

Some taxonomic and ecological notes on *Volvariella caesiotincta* (Basidiomycota, Pluteaceae) and its distribution in the Czech Republic

VLADIMÍR ANTONÍN

Moravian Museum, Dept. of Botany, Zelný trh 6, CZ-569 37 Brno, Czech Republic; e-mail:
vantoin@mzm.cz

ANTONÍN V. 2012: Taxonomic and ecological notes on *Volvariella caesiotincta* (Basidiomycota, Pluteaceae) and its distribution in the Czech Republic. *Acta Musei Moraviae, Scientiae biologicae* (Brno) 96(2): 87–99. – This paper summarises the discriminative characters, ecology and phenology of *Volvariella caesiotincta* and its distribution in the Czech Republic, based on 96 herbarium specimens labelled as *V. caesiotincta* and *V. murinella*. Differences between *V. murinella* and *V. taylorii* are discussed. The main distinguishing features are a strongly fibrillose to streaky pileus and distinct cheilocystidia, mostly with an abrupt, often irregular or branched apical projection, in *V. caesiotincta*. The basidiospores also may help distinguish *V. caesiotincta* from *V. murinella*, being clearly narrower in the latter species. *Volvariella caesiotincta* has 53 known localities in the Czech Republic, most of them in Moravia.

Key words. Basidiomycetes, *Volvariella caesiotincta*, *Volvariella murinella*, *Volvariella taylorii*, taxonomy, ecology, phenology, distribution, Czech Republic

Introduction

Volvariella caesiotincta P.D. Orton is a wood-inhabiting fungus first described in 1974. It has a 33–100-mm-broad pileus, at first sepia, snuff-brown, hazel, drab or grey-olivaceous at centre, tending to paler, white or whitish at the margin, later often with a bluish or lead-grey tinge around the centre, fading to pale grey-olivaceous or smoke-grey with a darker centre with age and when dry; it is, except for a fibrillose-tomentose centre, radially fibrillose or darker streaky, then sometimes minutely scaly near the margin when fresh. The stem is robust (34–100 × 3.5–11 mm, up to 22 mm at base) with a distinct, externally grey-olivaceous or hazel, later paler, greyish or buff-tinged volva with floccose-punctate scales especially near the free edge. Its smell has been described as strong pungent-fruity or “winey”. The basidiospores are 5.5–7.5(8.0) × 3.3–4.0 μm, narrowly ellipsoid or slightly angular (coffin-shaped) (ORTON 1974). It was described to distinguish it from *Volvariella murinella* (Quélet, 1883) M.M. Moser ex Dennis, P.D. Orton & Hora 1960, a species earlier often misidentified as *V. caesiotincta*. However, *V. murinella* was originally described as a terrestrial fungus with white volva and a finely silky-fibrillose and felt-like, scaly pileus; its smell was not mentioned (ORTON 1974, 1986, QUÉLET 1883). However, since its description by Orton, *V. murinella* has been referred to as a taxon that is grey-volvate and/or with a *Pelargonium*-like smell in most recognised keys (e.g. MOSER 1983, GMINDER & KRIEGLSTEINER 2003, HORAK 2005, KOSONEN 2008). LUDWIG (2000, 2001) even synonymized the two species.

The author and those working with him have collected *V. caesiotincta*- and *V. murinella*-like fungi both on soil (detritus) and decaying wood on a number of occasions in the course of recent years. The aims of this paper include contributing to knowledge of the taxonomy and ecology of these taxa, establishment of distinguishing macroscopic characters for these fungi in herbarium specimens, and publication of a distribution of *V. caesiotincta* in the Czech Republic.

Volvariella murinella (listed as an endangered taxon), and *V. caesiotincta* (vulnerable) are included in the Red List of fungi (macromycetes) of the Czech Republic (ANTONÍN 2006a, b). Moreover, the latter is included (as an acutely endangered taxon) among the fungi protected by Czech law (ANTONÍN & BIEBEROVÁ 1995).

Material and methods

A total of 96 specimens identified as *V. caesiotincta* or *V. murinella* from the main herbaria in the Czech Republic (BRNM – including the author's findings, BRNU, CB, HR and PRM; for herbarium acronyms see THIERS 2012), and the J. Běťák private herbarium, were examined in this study. The taxonomically most important characters, the size and shape of basidiospores and the character of the cheilocystidia, were examined with an Olympus BX 50 light microscope, employing material mounted in Congo-red and *c.* 5% KOH. The basidiospores are reported in terms of: E, an average of size (the quotient of length and width for any one spore) and Q, the mean of E-values.

Results

Volvariella caesiotincta P.D. Orton

Bull. Soc. Linn. Lyon, Num. Spéc., 43: 319, 1974.

Syn. *Volvaria murinella* var. *umbonata* J.E. Lange, Dansk Bot. Ark. 5: 97, tab. 200B, 1940. – *Volvariella murinella* var. *umbonata* (J.E. Lange) Wichanský, Mykol. Sborn. 44: 51. 1967.

Selected descriptions. KOSONEN (2008), LANGE (1936, as *Volvaria murinella* var. *umbonata*), ORTON (1974, 1986).

Selected icons. BREITENBACH & KRÄNZLIN (1995), BRÜCKNER & CONRAD (1991), COURTECUISSÉ & DUHEM (1994), IVANOV (2010), LANGE (1936, as *Volvaria murinella* var. *umbonata*), PAVLÍK (2011), PILAŘ (2011), SCIARA (2012), ŠKUBLA (2007, as *V. caesiotincta* and *V. murinella*), ZUCCHERELLI (2006), ZUGNA (2008).

Character of pileus surface. ORTON (1974) pointed out that *V. caesiotincta* has (apart from a fibrillose-tomentose centre) a typically radially fibrillose-to-darker, streaky pileus. This feature is quite clear even in dry basidiocarps. The pilei of the *V. murinella* studied and of all the *V. taylorii* specimens were (sub)tomentose or finely fibrillose, but never featured distinct darker streaks.

Basidiospores. The results of basidiospore measurement are summarised in Table 1. A total of *c.* 1200 basidiospores from 60 herbarium specimens of *Volvariella caesiotincta* were examined. The basidiospore sizes of all spores were (6.0)6.5–8.5(9.0) × 4.0–5.5 µm, average = 7.1 × 4.9 µm, Q = 1.50. These sizes do not accord with the data presented by ORTON (1974, 1986: 5.5–7.5(8.0) × 3.3–4 µm, see Discussion).

