Hygrophorus taxa from Slovakia described by Kalchbrenner

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Taxa of *Hygrophorus* described by Kalchbrenner from Slovakia were studied. Original descriptions were compared with data of recently collected specimens from type areas and current taxonomic concepts. Kalchbrenner's illustrations of *Hygrophorus erubescens* var. *capreolarius*, *H. hypothejus* var. *mendax* and *H. lucorum* were selected for lectotypes. Epitypes for *H. hypothejus* var. *mendax* and *H. lucorum* were designated. *Hygrophorus capreolarius* and *H. lucorum* are well delimited species, the name *H. hypothejus* var. *mendax* represents a synonym of *H. hypothejus* var. *hypothejus*. *Hygrophorus lucorum* was re-described.

Key words: *Hygrophorus capreolarius*, *H. hypothejus*, *H. lucorum*, type, taxonomy.

Carl Kalchbrenner settled in Slovakia in 1832 when he has accepted a position of an evangelic priest in Spišské Vlachy[1], north-eastern Slovakia (Lizoň, 1985). After being introduced to botany and mycology by Friedrich Hazslinszky[2] he started his investigations of the region of Spiš[3]. During his career he published 60 papers and described more than 400 fungi from Europe, Asia, Australia and South America (Lizoň, 1992; 1997). Most of Kalchbrenner's collections have been destroyed (about 2 500 rescued specimens are held in BRA).

Kalchbrenner described numerous new fungi in his well-known Icones selectae Hymenomycetes Hungariae, including three taxa of *Hygrophorus* based on material collected in the region of Spiš: *H. erubescens* var. *capreolarius* (Kalchbrenner 1874), *Hygrophorus*

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hypothejus var. *mendax* (Kalchbrenner 1875) and *Hygrophorus lucorum* (Kalchbrenner 1874). Both *H. lucorum* and *H. capreolarius* are well-known species recently accepted by most mycologists (e.g. Arnolds 1990, Breitenbach & Kränzlin 1991, Bon 1992, Candusso 1997). *H. hypothejus var. mendax* is a forgotten name mentioned neither in recent literature nor in Index Fungorum (Kirk 2005).

The aim of this study is to typify and compare the original concept with current delimitations of those taxa of *Hygrophorus*.

Material and methods

Fresh material was used for observation of all macroscopic characters. Colour notations are from Kornerup & Wanscher (1978). Microscopic characters were observed in material from dried specimens: fragments of lamellae, stipe and pileipellis were examined in 5 % KOH and a solution of Congo Red in ammonia (1 mL of 25 % ammonia dissolved in filtrated solution of 1.5 g of Congo Red and 50 mL of distilled water). Dimensions of micromorphological characters were calculated as average ± standard deviation of 30 measurements (extreme values in parenthesis). Acronyms of herbaria follow Index herbariorum (Holmgren *et al.* 1990). Location of collecting sites is presented by geographical coordinates and quadrants (Q) of the Central European grid mapping system.

Taxonomy

Hygrophorus erubescens var. ***capreolarius*** Kalchbr., Icon. Select. Hymenom. Hung. 2: 35, 1874.

Lectotype. – Kalchbrenner, Icon. Select. Hymenom. Hung. 2: pl. 18, fig. 3, 1874 (the copy in the library of the Institute of Botany, Bratislava); designated here.

