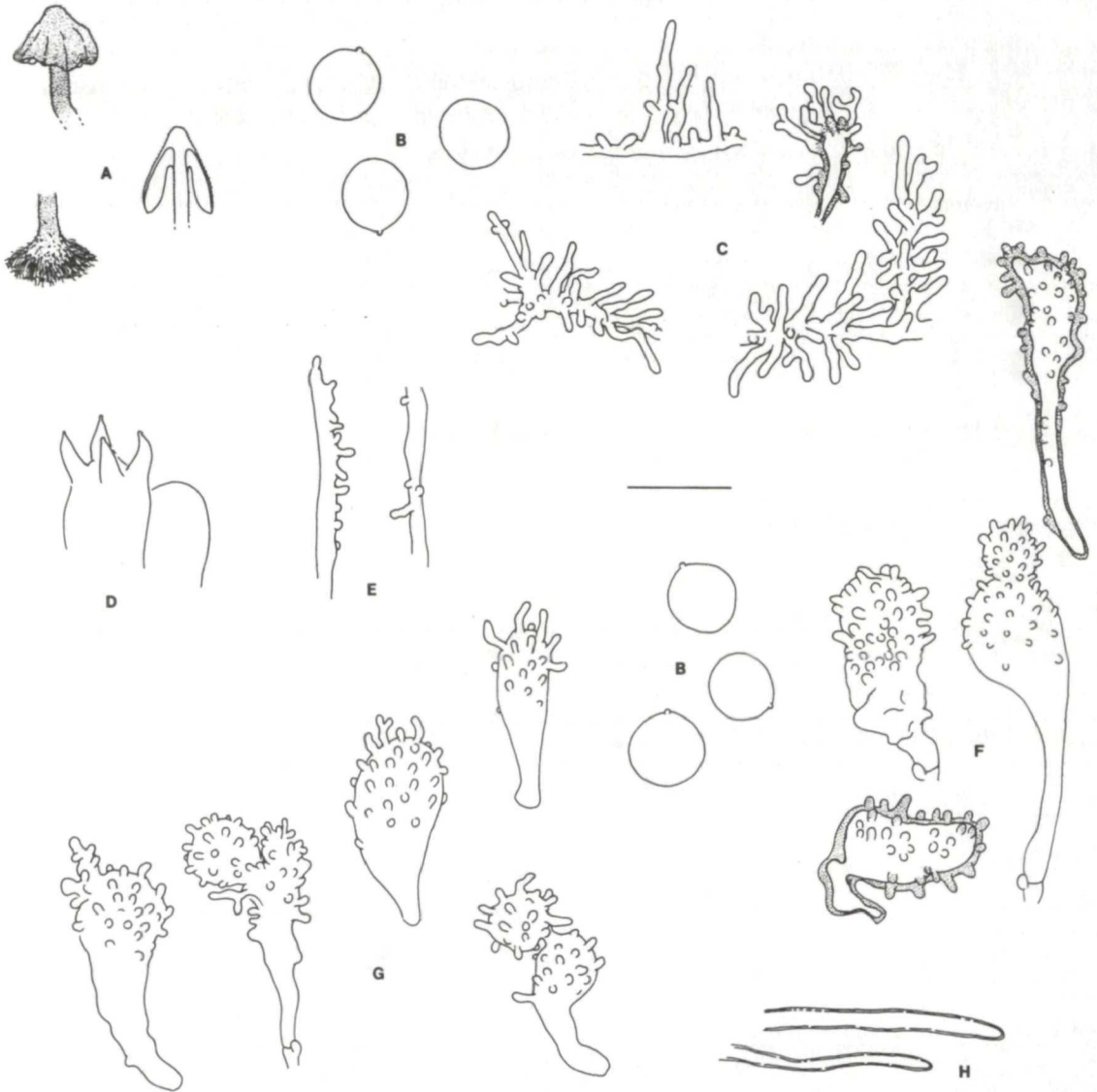


Fig. 1. *Mycena conicoalba*, holotype. A Pileus, section of pileus and detail of basal patch of the stipe. B Spores. C Hyphae of the pileipellis. D Basidium. E Hyphae of the stiptipellis. F Caulocystidia. G Cheilocystidia. H Hyphae of the basal patch of the stipe. Bar: 15 μ m.

ording to MAAS GEESTERANUS (1991) a possible member of sect. *Supinae*, with white pileus, but the very small spores ($4 \times 3 \mu\text{m}$) and growth on dead twigs clearly suggest that it is a different species. In South America, *Mycena yalensis* SINGER, described growing on living bark of *Alnus jorullensis* H. B. K. (SINGER 1973), shares the white colours and the completely pruinose basidiomata, but differs in its campanulate pileus, smaller spores ($6\text{-}7 \times 5.5\text{-}6 \mu\text{m}$) and short diverticulae of the pileipellis ($\text{-}1 \mu\text{m}$). After revision of the holotypus, DESJARDIN (1995) included this taxon in sect. *Sacchariferae* KÜHNER ex SINGER.

M. conicoalba was fruiting at the same time and location as *M. alba*, *M. meliigena* (BERK. & COOKE apud COOKE) SACC. and *Phaeomarasmium rimulincola* (RABENH.) P. D. ORTON.

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Lepiota and *Cystolepiota* (Agaricales) in Arctic-alpine habitats

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Key words: Arctic-alpine Agaricales, Basidiomycota, *Lepiota*, *Cystolepiota*. - Ecology, key.

Abstract: A search of the pertinent literature and collections made by the authors were brought together. As a result eight taxa of *Lepiota* and two taxa of *Cystolepiota*, respectively, are found to occur in Arctic and alpine habitats world-wide. Detailed descriptions and illustrations of specific microscopical characters are provided for *Lepiota alba*, *L. clypeolarioides*, *L. cortinarius* var. *dryadicola*, *L. favrei*, *L. aff. pilodes*, and *Cystolepiota sistrata*. Besides taxonomical and ecological remarks, a key to Arctic and alpine species of *Lepiota* and *Cystolepiota* is provided.

Zusammenfassung: Basierend auf Aufsammlungen der Autoren und Daten aus der Literatur werden die bisher weltweit aus arktisch-alpinen Habitaten bekannten *Lepiota* (8 spp.) und *Cystolepiota* (2 spp.) Arten vorgestellt. Arktisch-alpine Aufsammlungen von *Lepiota clypeolarioides*, *L. cortinarius* var. *dryadicola*, *L. favrei*, *L. aff. pilodes* und *Cystolepiota sistrata* werden ausführlich beschrieben und deren mikroskopische Differentialmerkmale abgebildet. Neben Hinweisen zur Ökologie und Taxonomie erleichtert ein Schlüssel die Bestimmung der arktisch-alpinen Arten von *Lepiota* und *Cystolepiota*.

Based upon personal observations and data taken from the literature (GUZMÁN & GUZMÁN-DÁVALOS 1992; HORAK 1980, unpubl. data), the centre of species diversity for the genera *Lepiota* (PERS.) S. F. GRAY and *Cystolepiota* (SINGER) SINGER & DIGILIO is situated in tropical and subtropical regions where those saprotrophic agarics play an important ecological role in natural ecosystems. The number of taxa distinctly decreases, however, towards temperate and boreal habitats (ENDERLE & KRIEGLSTEINER 1989, CANDUSSO & LANZONI 1990). Finally, the mostly delicate and ephemeral basidiomata of only few species belonging to the above-mentioned genera have adapted to the harsh ecological conditions in Arctic and alpine environments.