Cheilocystidia. The sizes of the cheilocystidia are also summarised in Table 1. They are very variable: (20)27–110(120) × (8.0)10–40(46) μm, and are clavate, fusoid, less frequently subvesiculose or utriform, mostly with a rostrum that is often abruptly connected with a basal part and often irregular, branched to occasionally subcoralloid (Pl. 2 below, Fig. 1). The shape of the cheilocystidia is quite a characteristic feature of *V. caesiotincta*, facilitating its identification.

Distribution, ecology and phenology in the Czech Republic. *Volvariella caesiotincta* is known from 53 localities in the Czech Republic, 19 in the Bohemian part, 34 in the Moravian and Silesian part, Fig. 3. (this study and DVOŘÁK 2009). It was found in only 10 localities before 1970 (a date limit for earlier and recent collections set by the Red List of fungi (macromycetes) of the Czech Republic; HOLEC & BERAN, eds., 2006). It appears that this species has become more common and widespread in the Czech Republic in recent decades.

It grows on a wide range of broadleaved substrates, largely on *Fagus sylvatica* (15 findings) and *Quercus* spp. (14), but also frequently on *Carpinus betulus* (7); other substrates included *Acer campestre* (3; Pl. 1, upper photo), *Acer platanoides* (1), *Acer pseudoplatanus* (1), *Fraxinus excelsior* (1), *Populus tremula* (3), *Sorbus torminalis* (1), *Tilia cordata* (1) and some unidentified broadleaved trees (4). However, three collections were made on *Picea abies* wood. In 20 cases, this fungus grew not on wood, but directly on soil or from submerged remnants of wood in an advanced state of decay (Pl. 2, upper photo). Most of the localities (48) were in hilly country (alt. 201–500 m); only rarely is it known from the lowlands, up to alt. 200 m (5) and above alt. 500 m (4). This distribution accurately reflects the general geography of the Czech Republic.

Volvariella caesiotincta is a summer fungus in the Czech Republic, with most collections made in August (26) and July (21); it has been found less frequently in May (2), June (7), September (9), and October (5).

Revised specimens of *V. caesiotincta* from the Czech Republic. **Bohemia:** Český kras LPA, between Dřínová hora Hill and Skalka, on old, decayed wood (probably *Carpinus betulus*) buried in soil, 23 Aug. 2005 leg. B. Bušek and J. Borovička, det. J. Borovička (PRM 905431). – Český kras LPA, 1 km NE of Suchomasty, site known as Na Voskopě, W slope of Újezdce hill, alt. 440 m, deciduous forest (*Quercus*, *Carpinus*, *Fagus*, *Acer*), on heavily decayed wood of *Fagus sylvatica*, 26 June 2001 leg. et det. J. Holec JH 69/2001 (PRM 895070). – Český kras LPA, Doutnáč hill, *Carpinion*, on soil, 28 June 1998 leg. E. Dlouhý, det. J. Holec (PRM 892722, as *V. murinella*). – Český kras LPA, Karlické údolí Nature Reserve, alt. 350 m, on soil in detritus, 28 Aug. 2004 leg. J. Burel, det. O. Jindřich (PRM 902255, as *V. murinella*). – Český Šternberk, near the border of the Na Stříbrné Nature Reserve, on decayed wood of *Picea abies*, 10 July 2005 leg. et det. J. Borovička (PRM 905458). – Kokořínsko LPA, Zakšín, Osinalické bučiny Nature Reserve, on root of living *Populus tremula* and under decayed branch of *Corylus?*, alt. 235–340 m, 19 Aug. 2010 leg. D. Dvořák DD 411/10 (BRNU). – Ibid., 19 Aug. 2010 leg. D. Dvořák DD 413/10 (BRNU). – Ibid., decaying branch of *Fagus sylvatica*, alt. 235–340 m, 19 Aug. 2010 leg. D. Dvořák DD 414/10 (BRNU). – Ibid., 19 Aug. 2010 leg. D. Dvořák DD 412/10 (BRNU). – Ibid., decayed stump of *Carpinus betulus*, 19 Aug. 2010 leg. D. Dvořák DD 396/10 (BRNU). – Křivoklátsko LPA, Skryje, Týřovické skály, stump of *Quercus petraea*, 28 July 1966 leg. et det. Z. Pouzar (PRM 946239, as *V. murinella*). – Dolní Ředice, Žernov Nature Reserve, broad-leaved forest, on soil, alt. 230 m, 9 Aug. 2010 leg. S. Flekrová, det. L. Tmej (HR 86134, as *V. murinella*). – Licibořice, Krkanka Nature Reserve, decaying stem of *Fagus sylvatica*, alt. 375 m, 13 July 2005 leg. et det. R. Doležal (HR 78060). – Vysoká nad Labem, Stará paseka forest, close to *Quercus* stump, alt. 275 m, 11 Aug. 2010 leg. et det. J. Wipler (HR 86124, as *V. murinella*). – Měcholupy, Chejlava National Nature Reserve, alt. 600 m, old humose herb-rich beech forest, highly decayed stem of *Fagus sylvatica*, 24 Aug. 2010 leg. D. Dvořák CH 22/107 (BRNU). – Zátoň, Zátoňská