The first record relating to alpine *Lepiota* has been published by FAVRE (1955) who described two species associated with dwarf *Salix* and/or *Dryas* on base-rich localities in the Swiss National Park. Later, KÜHNER (1983) reported four species from alpine sites in the French Alps. To date, this publication furnishes the most comprehensive contribution towards taxonomy and ecology of alpine representatives of *Le-*

piota and *Cystolepiota*. In the following years numerous records relating to Arctic and alpine *Lepiota* and *Cystolepiota* have been published and are discussed below.

The present contribution is primarily based upon our personal observations of specimens collected on sites above the tree line in the Alps and in treeless vegetation types in the Arctic. These data are further supplemented with published records found in the relevant Arctic-alpine literature. As a result, we can herewith refer to eight *Lepiota* spp. and two *Cystolepiota* spp. described from this ecologically unique habitat. Dealing with those species it became evident that the taxonomy of several taxa is still in doubt. The macroscopical and microscopical characters of five species are presented. In addition, the ten Arctic-alpine taxa taken into consideration are keyed out.

Unfortunately, in many cases rather scant ecological information can be extracted from the original literature relating to Arctic-alpine records. However, in order to characterise the ecological parameters, all available data are scrutinised and listed.

The list of considered records indicates that *L. cortinarius* LANGE var. *dryadicola* (KÜHNER) M. BON and *L. favrei* KÜHNER ex M. BON are distinctly substrate-specific (on debris of *Dryas*, *Salix*, *Arctostaphylos*) and accordingly the two taxa are bound to Arctic-alpine habitats. All other species mentioned in this contribution have a much wider ecological range which extends from lowland to Arctic-alpine sites.

Methods

Microscopical examination was carried out with a Nikon Optiphot using 3% KOH as solvent for mounts of both fresh and dried specimens. All microscopical drawings were made with a camera lucida. The microscopical measurements are taken from video prints (Sony Miltuscan Videoprinter UP-930). Mature spores were measured using spore prints or samples taken from the stipe apex or pileipellis. Spore and cheilocystidia measurements are recorded as (minimum-) mean value \pm standard deviation (-maximum). The length of mature basidia does not include sterigmata. Sample size = n. The abbreviation Q is the ratio of spore length (measured without apiculus) versus spore width.

Key to Arctic-alpine species of *Lepiota* and *Cystolepiota*

- | | | |
|----|--|---|
| 1 | Pileipellis a trichoderm or hymeniderm (<i>Lepiota</i>) | 2 |
| 1* | Pileipellis exclusively consisting of sphaerocysts (<i>Cystolepiota</i>) | 9 |
| 2 | Basidiospores distinctly spurred | 3 |
| 2* | Basidiospores fusoid, ellipsoidal, or ovoid | 4 |
| 3 | Pileipellis a hymeniderm of clavate cells | 1. <i>L. cristata</i> |
| 3* | Pileipellis a palisade of erect cylindrical cells (up to 200 μ m long) | 2. <i>L. aff. pilodes</i> |
| 4 | Basidiospores fusoid | 5 |
| 4* | Basidiospores ellipsoidal or ovoid | 8 |
| 5 | Basidiospores 7-9 x 3-4 μ m | 3. <i>L. cortinarius</i> var. <i>dryadicola</i> |
| 5* | Basidiospores longer than 11 μ m | 6 |
| 6 | Pileus white or cream-coloured, only disc with yellow tinge | 4. <i>L. alba</i> |
| 6* | Pileus ochraceous, reddish brown or brown | 7 |

- 7 Pileus smooth or slightly fibrillose, ochraceous to pale reddish brown
 5. *L. oreadiformis*
- 7* Pileus with ochre scales (on white background), calotte compact
 6. *L. clypeolaria*
- 8 Pileus with pinkish brown to red-brown scales in contrast with the white background, sometimes with pale purple-red tinge; pileipellis cells up to 300 µm long
 7. *L. favrei*
- 8* Pileus with ferruginous brown scales, pinkish tinges absent; pileipellis cells up to 140 µm long
 8. *L. clypeolarioides*
- 9 Pileus white to cream-coloured, mealy to granulose; pileipellis composed of globose to ovoid, loose cells
 9. *C. sistrata*
- 9* Pileus (and stipe) uniformly covered with umber, woolly squamules on pale background; pileipellis composed of chains of cylindrical to globose cells
 10. *C. eriophora*

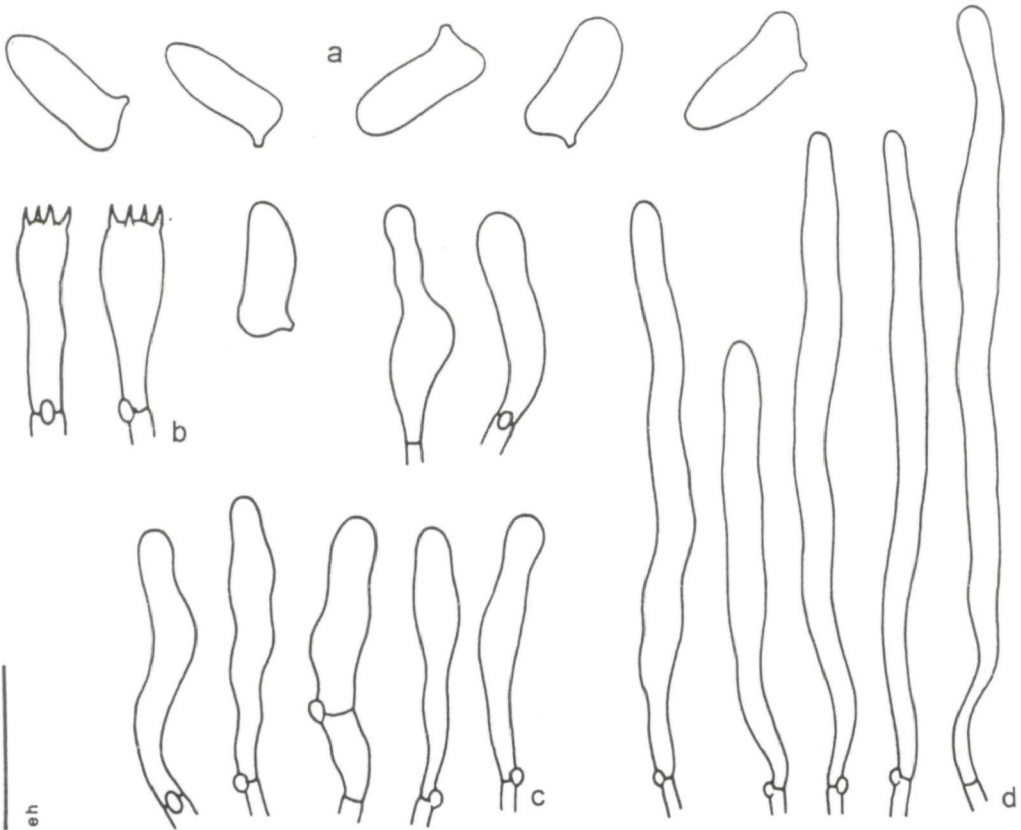


Fig. 1. *Lepiota* aff. *pilodes* (Siberian material, IB 96-774); a basidiospores. b basidia. c cheilocystidia. d pileipellis. Bar: a 5 µm, b, c 10 µm, d 20 µm.

Enumeration and descriptions of Arctic-alpine taxa of *Lepiota* and *Cystolepiota*

***Lepiota* (PERS. 1801) S. F. GRAY 1821.** Nat. Arr. Brit. Pl. 1: 601.

Type species: *Agaricus clypeolarius* BULL. 1789: FR. 1821. Syst. Mycol. 1: 21.

Lepiota clypeolaria (BULL.: FR.) P. KUMMER 1871. Führ. Pilzk., 137.