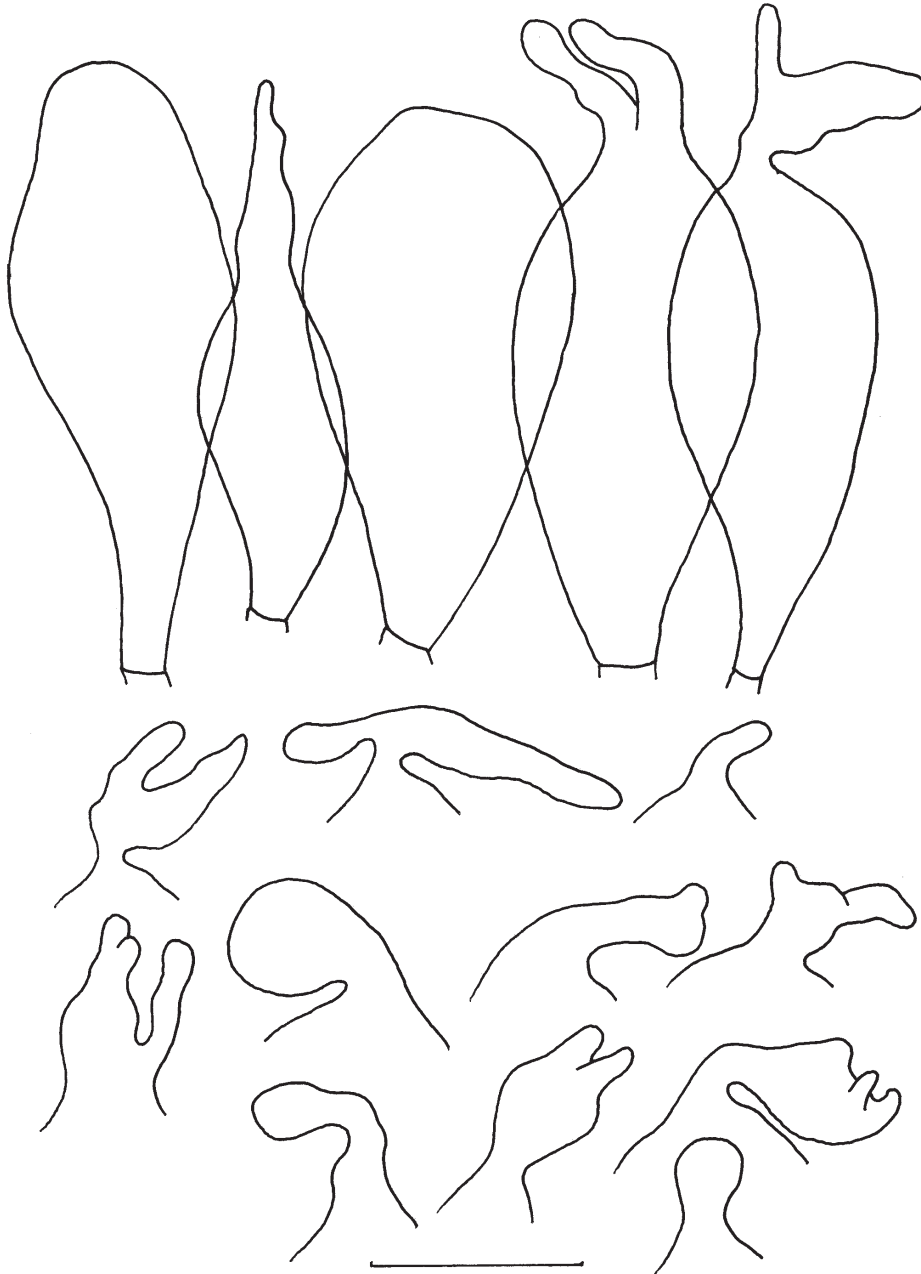


Fig. 1. *Volvariella caesiotincta*. Cheilocystidia (complete cystidia above, apical part of cystidia below). Scale bar = 20 μ m.

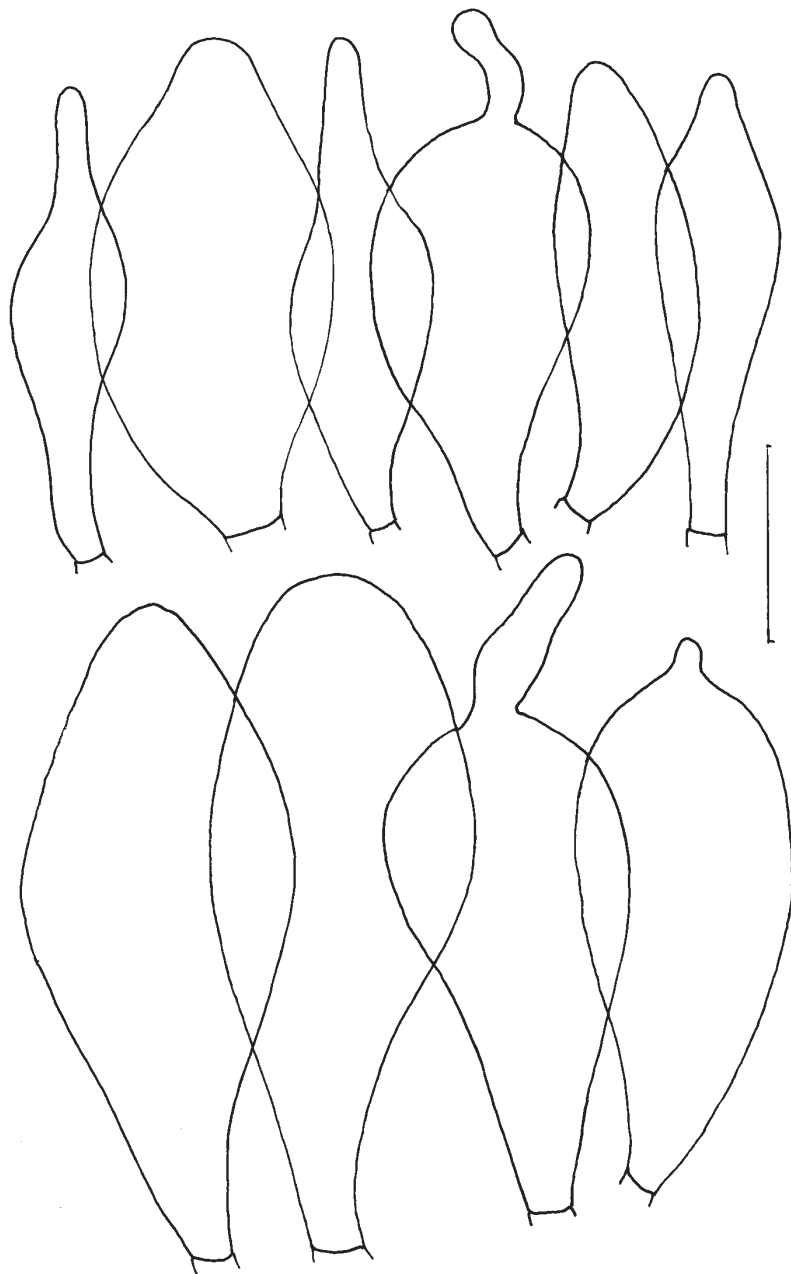


Fig. 2. *Volvariella murinella*. Cheilocystidia. Scale bar = 20 μ m.

hora Nature Reserve, near-natural montane mixed forest, in cavity of decaying stump of *Picea abies*, alt. c. 950 m, 16 Aug. 2009 leg. A. Kunze, det. O. Jindřich (CB 16301). – Hluboká nad Vltavou, castle park, grassy stand with a group of oaks, on decaying remnants of *Quercus*(?), alt. 410 m, 27 Oct. 2000 leg. M. Černý, det. M. Beran (CB 12386). – Staňkov, vrch Nadějov, mesotrophic herb-rich beech forest with *Acer pseudoplatanus*, on decaying broad-leaf wood, alt. 490 m, 31 July 2008 leg. et det. M. Beran (CB 15915). – **Moravia:** Beskydy Mts., Šilheřovice, Černý les National Nature Reserve, on decaying wood of *Fagus sylvatica*, alt. 220–230 m, 24 Sept. 1992 leg. P. Škubla, det. P. Škubla and V. Antonín 92.92 (BRNM 571198). – Vratěnín, Bílý Kříž Nature Reserve, *Querceto-Carpinetum*, heavily decayed wood at stem base of *Tilia cordata*, 31 July 2011 leg. et det. J. Běťák (herb. J. Běťák JB 11/284). – ? Česká, Šiberná, alt. 350 m, *Querceto-Potentilletum albae*, 17 July 1965 leg. K. Koncerová, det. F. Šmarda (BRNM 325435, as *V. murinella*). – Ibid., 24 Oct. 1960 leg. et det. F. Šmarda (BRNM 325434, as *V. murinella*). – Moravian Karst LPA, Blansko, Vývěry Punkvy National Nature Reserve, fallen stem of *Populus tremula*, 22 July 2005 leg. D. Dvořák DD 141/05 (BRNU). – Moravian Karst LPA, Vilémovice, Vývěry Punkvy National Nature Reserve, Pustý žleb, on decaying stump of *Picea abies*, alt. 350 m, 21 July 2004 leg. et det. A. Vágner (BRNM 695377). – Moravian Karst LPA, Blansko, Vývěry Punkvy National Nature Reserve, Blanské, on soil in a broadleaved forest, 22 July 2005 leg. D. Dvořák DD 149/05 (BRNU). – Moravian Karst LPA, Habrůvka, U Výpustku Nature Reserve, northern part, decaying wood of a broadleaved tree, 18 July 2008 leg. et det. D. Dvořák DD 128/08 (BRNU). – Moravian Karst LPA, Adamov, Josefovské údolí valley, Býčí skála National Nature Reserve, close to decaying wood of *Quercus*, alt. 300–480 m, 28 May 2003 leg. et det. V. Antonín 03.09 (BRNM 677304). – Moravian Karst LPA, Habrůvka, Habrůvecká bučina National Nature Reserve, on base of dead standing stem of *Fagus sylvatica*, alt. 330–510 m, 5 Aug. 2010 leg. et det. A. Vágner (BRNM 733102). – Ibid., decaying stem of *Fagus sylvatica*, 5 Aug. 2010 leg. et det. D. Dvořák DD 225/10 (BRNU). – Moravian Karst LPA, Líšeň, Hádecká planinka National Nature Reserve, 15 July 1970 leg. J. Dušek, det. K. Kříž (BRNM 325442, as *V. murinella*). – Ibid., on humose soil under fallen stem of *Sorbus torminalis*, alt. 395 m, 6 July 2009 leg. et det. D. Dvořák DD 173/09 (BRNU). – Ibid., apparently on soil, under *Quercus petraea* and *Acer campestre*, alt. 400–424 m, 11 Aug. 2010 leg. et det. V. Antonín 10.118 (BRNM 733259, as *V. murinella*). – Adamov, Couřavá Nature Reserve, on decaying stem of *Fagus sylvatica*, 9 Aug. 1986 leg. et det. A. Vágner (BRNM 457906, as *V. taylorii*). – Ibid., 14 Oct. 2010 leg. D. Dvořák DD 705/10 (BRNU). – Babice, on decaying stump of *Fagus sylvatica*, 16 July 1984 leg. et det. A. Vágner (BRNM 457907, as *V. taylorii*). – Mokrý u Brna, close to Mokerská myslivna gamekeeper's lodge, on coniferous detritus, alt. 360 m, 26 Aug. 2006 leg. et det. D. Dvořák DD 145/06 (BRNU). – Ibid., Mokerský les forest, a margin of the allotment of a quarry, decaying wood of *Carpinus betulus*, 9 Aug. 2001 leg. et det. V. Antonín 01.197 (BRNM 666465, as *V. taylorii*). – Ibid., in detritus under *Picea abies* a *Sambucus nigra*, alt. 375–440 m, 21 June 2006 leg. et det. A. Vágner (BRNM 699817, as *V. murinella*). – Mokrý, place called Nad dlouhým (Sivický les), in detritus under *Carpinus betulus*, *Pinus sylvestris* and *Quercus* sp., alt. 370–400 m, 22 Aug. 2006 leg. et det. A. Vágner (BRNM 705315, as *V. murinella*). – Jundrov, on stump of a broadleaved tree, 23 June 1963 leg. et det. O. Nováková and F. Valkoun (BRNM 313387, as *V. murinella*). – Bosonohy, Bosonožský háj Nature Reserve, thermophilic oak forest, 27 Oct. 1967 leg. et det. J. Lazebníček (BRNM 325444, as *V. murinella*). – Ibid., 27 July 1970 leg. et det. K. Kříž (BRNM 325441, as *V. murinella*). – Ibid., under decaying mossy stem of *Populus tremula* and a broadleaved tree, 16 Aug. 2010 leg. J. Běťák and D. Dvořák DD 346/10, det. J. Běťák (BRNU). – Moravské Knínice, Podhájí gamekeeper's lodge, alt. 350 m, on stump of *Carpinus betulus*, 1 Aug. 1961 leg. et det. F. Šmarda (BRNM 325431, as *V. murinella*). – Vedrovice, Leskoun forest, under *Quercus* and *Betula*, 3 Aug. 1974 leg. et det. A. Vágner (BRNM 325443, as *V. murinella*). – Strážovice, *Querceto-Carpinetum*, alt. 300 m, 18 July 1968 leg. et det. K. Koncerová (BRNM 325437, as *V. murinella*). – ? Dambořice, Lichý forest, 28 June 1969 leg. K. Koncerová (BRNM 333339, as *V. murinella*). – Koryčany, Stříbrník stream valley, on submersed decayed wood of *Fagus sylvatica*(?), 1 Aug. 2008 leg. J. Běťák (herb. J. Běťák CH08/124, BRNU). – Milonice, 14 Aug. 1970 leg. A. Brabencová, det. K. Kříž (BRNM 699674, as *V. murinella*). – Chřiby, Buchlovice, Holý kopec Nature Reserve, SE margin, old *Fageto-Quercetum* stand, decayed remnants around a stem of *Fagus sylvatica*, 2 Aug. 2010 leg. et det. J. Běťák (herb. J. Běťák JB 10/724). – Ibid., NE part, herb-rich beech forest with *Quercus* and *Carpinus*, decaying stem of *Fagus sylvatica*, 4 Aug. 2011 leg. et det. J. Běťák (herb. J. Běťák JB 11/333). – Chřiby Mts., Čeložnice, Smradávka stream valley, alt. c. 360 m, *Querceto-Carpinetum* with common *Tilia cordata*, on fallen stem of *Carpinus betulus*, 25 Sept. 2007 leg. J. Běťák (herb. J. Běťák CH/336, BRNU). – Boleradice, Velký Kuntínov Nature Reserve, wood remnants under *Quercus*, *Fraxinus*, *Corylus*, *Acer campestre*, 25 Sept. 1995 leg. et det. V. Antonín 95.265 (BRNM 603697, as *V. murinella*). – Ibid., on soil in detritus, alt. 220–230 m, 15 Sept. 2010 leg. et det. V.