1. *Lepiota cristata* (BOLTON: FR.) P. KUMMER 1871. Führ. Pilzk., 137.

Bas.: *Agaricus cristatus* BOLTON 1788. Hist. Fung Halifax, 7.

Agaricus cristatus BOLTON: FR. 1821. Syst. Mycol. 1821: 21.

Syn.: *Lepiotula cristata* (BOLTON: FR.) LOCQUIN ex HORAK 1968. Beitr. Krypt. Fl. Schweiz 13: 338. Further synonyms in CANDUSSO & LANZONI (1990: 205).

Illustrations: CANDUSSO & LANZONI (1990: 20), SOCIEDAD CATALANA DE MICOLOGIA (1992-: 479); LANGE (1935: 12A); MOSER & JÜLICH (1985-: *Lepiota* 2).

Habitat and ecology: On acid (with *Salix herbacea* L.) and base-rich (with *Dryas octopetala* L.) soil, from sea level (New Hebrides) to 2200 m s. m. (Italy).

Material examined: None.

Arctic-alpine distribution: France: -1900 m s. m. (KÜHNER & LAMOURE 1986: 166). Italy: -2200 m s. m. (JAMONI 1995: 25). New Hebrides (WATLING 1988: 19). Scotland: -930 m s. m. (WATLING 1987: 39).

Notes: This morphologically distinctive taxon is rarely encountered in Arctic-alpine habitats. In the Alps, it has been recorded only twice viz. in France and Italy.

2. *Lepiota* aff. *pilodes* VELLINGA & HUIJSER 1993. Persoonia 15: 226.

Misapplied name: *L. tomentella* ss. CANDUSSO & LANZONI 1990. Fungi Eur. 4: 226-228.

Illustrations: Colour Fig. IV, Figs. 1, 2.

Habitat and ecology: On base-rich soil (limestone), among *Dryas* spec., *Salix reticulata* L., *Arctostaphylos* spec., 200 m s. m.

Description of the Siberian material:

Pileus: 20-25 mm, convex to plano convex, orange-brown to red-brown at centre (CAILLEUX 1981: P39) and paler towards the margin (CAIL.: L35), covered with radial fibrillose squamules showing the cream-coloured to whitish underlying context.

Lamellae: crowded, free, cream-coloured to ochraceous (CAIL.: M60-69), with concolorous flocculose edge.

Stipe: 20-30 x 2-2.5 mm, at apex cream-coloured to beige, otherwise reddish (CAIL.: M-N39), with adnate red-brown (CAIL.: R15, R17) fibrillose squamules.

Context: whitish in apex of stipe, elsewhere concolorous. Smell similar to *L. cristata* (BOLTON: FR.) KUMMER.

Basidiospores: in side view (7.2-) 8.7 ± 0.5 (-9.6) x (3.5-) 3.9 ± 0.2 (-4.3) μm , Q = (1.8-) 2.3 ± 0.2 (-2.6), V = (47-) 68 ± 9 (-93) μm^3 (n = 31), spurred, dextrinoid.

Basidia: 20-26 x 7-8 μm (n = 5), 4-spored, sometimes also 2-spored.

Cheilocystidia: (19-) 26 ± 3.5 (-35) x (4-) 7 ± 1.5 (-9.5) μm (n = 25), cylindrical, utriform, irregularly clavate, edges sterile. Pleurocystidia and Caulocystidia absent.

Pileipellis: a palisade composed of erect to prostrate cylindrical to slightly fusiform cells [40-200 x (9-) 13.5 ± 2 (-17) μm (n = 25)], with brown parietal (but also intracellular) pigment.

Clamp connections: present.

Material examined: **Russia:** Western Siberia, Jamal district, Polar Ural, Iangana, 67°43' N 67°50' E, 26. 8. 1996, leg. U. PEINTNER 96-774 (IB). *Lepiota pilodes* VELLINGA & HUIJSER: **The Netherlands:** Groensveld, Riesberg, 4. 10. 1989, leg. & det. E. C. VELLINGA, Rijksherbarium Leiden 1621.

Arctic-alpine distribution: Russia (see above).

Notes: The present collection resembles closely *Lepiota pilodes* (= *L. tomentella* ss. CANDUSSO & LANZONI 1990), but typical *L. pilodes* has broader, regularly cylindrical cheilocystidia (Fig. 2) with a diameter of 5-15(-18) μm , and a more slender habit.

Lepiota tomentella J. LANGE is another related taxon, that differs by septate pileipellis hyphae and narrower cheilocystidia. In addition, ZECCHIN & MIGLIOZZI (1996) emphasise that *L. tomentella* has longer and narrower pileipellis cells that reach $300 \times 16 \mu\text{m}$ [vs. $200(-240) \times 22(-24) \mu\text{m}$]. Furthermore, the basidiospores in *L. pilodes* are 10.5 μm long, instead of 9.3 (9.8) μm in the case of *L. tomentella*.

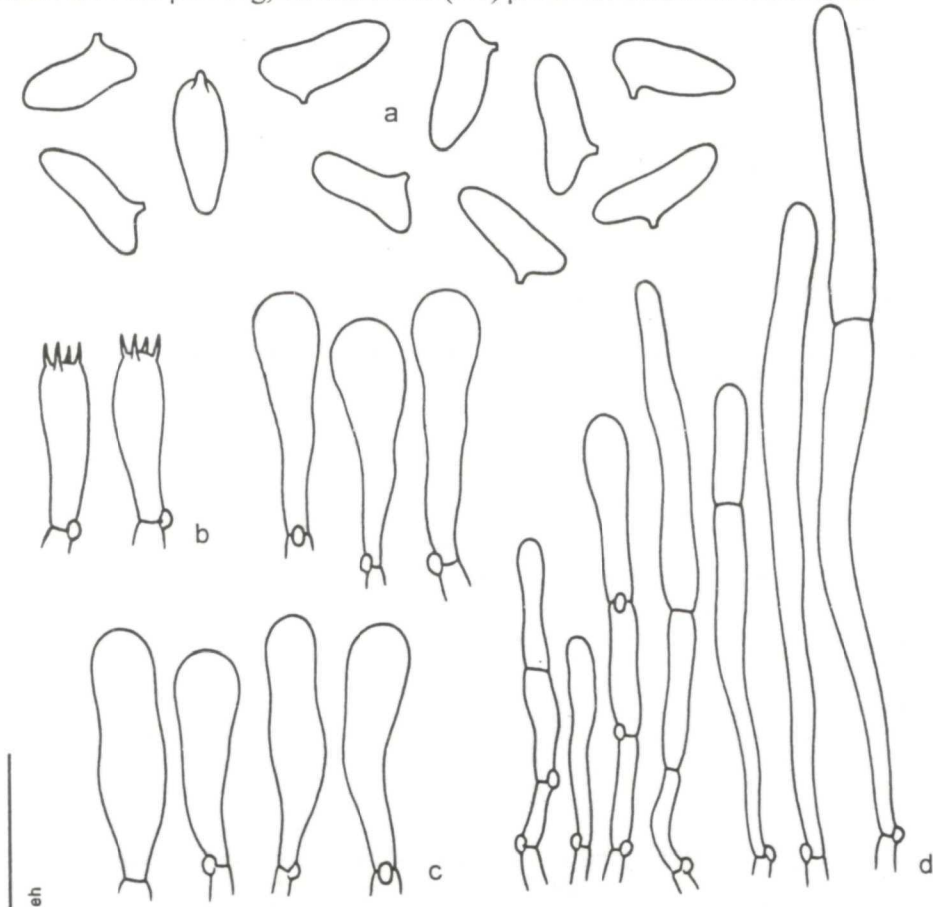


Fig. 2. *Lepiota pilodes* (authentic material, L 1621, VELLINGA). a basidiospores. b basidia. c cheilocystidia. d pileipellis. Bar: a 5 μm , b, c 10 μm , d 20 μm .