Antonín 10.341 (BRNM 737622). – Kobyly na Moravě, Panský les forest, under *Fraxinus*, *Tilia* and *Quercus*, alt. c. 240 m, 19 May 1996 leg. et det. V. Antonín 96.07 (BRNM 612043). – Ibid., decaying stem of *Quercus petraea*, 15 Sept. 2010 leg. et det. V. Antonín 10.328 (BRNM 733303). – Bílé Karpaty LPA, Velká nad Veličkou, Zahrady pod Hájem National Nature Reserve, decaying stump of *Quercus*, alt. 350–500 m, 27 July 2005 leg. et det. A. Vágner (BRNM 699633). – Dyjskomoravská pahorkatina Hills, Ratiškovice, Roztrhánky forest, in broadleaved forest with dominance of oak, alt. c. 200 m, 15 Sept. 2006 leg. et det. E. Skála, P. Špinar and V. Zíta (BRNM 706958). – Valtice, Rendezvous National Nature Reserve, decayed wood of *Acer campestre* or *Quercus*, alt. 200 m, 18 June 1993 leg. et det. V. Antonín 93.21 (BRNM 576454). – Podyjí National Park, Lukov, on slope above the valley of Klaperův potok Stream, decaying branch of *Quercus*, 14 June 2010 leg. et det. J. Běťák (herb. J. Běťák JB 10/425). – Valtice, Rendezvous National Nature Reserve, thermophilic oak forest with *Quercus cerris*, heavily decayed stem of *Q. cerris*, 24 May 2010 leg. et det. J. Běťák (herb. J. Běťák JB 10/225). – Ibid., heavily decayed stem of *Quercus cerris*, 12 Aug. 2010 leg. et det. J. Běťák (herb. J. Běťák JB 10/844). – Pálava LPA, Milovice, Milovická stráž Nature Reserve, *Quercus pubescens* and *Q. petraea*, alt. 250 m, 19 Sept. 1995 leg. et det. V. Antonín 95.180 (BRNM 603632). – Ibid., on small stump of *Fraxinus excelsior*, alt. 200–250 m, 7 Oct. 2007 leg. et det. D. Dvořák DD 422/07 (BRNU). – Pálava LPA, Dolní Věstonice, Děvičky, 12 June 1963 leg. et det. F. Šmarda (BRNM 325438, as *V. murinella*). – Lanžhot, Raňpurk National Nature Reserve, alluvial forest, on soil around decaying stem of *Carpinus betulus*, 153 m, 19 June 1999 leg. et det. V. Antonín 99.03 (BRNM 642791, as *V. taylorii*).

Revised specimens of *V. murinella* from the Czech Republic. Bohemia: Karlštejn, spruce forest, 9 Aug. 1950 leg. et det. A. Pilát and Z. Pouzar (PRM 797026). – Trusnov, Lodrant pond reservoir, on soil, alt. 250 m, 2 Aug. 2010 leg. S. Fleková, det. L. Tmej (HR 86232). – Rozhraní, mixed forest, 30 July 2009 leg. et det. J. Zedník (BRNM 721628, as *V. taylorii*). – **Moravia:** Hlohovec, close to Hraniční zámek Castle, in moist, mown grassland in a park, 16 Sept. 2009 leg. et det. J. Běťák (herb. J. Běťák 09/31). – Chřiby Mts., Čeložnice, close to the Kolomaznica spring, on soil in a marshy alder stand, 1 Sept. 2007 leg. et det. J. Běťák (herb. J. Běťák CH/158, BRNU).

Discussion

In *Volvariella caesiotincta*, apart from the grey coloured volva (which may sometimes turn pale in dry specimens), the character of the pileus surface may serve for identification. Except for a fibrillose-tomentose centre, its typically radially fibrillose to darker streaky pileus is distinct even in dry basidiocarps. The pilei of the *V. murinella* studied and of all *V. taylorii* specimens were (sub)tomentose or finely fibrillose but never with distinct darker streaks.

The basidiospore sizes of all spores measured were $(6.0)6.5\text{--}8.5(9.0) \times 4.0\text{--}5.5 \mu\text{m}$, average = $7.1 \times 4.9 \mu\text{m}$, $Q = 1.50$. In comparison with the original description by ORTON (1974, 1986: $5.5\text{--}7.5(8.0) \times 3.3\text{--}4 \mu\text{m}$), and also that by MOSER (1983: $5.5\text{--}8 \times 3.3\text{--}4 \mu\text{m}$), they are slightly longer but distinctly broader. The narrowest basidiospores ($3.5)3.75\text{--}4.5 \mu\text{m}$, average = $4.1 \mu\text{m}$) were found in specimens BRNM 603632 and CB-Zátoňská hora. It is a surprising finding, because all other characters are fully in agreement with the original description. The sizes given by Orton tend to agree with those measured in *V. taylorii* (see Table 1 and below). HORÁK (2005) mentioned a similar size ($5.5\text{--}8 \times 3.5\text{--}4.5 \mu\text{m}$). However, the measurements given by KOSONEN (2008: $5.5\text{--}7.5 \times 3.5\text{--}5 \mu\text{m}$), except for slightly shorter basidiospores, fit quite well. For confirmation of basidiospore size variability in *V. caesiotincta*, further study in collections from other parts of Europe may prove revealing.

The cheilocystidia shape, especially the presence of the often abruptly connected and irregular, branched to sometimes subcoralloid rostrum (Pl. 2 below, Fig. 1), is quite

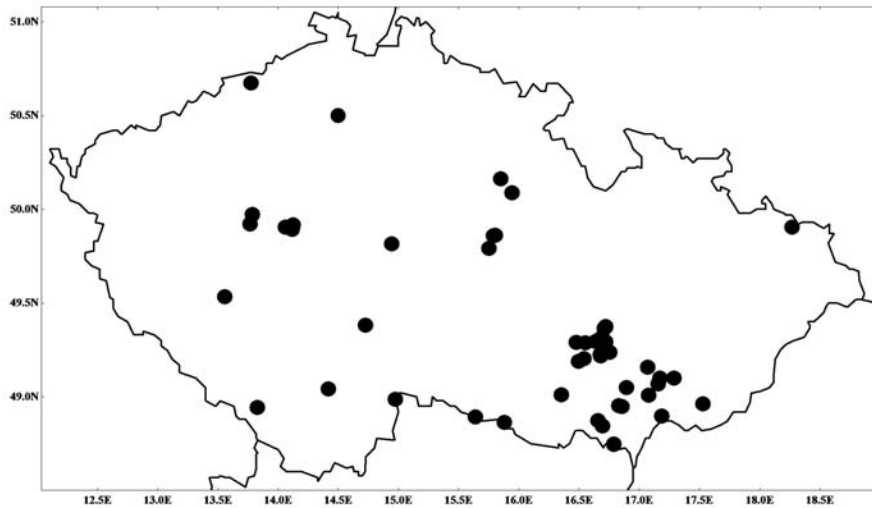


Fig. 3. Distribution of *Volvariella caesiotincta* in the Czech Republic.

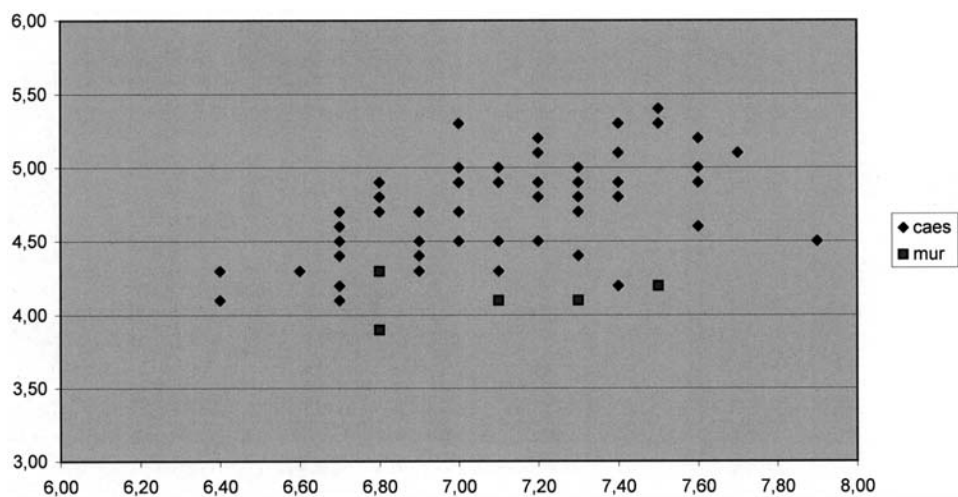


Fig. 4. Comparison of basidiospore size of *Volvariella caesiotincta* and *V. murinella*.

a typical character of *V. caesiotincta*, enabling its identification. In the literature, KOSONEN (2008) mentioned a cheilocystidia size of $35\text{--}80 \times 15\text{--}30 \mu\text{m}$, and ORTON (1974, 1986) $40\text{--}120 \times 8\text{--}24(32) \mu\text{m}$, with shapes in accord with our observations.

Volvariella caesiotincta is a quite widely distributed fungus in the Czech Republic growing on wood, sub-surface wood remnants, or directly on soil. Therefore, the first step

Volvariella caesiotincta (Basidiomycota, Pluteaceae) in the Czech Republic



Pl. 1. *Volvariella caesiotincta*. Slovakia, Slanské vrchy Mts., Herľany, Malé Brdo Nature Reserve, 12 Sept. 2008, BRNM 710305, photo V. Antonín (upper photo). Czech Republic, Zátoňská hora Nature Reserve, 16 Aug. 2009, CB, photo O. Jindřich (lower photo).



Pl. 2. *Volvariella caesiotincta*. Czech Republic, Český kras LPA, Karlické údolí Nature Reserve, 28 Aug. 2004, PRM 902255, photo O. Jindřich (upper photo). Cheilocystidia of *Volvariella caesiotincta* under a light microscope. Photo V. Antonín (lower photo).

of identification in most of the important keys, based on substratum (“growing on wood” or “growing on soil, decomposed straw, compost, etc.”; e.g. KOSONEN 2008) may lead to misidentifications; collections on the last-named may be misidentified as *V. murinella*.

Volvariella murinella, however, is a terrestrial fungus with a white volva, tending to pale greyish only near the edge, and never with a distinctly radially fibrillose to streaky pileus surface. The other distinguishing characters of the latter fungus are cheilocystidia that lack an abrupt and branched rostrum; they are mostly clavate or fusoid with gently broadening (only rarely subabrupt), but always simple, apical rostrum (Fig. 2). Moreover, they are smaller, $40\text{--}80(114) \times 10\text{--}24 \mu\text{m}$ (according to ORTON 1974, 1986), $30\text{--}75 \times 12\text{--}28 \mu\text{m}$ according to our studies. The size of basidiospores may also help in discrimination between the two species. The *V. murinella* basidiospores in the specimens studied measured $6.0\text{--}7.5(8.0) \times 3.5\text{--}4.5 \mu\text{m}$ (average $7.0 \times 4.1 \mu\text{m}$, $Q = 1.76$). Therefore they appear to be at the lower limit of the basidiospore variability of *V. caesiotincta* (Fig. 4). However, only a few specimens of *V. murinella* were found in the material studied, and it is therefore not possible to decide if basidiospore size (especially width) may be considered a distinguishing character of *V. murinella*.