Lepiota pilodes differs from *L. boudieri* BRES. ss. VELLINGA & HUIJSER (1993), (syn. to *L. fulvella* REA) by the non-septate hyphae of the pileipellis, and the paler red-brown, radial fibrillose squamules in the centre of the pileus. BON (1994), however, considers *L. boudieri* and *L. fulvella* as distinctive species which can be separated by the length of the pileipellis cells being 40-70(-100) x 8-10 µm in *L. boudieri*, and 150 (-200) x 12-15(-25) µm in *L. fulvella*, respectively.

3. *Lepiota cortinarius* LANGE var. *dryadicola* (KÜHNER) M. BON 1994. Doc. Mycol. **23**: 48.

Bas.: *Lepiota dryadicola* KÜHNER 1983. Crypt. Mycol. **4**: 65.

Syn.: *Lepiota audreae* (D. REID 1968) M. BON var. *dryadicola* (KÜHNER) M. BON 1993b (ad int.). Doc. Mycol. Mém. Hors Sér. **3** (nom. inval.). Validation in BON (1994: 48).

Illustrations: MIGLIOZZI & BIZIO (1994: 37). PEINTNER (1998: 128). Fig. 3.

Habitat and ecology: On base-rich soil, among *Dryas octopetala*, *Salix reticulata*, *Arctostaphylos* spec. in alpine habitats (-2400 m s. m.), and in the Siberian Arctic tundra.

Description of the Siberian material:

Pileus: 40 mm diam., conical, surface disrupting into numerous, small granular scales of a red-brown colour on a whitish background; these scales are denser towards the centre and form a distinctive calotte on the disc; ground colour pale ochre with pink tinge (CAIL.: L-M69), colour of the velvety scales reddish brown (CAIL.: P37 - R37), margin at first involute, woolly, exceeding the gills.

Lamellae: free, dense, up to 5 mm wide, white, with 1-2 series of lamellulae, concolorous edges slightly dentate.

Stipe: 30 x 6 mm, cylindrical, with swollen base (-10 mm diam.), beige (CAIL.: L-M69), persistent annulus absent but the lower part of the stem is covered by remnants of the cortinous veil, forming reddish brown girdles.

Context: beige, soft.

Smell: acidulous, similar to *Fomitopsis pinicola* (FR.) P. KARST.

Basidiospores: (6.8-)8 ± 0.4(-9) x (2.9-)3.4 ± 0.2(-3.9) µm, Q = (2.2-)2.4 ± 0.2 (-2.75), V = (31-) 49 ± 5.5 (-71) µm³ (n = 50), fusiform with distinctive suprahilar depression, but not typically spurred (shape suggestive of basidiospores found in many taxa of *Boletus*), thin-walled, hyaline, weakly dextrinoid.

Basidia: (20-)22.8 ± 2.6(-28) x (5.9-)6.6 ± 0.8(-7.8) µm (n = 12), clavate with 4 sterigmata, with basal clamp connections.

Cheilocystidia: (24-)29.2 ± 3.5(-36) x (6.7-)9.7 ± 2.4(-15.7) µm, Q = (2-)3.1 ± 0.5(-3.8), n = 10, thin-walled, hyaline, varying in shape from narrowly clavate, broadly clavate, vesiculose to balloon shaped, with basal clamp connections. Pleurocystidia absent.

Pileipellis: consisting of elongated, repent, non-septate, thin-walled, brown or subhyaline cells, -260(320) x (8-)16.8 ± 4(-23.6) µm (n = 45), mostly cylindrical, with obtuse apices (8-)10.5 ± 2(-12) µm, only very few tapering toward the tip, with basal clamp connections. Pigment parietal.

Stipitipellis: of cylindrical, parallel hyphae (4-10 µm diam.). Clamp connections present.

Material examined: **France:** Savoie, Vanoise, Haute Vallée de Champagny, Lac de Glière, 2000 m s. m., exposition S, 14. 9. 1970, leg. R. KÜHNER K 70-141 (GC 2387-9, holotype!). **Russia:** Western Siberia, Jamal district, Polar Ural, Iangana, 67°43' N 67°50' E, 200 m s. m., Arctic tundra, 26. 8. 1996, leg. U. PEINTNER 96-773 (IB).

Arctic-alpine distribution: France (see above). Additional records: Vanoise -2350 m (KÜHNER 1983: 65, type; KÜHNER & LAMOURE 1986: 167). Italy: Dolomites, -2400 m (MIGLIOZZI & BIZIO 1994: 33). Russia (see above).

Notes: Based upon pertinent literature, *Lepiota cortinarius* var. *dryadicola* has been reported only two times from the Alps. The above described collection from the Arctic region in Russia is the first extralimital record. The ecological data indicate that this species occurs preferably in Dryadeta on calcareous soils.

The present taxon is readily recognised by its fusiform basidiospores with a supra-hilar depression.

Taxonomically, *Lepiota cortinarius* s. str. and *L. cortinarius* var. *audreae* D. REID are closely related to the Arctic-alpine variety, which, however, has smaller and more slender basidiomata and different colours.

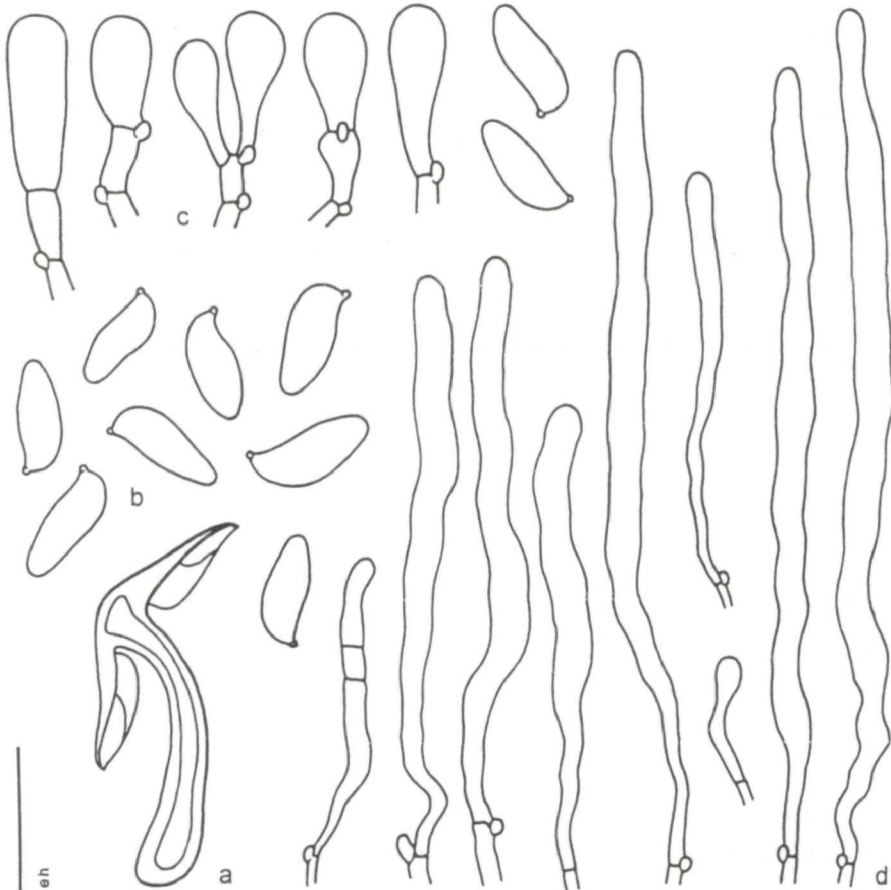


Fig. 3. *Lepiota cortinarius* var. *dryadicola* (GC, K 70-141, holotype); a basidiome. b basidiospores. c cheilocystidia. d pileipellis. Bar: a 20 mm, b 5 µm, c 10 µm, d 20 µm.