Volvariella caesiotincta may also be confused with basidiocarps of *V. taylorii* (Berk. et Broome) Singer, which also has a grey volva and sometimes grows directly on wood. *Volvariella taylorii* differs in having a less robust pileus lacking pure grey colour – it may be centrally brown, grey-brown or snuff-brown with a persistently whitish margin, lacking distinct fibrilosity, and its cheilocystidia are clavate or fusoid with slowly broadened or subcapitate rostrum, never with an abrupt and irregular-to-branched projection. The dry pilei (herbarium specimens) have a distinct brown tinge at centre.

Volvariella volvacea (Bull.: Fr.) Singer may also be similar, having robust basidiocarps with a fibrillose, sepia, brown to olivaceous black pileus and a greyish, brownish or blackish grey volva. It differs particularly in having larger basidiospores ($7\text{--}9.5 \times 5\text{--}6.5 \mu\text{m}$), clavate, fusoid to lageniform cheilocystidia without an abruptly connected, irregular, branched-to-subcoralloid rostrum, and it grows on sawdust and compost heaps in gardens and greenhouses (KOSONEN 2008, ORTON 1986).

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specimen	basidiospores			E	Q	cheilocystidia size (µm)
	length (µm)	width (µm)	average (µm)			
<i>Volvariella caesiointacta</i>						
BRNM 313387	(6.5)7.0-8.0(8.25)	4.5-5.2	7.3 × 4.9	1.34-1.69	1.48	34-45 × 17-18
BRNM 325430	(6.0)6.5-8.0	(4.5)5.0-5.75	7.0 × 5.3	1.15-1.45	1.34	40-75 × 12-28
BRNM 325431	6.5-7.5(8.0)	(4.0)4.25-5.0	7.2 × 4.5	1.40-1.78	1.59	28-65 × 11-34
BRNM 325434	(6.5)7.0-8.5	4.5-5.75(5.5)	7.6 × 4.9	1.44-1.71	1.56	27-70 × 12-23
BRNM 325435	(6.0)6.5-7.0	4.25-5.0	6.7 × 4.7	1.34-1.56	1.45	35-56 × 12-28
BRNM 325437	(6.5)7.0-8.0	4.5-5.5	7.3 × 4.8	1.40-1.60	1.50	37-70 × 12-27
BRNM 325438	7.0-8.0	4.5-5.0(5.25)	7.4 × 4.9	1.40-1.71	1.53	35-62 × 12-32
BRNM 325441	7.0-8.0(8.5)	4.5-6.0(6.5)	7.5 × 5.4	1.23-1.70	1.40	30-80 × 14-35
BRNM 325442	7.25-8.5	(4.5)4.75-5.5	7.7 × 5.1	1.31-1.70	1.51	35-85 × 15-31(40)
BRNM 325443	(6.0)6.25-7.0	(4.0)4.25-5.0	6.7 × 4.6	1.30-1.67	1.44	31-78 × 14-35
BRNM 325444	(7.0)7.5-8.0(8.5)	4.75-5.5	7.6 × 5.0	1.36-1.70	1.53	30-61 × 12-25(40)
BRNM 333339	(6.75)7.0-8.5	(4.5)5.0-5.5	7.4 × 5.1	1.31-1.63	1.46	40-69 × 14-30
BRNM 571198	6.5-7(7.2)	4.0-4.75	6.8 × 4.7	1.38-1.75	1.54	45-95 × 17-37
BRNM 576454	6.0-7.0	4.0-5.0	6.7 × 4.5	1.38-1.68	1.48	35-110 × 13-38
BRNM 603632	6.0-7.5	4.0-4.5(5.0)	6.7 × 4.4	1.38-1.81	1.54	40-80 × 20-32
BRNM 603632	6.2-7.3	3.5-4.5	6.7 × 4.1	1.48-1.72	1.61	52-60 × 13-19
BRNM 603697	6.5-7.5(8.0)	(4.25)4.75-5.5	7.2 × 5.1	1.30-1.79	1.43	33-60 × 10-23
BRNM 612043	(5.75)6.0-7.0	4.0-4.5	6.4 × 4.3	1.33-1.75	1.48	45-94 × 15-34
BRNM 677304	6.0-7.0	4.0-4.5(4.75)	6.6 × 4.3	1.38-1.75	1.54	20-70 × 11-31
BRNM 695377	(5.75)6.0-7.25	3.75-4.75(5.0)	6.7 × 4.2	1.40-1.80	1.59	37-72 × 15-35
BRNM 699633	(6.25)6.5-7.5(7.75)	4.0-4.5	7.1 × 4.3	1.44-1.88	1.65	27-62 × 8.0-33
BRNM 699674	(6.75)7.0-7.75(8.25)	(4.25)4.5-5.0(5.25)	7.3 × 4.7	1.40-1.71	1.56	40-86 × 13-28
BRNM 699817	6.5-7.5	4.5-5.25	7.0 × 4.9	1.34-1.56	1.43	29-65 × 14-33
BRNM 705315	6.5-7.5(8.0)	4.5-5.25(5.5)	7.1 × 4.9	1.34-1.78	1.45	33-110 × 13-31
BRNM 706958	(6.75)7.0-7.5	4.0-4.75	7.3 × 4.4	1.49-1.88	1.67	38-72 × 18-32
BRNM 710305	6.7-7.5	4.0-4.75	6.9 × 4.3	1.44-1.75	1.61	40-68 × 15-35
BRNM 733102	(6.0)6.5-7.25(8.0)	4.0-4.75(5.0)	6.9 × 4.3	1.40-1.88	1.61	29-62 × 10-31
BRNM 733259	(6.25)6.5-7.0(7.5)	(4.0)4.25-5.0	6.7 × 4.5	1.34-1.68	1.48	23-60 × 16-37
BRNM 737621	7.0-8.0(9.5)	4.0-5.0	7.6 × 4.6	1.38-1.78	1.63	33-92 × 11-28
BRNM 737622	(6.0)6.5-7.0(7.5)	4.0-4.5(5.0)	6.7 × 4.4	1.43-1.75	1.53	52-65 × 13-27
BRNU (DD128/08)	(6.0)6.5-7.0(8.0)	4.5-5.25(5.5)	6.8 × 4.9	1.27-1.54	1.39	38-84 × 19-35
BRNU (DD141/05)	(6.75)7.0-7.5(8.0)	(4.75)5.0-5.5(6.0)	7.2 × 5.2	1.25-1.50	1.37	37-66 × 10-28
BRNU (DD145/06)	6.75-8.0(8.5)	5.0-5.5	7.4 × 5.3	1.29-1.55	1.41	20-75 × 13-23
BRNU (DD149/05)	6.5-8.0	4.5-5.5(6.0)	7.2 × 5.1	1.27-1.60	1.43	30-105 × 14-36
BRNU (DD173/09)	6.5-7.5	(4.0)4.5-5.0	7.0 × 4.7	1.40-1.62	1.51	25-100 × 12-31
BRNU (DD20/26)	7.0-8.0(8.5)	4.5-5.25	7.4 × 4.8	1.35-1.70	1.54	28-70 × 14-26(46)
BRNU (DD225/10)	6.5-7.5	4.5-5.0(5.25)	6.9 × 4.7	1.35-1.60	1.46	21-72 × 14-31
BRNU (DD346/10)	6.5-7.0(7.25)	4.25-5.0	6.8 × 4.8	1.30-1.56	1.44	23-82 × 14-35
BRNU (DD373/10)	(6.5)7.0-8.0(9.0)	(4.75)5.0-6.0	7.5 × 5.4	1.23-1.54	1.38	30-95 × 12-31
BRNU (DD396/10)	(6.0)6.5-7.0(7.5)	4.25-5.0	6.8 × 4.7	1.30-1.67	1.44	30-75 × 13-28
BRNU (DD411/10)	(6.75)7.0-7.75(8.0)	(4.5)5.0-5.5(5.75)	7.2 × 5.1	1.27-1.60	1.43	42-88 × 19-34
BRNU (DD412/10)	6.5-7.5(7.75)	(4.0)4.25-4.25(5.0)	6.9 × 4.4	1.44-1.79	1.58	30-53 × 11-22
BRNU (DD413/10)	7.0-8.0	4.5-5.25(5.5)	7.4 × 4.9	1.35-1.78	1.52	35-101 × 11-32(39)
BRNU (DD414/10)	(6.5)7.0-8.0(9.0)	4.5-5.5	7.4 × 4.9	1.43-1.64	1.53	47-70 × 15-28
BRNU (DD422/07)	(6.75)7.0-7.75(8.5)	4.5-5.0	7.2 × 4.8	1.34-1.70	1.52	24-120 × 11-38
BRNU (DD680/10)	6.5-8.0(8.5)	4.5-5.5(6.0)	7.5 × 5.3	1.30-1.50	1.42	24-108 × 15-35
BRNU (DD686/10)	(6.5)7.0-7.75	4.5-5.5	7.2 × 4.9	1.30-1.67	1.47	38-74 × 12-31
BRNU (DD705/10)	7.0-8.0(9.0)	(4.25)5.0-5.75	7.6 × 5.2	1.35-1.67	1.48	40-77 × 12-34(45)
BRNU (CI108/124)	6.5-7.5	(4.25)4.5-5.0	7.0 × 4.7	1.38-1.67	1.50	42-78 × 14-25
BRNU (JB-CH22/107)	(6.0)6.5-7.0(7.5)	4.0-4.75	6.7 × 4.5	1.38-1.60	1.50	29-89 × 16-30(39)
CB 12386	(6.0)6.5-7.5(8.0)	4.2-5.0	7.0 × 4.5	1.33-1.70	1.54	34-75 × 13-27
CB 15915	6.25-8.0	4.0-5.25	6.9 × 4.5	1.40-1.68	1.55	30-71 × 13-38
CB 16301	(5.5)5.75-6.75(7.0)	3.75-4.5	6.4 × 4.1	1.44-1.76	1.58	45-65 × 15-32
HR 78060	7.0-8.0	4.5-5.5	7.4 × 5.1	1.31-1.54	1.45	40-120 × 21-39
HR 86124	6.5-7.0(7.5)	4.5-5.25	6.8 × 4.3	1.33-1.50	1.42	36-61 × 18-38
HR 86134	6.5-7.5(7.75)	4.75-5.5	7.0 × 5.0	1.27-1.50	1.40	37-76 × 17-50
PRM 605799	6.5-7.75(8.0)	4.0-4.5(5.0)	7.1 × 4.3	1.44-1.85	1.65	27-70 × 10-31
PRM 814283	6.5-7.5(7.75)	4.25-4.75(5.25)	7.1 × 4.5	1.40-1.67	1.57	34-70 × 10-32
PRM 842276	7.0-7.75	4.0-4.75	7.4 × 4.2	1.56-1.93	1.79	47-86 × 12-35(40)
PRM 892722	6.5-7.5	4.5-5.25(5.5)	7.1 × 5.0	1.27-1.60	1.42	51-72 × 14-28
PRM 895070	(6.0)6.5-7.0(7.5)	4.25-5.0(5.5)	6.7 × 4.6	1.27-1.60	1.45	49-105 × 18-25(42)
PRM 902255	7.0-8.0	4.5-5.25(5.5)	7.4 × 4.8	1.40-1.67	1.55	38-70 × 15-30
PRM 905431	(6.75)7.0-8.0	(4.25)4.5-5.75	7.4 × 5.1	1.31-1.79	1.47	37-75 × 15-29
PRM 905458	(7.0)7.5-8.5	4.0-4.75	7.9 × 4.5	1.49-2.00	1.77	28-65 × 17-24(36)
PRM 946239	(6.5)7.0-7.5(8.0)	4.5-5.2(5.5)	7.3 × 5.0	1.35-1.67	1.46	28-54 × 15-22
<i>Volvariella murinella</i>						
BRNM 721628	6.5-8.0	(3.25)3.75-4.5	7.3 × 4.1	1.62-2.00	1.76	30-55 × 10-21
BRNU (JB-CH/158)	6.75-7.75	3.5-4.5	7.1 × 4.1	1.67-2.00	1.78	42-72 × 12-32
BRNU (JB 09/31)	6.25-7.0(7.5)	3.5-4.25	6.8 × 3.9	1.55-2.00	1.77	32-61 × 9.0-25
HR 86232	(6.75)7.0-8.0	4.0-4.5	7.5 × 4.2	1.67-1.93	1.79	32-61 × 9-22
HR 797026	6.0-7.0(7.5)	(3.75)4.0-4.5	6.8 × 4.3	1.43-1.75	1.76	30-75 × 12-28

Tab. 1. Basidiospore and cheilocystidia sizes in studied specimens of *Volvariella caesiointacta* and *V. murinella*.

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