4. *Lepiota alba* (BRES.) SACC. 1887. Syll. Fung. 5: 37.Bas.: *Lepiota clypeolaria* var. *alba* BRES. 1882. Fung. Trid. 1: 15, t. 16, fig. 1.Illustrations: BRESADOLA (1882: 16, 1); LANGE (1935: 11A); CANDUSSO & LANZONI (1990: 13B); MOSER & JÜLICH (1985-: *Lepiota* 5).**Habitat and ecology:** On base-rich soil (limestone, dolomite), among *Dryas octopetala*, *Salix reticulata*, *S. retusa* L., *S. pyrenaica* OUAN, between (1900-)2150-2800 m s. m.**Description of microscopic characters, based on all collections examined:****Basidiospores:** (10-)13.7 ± 1.4(-17.1) × (4.5-)5.7 ± 0.7(-7.4) µm, Q = (1.8-)2.4 ± 0.2(-2.9), V = (76-)242 ± 76(-552) µm³ (n = 110), fusiform, dextrinoid.**Basidia:** (28-)34 ± 4(-40) × (8-)10.3 ± 1.1(-12.9) µm (n = 24), 4-spored, sometimes 2-spored.**Cheilocystidia:** (20-)30 ± 6(-43) × (7.5-)10.6 ± 3.2(-19.2) µm (n = 25), claviform, hyaline. **Pleurocystidia** absent.**Pileipellis:** a palisade of erect non-septate cells (100-200 × 6.5-20 µm).**Clamp connections:** present.**Material examined:** **Austria:** Tyrol, Kalkkögel, Malgrubenspitze (Widdersberger Kar), 2200 m s. m., 21. 8. 1996, leg. M. KIRCHMAIR in HORAK 5802 (ZT). **France:** Savoie, Vanoise, entre les chalets inférieurs de l'Arcellin, 2200 m s. m., 26. 7. 1963, leg. R. KÜHNER K 63-42 (GC 2387-7); Savoie, Vanoise, Hte. Val de l'Arc, Col des Evettes, 2300 m s. m., 20. 8. 1982, leg. E. HORAK 1606 (ZT). Savoie, Pralognan de Val d'Isère, 22. 8. 1970, leg. R. KÜHNER K 64(GC 2387-4); Savoie, Pralognan, Le Moriond, 2300 m s. m., 17. 8. 1963, leg. R. KÜHNER K 63-118 (GC 2387-8); Savoie, Pralognan, Crête du Mont-Charvel, 2250 m s. m., 22. 8. 1968, leg. R. KÜHNER K 68-168 (GC 2387-1); Savoie, Pralognan, Vanoise, Cirque du Génepy, 2200-2350 m s. m., 24. 8. 1968, leg. R. KÜHNER K 68-181 (GC 2387-3); - same locality, Cirque du Génepy, 2200-2350 m s. m., 8. 9. 1970, leg. R. KÜHNER K 70-114 (GC 2387-6); Savoie, Vanoise, Haut Vallée de Champagny, sous Glacier de Rosolin, 2200 m s. m., 17. 9. 1970, leg. R. KÜHNER K 70-173 (GC 2387-1). **Spain:** Pyrenees, Aragon, Valle de Tena, Hoz de Jaca, Peña de Sabocos, 2150-2270 m s. m., 27. 8. 1996, leg. E. HORAK 5852 (ZT). **Switzerland:** Grisons, S-charl, Tablasot, 1900 m s. m., 13. 8. 1948, leg. J. FAVRE 736 (G-K 14868; GC 2387-21); - Ofen Pass, Munt la Schera, Parc National, 2500 m s. m., prairie alpine, 20. 8. 1953, leg. J. FAVRE 184 (G-K 14186, GC 2387-20); - same locality, 2380 m s. m., 9. 9. 1982, leg. E. HORAK 1762 (ZT); Parc National Suisse, Val Nügli, 2600-2800 m s. m., 27. 8. 1966, leg. R. KÜHNER 66 (GC 2387-5).**Arctic-alpine distribution:** Austria (see above). France (see above). Additional records: Savoie, Val Thorens, -2500 m s. m. (BON 1990: 27); Vanoise, -2350 m s. m. (KÜHNER & LAMOURE 1986: 166); Col de l'Iseran (BON 1985b: 20); Alpes Maritimes (TRIMBACH 1975: 55). Italy: Monte Rosa, -2400 m s. m. (JAMONI 1991: 25, 1994: 20). Spain (see above). Switzerland (see above).**Notes:** In the alpine zone of the Alps, *Lepiota alba* is widely distributed in its typical habitat, i.e. among rotting plant debris on base-rich soils with sun-exposed, xerophytic, and mosaic plant cover. It is readily recognised by the whitish and rather robust basidiomata, and its rather large fusoid basidiospores.*Lepiota erminea* (FR.: FR.) GILLET is a closely related species which can be separated from *L. alba* by its smaller size, the more umbonate pileus, the less distinctive veil remnants, the raphanoid smell, and the slightly smaller basidiospores.

5. *Lepiota oreadiformis* VELENOVSKY 1920. České Houby 1: 215.

Syn.: *Agaricus clypeolarius* var. *pratensis* (BULL.) FR. 1836. Epicrisis: 15.

Lepiota clypeolaria var. *pratensis* (BULL.: FR.) BIG. & GUILL. (fide CANDUSSO & LANZONI 1990: 180-181).

Lepiota pratensis (BULL.: FR.) QUÉL. & BERNARD 1888. Bull. Soc. Mycol. France 4:51, pl. 1, fig. 2.

Lepiota pratensis (BULL.: FR.) REA 1922. Brit. Basidiomyc.: 69. List of further synonyms: CANDUSSO & LANZONI (1990: 178).

Illustrations: LANGE (1935: 11C); CANDUSSO & LANZONI (1990: 16A); BON (1993b: 3C); MOSER & JÜLICH (1985-: *Lepiota* 6).

Habitat and ecology: On base-rich soil in alpine meadows and among *Dryas octopetala*, -2200 m s. m.

Material examined: None.

Arctic-alpine distribution: France: Savoie, Briançon, -2200 m s. m. (REMY 1964: 542). - Spain: Pyrenees, Girona, Vall de Núria, -2150 m s. m. (VILA & al. 1997: 226).

Notes: For re-examination the authentic material collected by REMY at several locations in the French Alps has not been located.

This *Lepiota* is characterised by the following features: Pileus fulvous-ochraceous or gilvous, smooth or weakly fibrillose, non-persistent veil remnants attached to the margin; stipe white, covered with white or reddish brown woolly to fibrillose squamules. The fusoid basidiospores measure 12-16 x 5-7 µm.

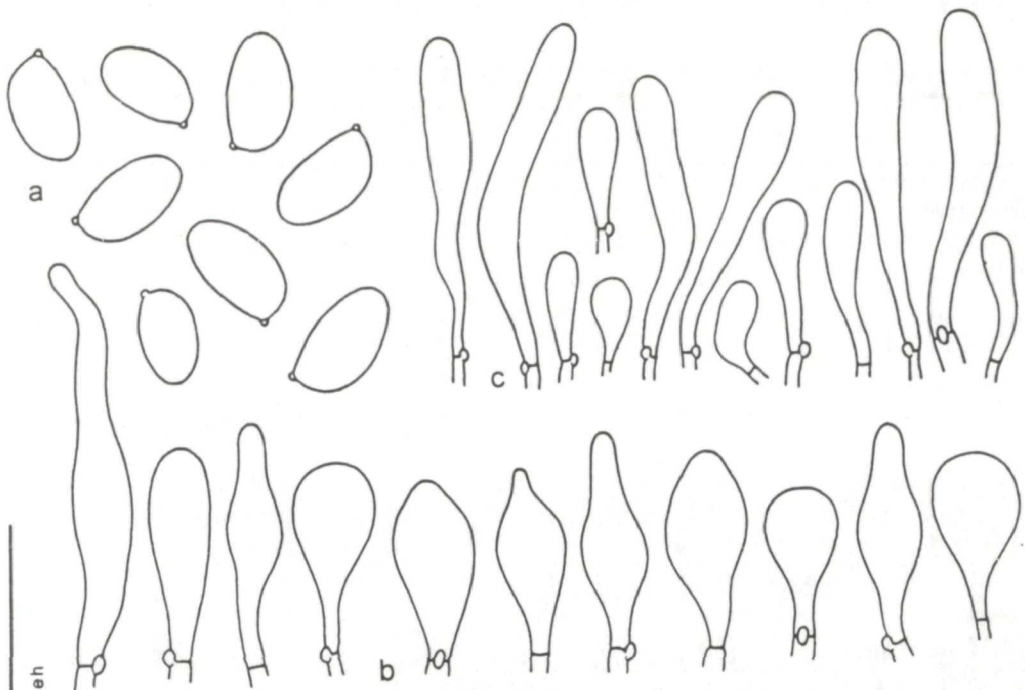


Fig. 4. *Lepiota favrei* (holotype, GC, K 66-30); a basidiospores. b cheilocystidia. c pileipellis. Bar: a 5 µm, b 10 µm, c 20 µm.

6. *Lepiota clypeolaria* (BULL.: FR.) P. KUMMER 1871. Führ. Pilzk., 137.Bas.: *Agaricus clypeolaria* BULL. 1791. Herb. France, t. 405, 506.Syn.: *Lepiota clypeolaria* (BULL.: FR.) SACC. 1887. Syll. Fung. 5: 36 (comb. superfl.).Illustrations: LANGE (1935: 11D); CANDUSSO & LANZONI (1990: 15); SOCIEDAD CATALANA DE MICOLOGIA (1982-: 729); MOSER & JÜLICH (1985-: *Lepiota* 7).**Habitat and ecology:** On base-rich and acid soil, among *Salix* spp., from sea level (Greenland) to 2200 m s. m. (Italy).**Material examined:** Italy: Monte Rosa, Val d'Olen, 2200 m s. m., leg. P. G. JAMONI 1286 (Herb. JAMONI).**Arctic-alpine distribution:** Italy (see above; cf. also JAMONI 1994: 20). Greenland: Narssarsuag, at sea level (KNUDSEN & BORGES 1987: 238).**Notes:** Usually distributed in lower elevations, this is a rarely encountered species of *Lepiota* in Arctic-alpine environs. According to BON (1993b), this taxon belongs to sect. *Lepiota* [= sect. *Clypeolariae* (FR.) QUÉL. = subgen. *Fusisporina* FAYOD] and is readily recognised by the absence of the annulus and the white, woolly veil remnants densely covering the lower half of the stipe.**7. *Lepiota favrei* KÜHNER ex M. BON 1993a.** Doc. Mycol. 22: 29.Bas.: *Lepiota favrei* KÜHNER 1983. Crypt. Mycol. 4: 68 (nom. nud.).Syn.: *Lepiota pseudohelveola* KÜHNER 1936. Bull. Soc. Mycol. France 52: 221 (nom. inval.).*Lepiota pseudohelveola* KÜHNER ss. FAVRE 1955. Ergebn. wiss. Forsch. Schweiz. Nationalpark 5 (33): 157.non *Lepiota pseudohelveola* KÜHNER ex HORA 1960. Trans. Brit. Mycol. Soc. 43: 99 (nom. inval.).

Illustrations: FAVRE (1955: 157, fig. 143; pl. XI. fig. 12); SENN-IRLET & al. (1990: 45). Figs. 4, 5.

Description of macroscopic and microscopic characters taken from all collections examined:**Pileus:** 15-25 mm, convex, on pale background covered with minute red-brown squamules becoming whitish, cream-coloured or beige with reddish tinge in age, margin of the pileus appendiculate from veil remnants.**Lamellae:** whitish, cream-coloured, slightly narrow, ventricose, with subfloc-cose edge.**Stem:** 13-27 x 2.5-4 mm, slightly bulbous, with brownish annulus or remnants of the latter, stem covered with whitish squamules below the ring.**Context:** whitish. Odour not distinctive.**Basidiospores:** (5.6-)6.8 ± 0.5(-8.0) x (3.5-)4.2 ± 0.3(-4.7) µm, Q = (1.4-)1.65 ± 0.1(-2), V = (42-)64 ± 12(-88) µm³ (n = 101), subelliptical to ovoid, dextrinoid.**Basidia:** (24)28 ± 2(32) x (6.3)7.2 ± 0.7(8.5) µm (n = 30), 4-spored, sometimes 2-spored.**Cheilocystidia:** (20-)29 ± 6(-50) x (6.0-)7.8 ± 1(-11.0) µm (n = 32), pyriform, claviform with fusiform apices, hyaline, edge sterile. Pleurocystidia absent.**Pileipellis:** a palisade or trichoderm composed of erect, non-septate cells (up to 300 x 8-14 µm).

Clamp connections: present.

Habitat and ecology: On base-rich soils (limestone and dolomite, rarely also on acid substrate), 2000-2700 m s. m., among debris of *Dryas octopetala*, *Salix retusa*, *S. reticulata*, *Loiseleuria procumbens* (L.) DESV., *Carex firma* HOST.

Material examined: **Austria:** Tyrol, Kalkkögel, N of Malgrubenspitze (Widdersberger Kar), 2180 m s. m., 21. 8. 1996, leg. E. HORAK 5798 (ZT). - Axamer Lizum, on the way from Halsl to Ampferstein, 2200-2300 m s. m., 14. 9. 1997, leg. U. PEINTNER 97-798 (IB). **Italy:** Col du Petit Saint-Bernard, versant Italien, 2000 m s. m., 20. 8. 1970, leg. R. KÜHNER K 1940 (GC 2387-11). **Switzerland:** Grisons: Val Murtaröl, Murtaröl d' Aint, 2500-2700 m s. m., 11. 8. 1966, leg. R. KÜHNER K 66-30 (G-K 2387-12, holotype!); - Blaisch dels Manaders, Haut Val Sesvenna, 2400 m s. m., 24. 8. 1951, leg. J. FAVRE 185a (GC 14187, cotype); - Val S-charl: Costainas, 2500-2700 m s. m., 20. 8. 1966, leg. R. KÜHNER 66-83 (GC 2387-10); - Val S-charl: Murters da Tamangur, 2100-2200 m s. m., 24. 8. 1966, leg. R. KÜHNER (GC 2387-14); - Val S-charl, Schombrina, 2420 m s. m., 31. 8. 1988, leg. E. HORAK 4120 (ZT); - Val Murtaröl, Murtaröl d' Aint, 2500-2700 m s. m., 31. 8. 1966, leg. R. KÜHNER 66 (GC 2387-13, topotypical material); - same locality, 2300 m s. m., 6. 9. 1982, leg. E. HORAK 1727 (ZT); - Ofen Pass, Buffalora, 2450 m s. m., 17. 9. 1981, leg. E. HORAK 1413 (ZT).

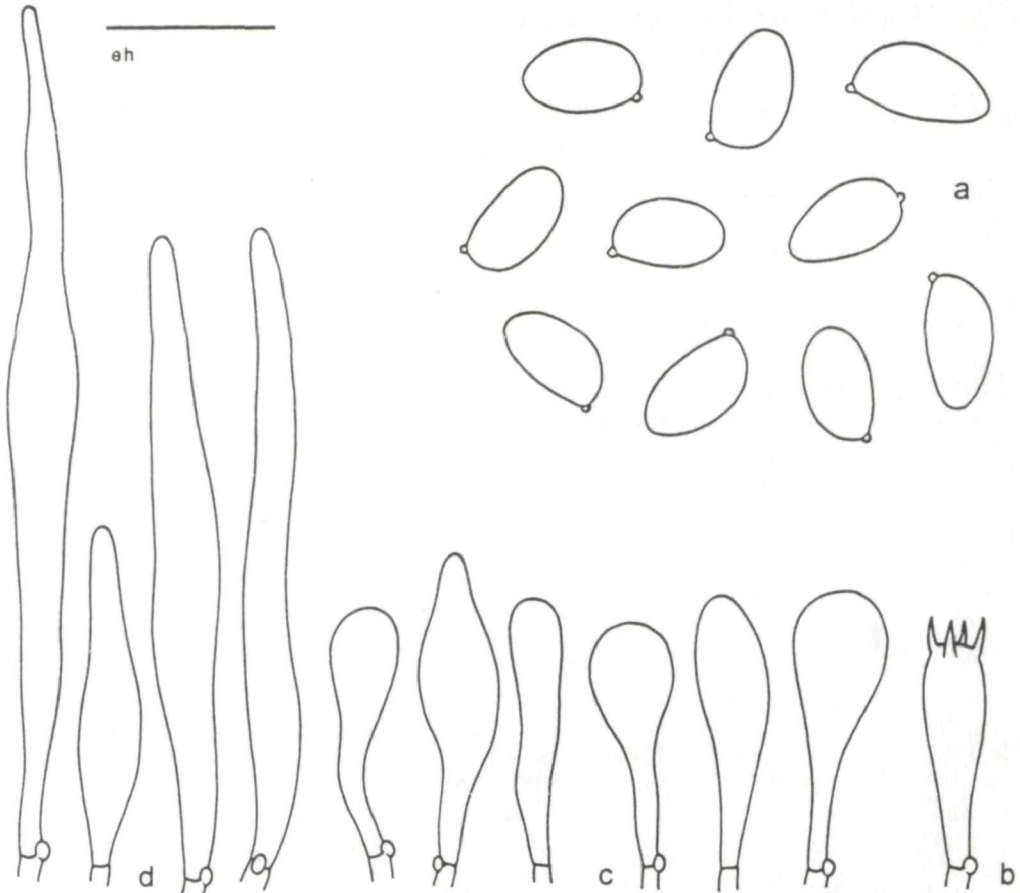


Fig. 5. *Lepiota favrei* (ZT 4120); a basidiospores. b basidia. c cheilocystidia. d pileipellis. Bar: a 5 μ m, b, c 10 μ m, d 20 μ m.

Arctic-alpine distribution: Austria (see above). France: Col Petit-St.Bernard, 2000 m s. m. (KÜHNER & LAMOURE 1986: 167). Italy (see above). Switzerland (FAVRE 1955: 157, holotype; see above). Additional record: Berner Oberland, -1970 m s. m. (SENN-IRLET & al. 1990: 45).

Notes: Describing this taxon for the first time from alpine habitats, FAVRE (1955: 157) noticed several differences between the specimens from the Swiss National Park and the original description of *L. pseudohelveola* KÜHNER (1936). Despite the discrepancies, FAVRE gave his collections the latter name. Subsequently, KÜHNER after having examined personal material collected in localities visited by FAVRE, proposed *L. favrei* (KÜHNER 1983: 68) as new (yet invalid) name for the alpine taxon. The two species are readily distinguished by the size of both the basidiomata and the basidiospores, and the occurrence in ecologically different habitats.

8. *Lepiota clypeolarioides* REA ss. HUIJSMAN ex HORA 1960. Trans. Brit. Mycol. Soc. **43**: 448.

Syn.: *Lepiota clypeolarioides* REA 1922. Brit. Basidiomyc., 69 ss. HUIJSMAN 1943. Medd. Ned. Mycol. Veren. **28**: 25.

(non *Lepiota clypeolarioides* REA ss. KÜHNER 1936. Bull. Soc. Mycol. France **52**: 228)

= *Lepiota kuehneri* HORA 1960. Trans. Brit. Mycol. Soc. **43**: 98 (nom. inval.)

= *Lepiota kuehneri* HORA ex HUIJSMAN 1962. Persoonia **2**: 362].

Illustrations: Fig. 6.

Habitat and ecology: On base-rich soil (limestone, dolomite), associated with *Dryas octopetala* and *Salix* spp., at sea level (Greenland), 2000-2500 m s. m.

Macroscopic description: cf. KÜHNER 1983: 67.

Microscopic description based on collections examined by the authors:

Basidiospores: $(6-6.9 \pm 0.4(-8) \times (3.7-4.2 \pm 0.3(-5) \mu\text{m}$, $Q = (1.4-)1.6 \pm 0.1(-2)$, $V = (48-64 \pm 11(-92) \mu\text{m}^3$ ($n = 90$), ellipsoidal, weakly dextrinoid.

Basidia: $(24-)26 \pm 2(-39) \times (6-)7.3 \pm 0.6(-8) \mu\text{m}$ ($n = 15$), 4-spored, sometimes 2-spored.

Cheilocystidia: $(16-)28 \pm 6(-37) \times (4-)7 \pm 2.5(-12) \mu\text{m}$ ($n = 20$), clavate to balloon-shaped, hyaline. Pleurocystidia absent.

Pileipellis: a palisade composed of erect non-septate cells (up to $140 \times 6-16 \mu\text{m}$), with brown parietal pigment.

Clamp connections: present.

Material examined: France: Savoie: Vanoise, Haute Vallée de Champagny, Lac des Vaches, 2340 m s. m., 6. 9. 1973, leg. R. KÜHNER K 73-372 (GC 2387-19); - Torrent de la Glière, 2200 m s. m., 17. 9. 1970, leg. R. KÜHNER K 70-172 (GC 2387-16); - Moraine d'Epéna, 2000-2100 m s. m., 16. 9. 1969, leg. R. KÜHNER K 69-334 (GC 2387-15); - - 2000-2100 m s. m., en exposition N, 14. 9. 1970, leg. R. KÜHNER K 70-159 (GC 2387-17); - - 2000-2100 m s. m., en exposition N, 14. 9. 1970, leg. R. KÜHNER K 70-152 (GC 2387-18).

Arctic-alpine distribution: France (see above). Greenland: Godhavn, about sea level (LAMOURE & al. 1982: 89). Italy: Monte Rosa, Val d'Olen, 2200 m s. m. (JAMONI 1994: 20). Russia: Pamir Alai, 2500 m s. m. (KALAMEES 1987: 6).

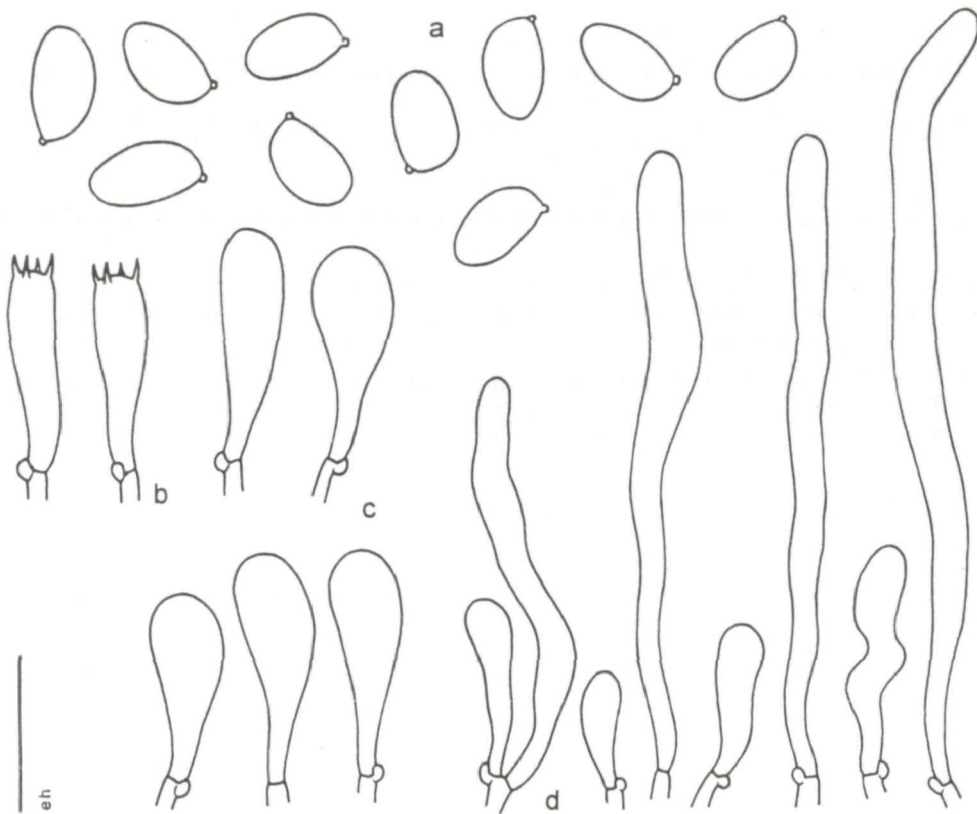


Fig. 6. *Leptota clypeolarioides* (GC, K 70-159); a basidiospores. b basidia. c cheilocystidia. d pileipellis. Bar: a 5 μ m, b, c 10 μ m, d 20 μ m.

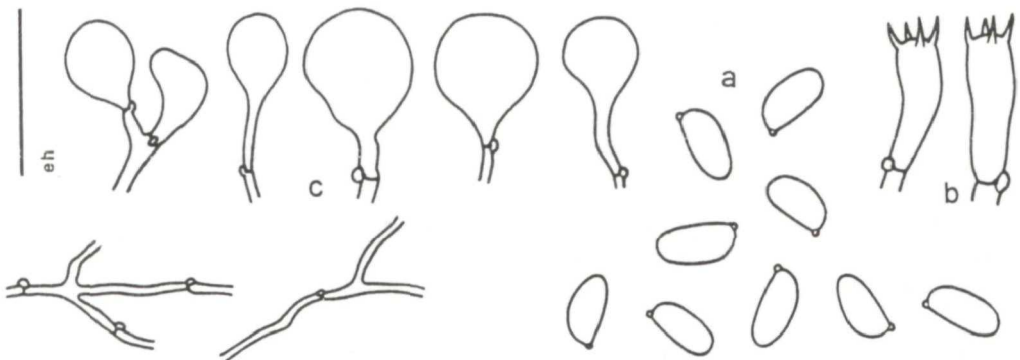


Fig. 7. *Cystoleptota sistrata* (ZT 6891); a basidiospores. b basidia. c pileipellis. Bar: a 5 μ m, b 10 μ m, c 20 μ m.

Notes: Unfortunately, no type material of *L. clypeolarioides* has been found in REA's herbarium (K). Thus the identity of this taxon is doubtful. Several interpretations are found in the current literature (BIZZI & MIGLIOZZI 1994: 95; MIGLIOZZI & BIZZI 1994: 47), and consequently the neotypification of this species has been proposed by BON (1996: 21) recently.

Concerning alpine collections, KÜHNER (1936) originally referred his material from the French Alps with hesitation only to *L. clypeolarioides* REA. Obviously, KÜHNER's portrayal is not in accordance with HUIJSMAN (1943) whose data more closely match REA's original description and COOKE's illustration [1881-1891: 29 (38)]. Consequently, HUIJSMAN (1943) proposed the new but invalid name *L. kuehneri* for *L. clypeolarioides* ss. KÜHNER. Subsequently, HORA (1960) validated the species epithet.

In the following years, KÜHNER (1983) and KÜHNER & LAMOURE (1986) accepted HUIJSMAN's interpretation and published their alpine collections of this taxon as *L. clypeolarioides* REA ss. HUIJSMAN but not *L. kuehneri* HORA (1960) which so far has not yet been recorded in Arctic-alpine localities.

Further comments about the identity and the correct name of *L. kuehneri* and its related species complex are found in BON (1996: 21).

***Cystolepiota* SINGER in SINGER & DIGILIO (1951) 1952.** Lilloa 25: 281.

Type species: *Cystolepiota constricta* SINGER (1951) 1952. Lilloa 25: 283.

9. *Cystolepiota sistrata* (FR.: FR.) SINGER ex M. BON & BELLÚ 1985. Doc. Mycol. 15/59: 51.

Bas.: *Agaricus sistratus* FR. 1821. Syst. Mycol. 1: 21.

Syn.: *Lepiota sistrata* (FR.: FR.) QUÉL. 1872. Champ. Jura Vosg., 210.

Illustrations: CANDUSSO & LANZONI (1990: 2a), SOCIEDAD CATALANA DE MICOLOGIA (1982-: 609), MOSER & JÜLICH (1985-: *Cystolepiota* 1). Fig. 7.

Habitat and ecology: On soil in an alpine meadow among plant debris, 2260 m s. m.

Material examined: France: Savoie, Hte. Maurienne, Col du Mt. Cenis, Ouillon des Arcillins, 2260 m s. m., 30. 7. 1992, leg. E. HORAK 6891 (ZT).

Arctic-alpine distribution: France (see above).

Notes: The elliptical and weakly dextrinoid basidiospores measure 4-4.5 x 2 µm.

In alpine habitats, this very delicate and ephemeral species has been recorded only once. For a full description and additional illustrations, cf. BON (1976: 317; 1985b: 51) and CANDUSSO & LANZONI (1990: 79).

10. *Cystolepiota eriophora* (PECK) KNUDSEN 1980. Bot. Tidsskr. 73: 130.

Bas.: *Lepiota eriophora* PECK 1903. Bull. Torrey Bot. Club 30: 95.

Syn.: *Lepiota echinella* var. *eriophora* (PECK) LANGE 1940. Fl. Agar. Dan. 5: 5.

Lepiota langei KNUDSEN (1980: 130, nom. inval.) = *L. jacobi* ss. VELLINGA & KNUDSEN in VELLINGA (1992: 407).

Illustrations: BRESADOLA (1927: 28), LANGE (1940: 12H), SOCIEDAD CATALANA DE MICOLOGIA (1982-: 410).

Habitat and ecology: On mossy soil in Arctic tundra near Lake Peters, Alaska.

Material examined: None.

Arctic-alpine distribution: USA: Alaska (KOBAYASI & al. 1967: 83).

Notes: A full description of this taxon is found in KNUDSEN (1978, 1980). The authentic material collected by KOBAYASI in Alaska has not been available for re-examination, and accordingly the identity of this *Cystolepiota* remains doubtful for us.

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