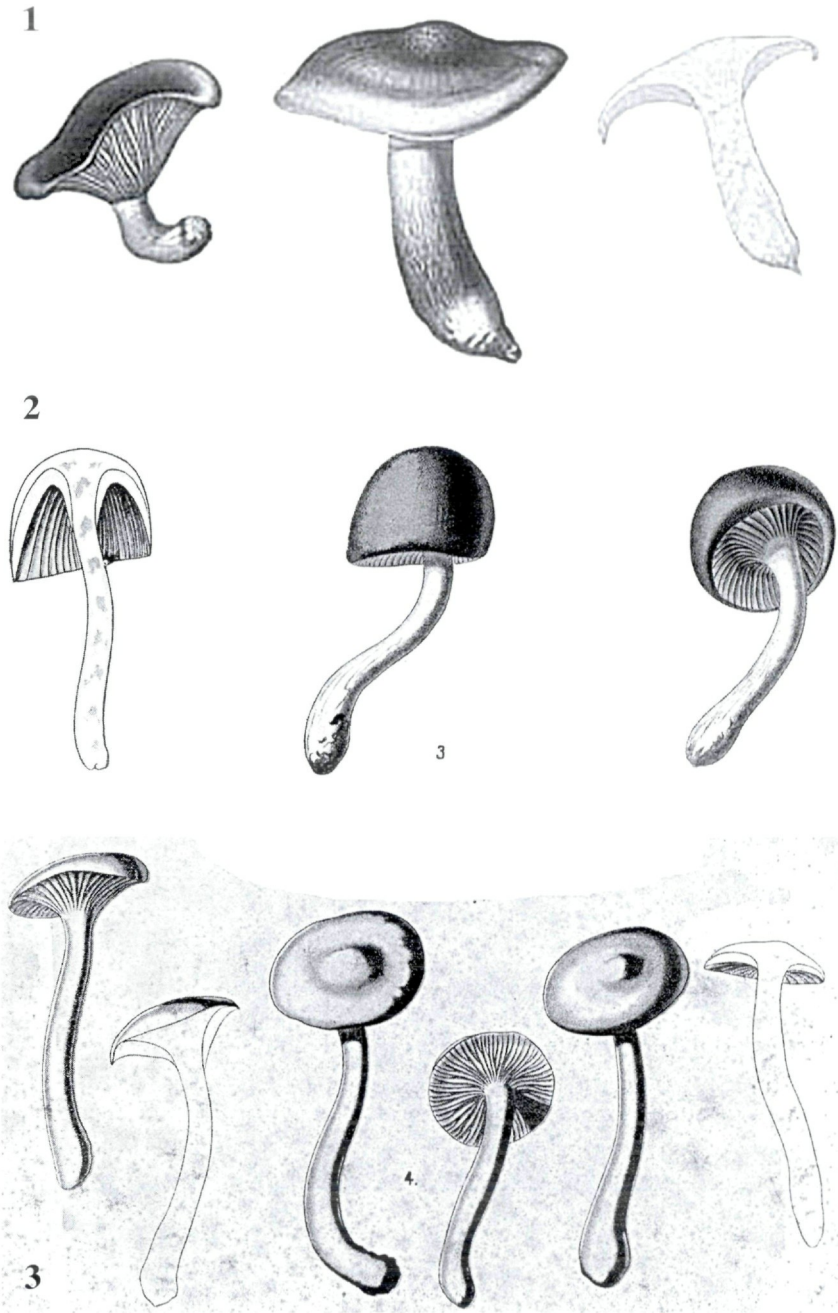
Original collecting site. – "In pinetis umbrosis prope Olaszinum, paucis locis, sed ibi copiose. Szept. Oct."

Accepted name – *Hygrophorus capreolarius* (Kalchbr.) Fr., Hymenom. Eur. p. 407, 1874.

Typification

The taxon was proposed without a specific rank as "*Hygrophorus erubescens* * *capreolarius*", but in the protologue Kalchbrenner noted that "varietatem insignem Hygrophori erubescenti videre debui" thus he treated it as a variety of *Hygrophorus erubescens.*

Kalchbrenner's protologue refers to the plate 18, fig. 3 that we have selected and designated as lectotype (Fig. 1). A specimen from Kalchbrenner's collection (BRA) labeled "*Hygrophorus capreolarius* Werpusch, 21. Oct. 868" might represent original material. The hill



Figs. 1–3. Black-and-white reproduction of Kalchbrenner's icons selected as lectotypes. – **1.** *Hygrophorus erubescens* var. *capreolarius*. – **2.** *Hygrophorus hypothejus* var. *mendax*. – **3.** *Hygrophorus lucorum*.

Werpusch (Verpuš now) is located south to Spišské Vlachy (Olaszinum) and is covered by pine dominated woods. The specimen is in very poor condition lacking almost all microscopic characters so it cannot be used for designation of a prospective epitype. The taxon was not recollected during our field research in the environs of Spišské Vlachy (incl. the hill Verpuš) and thus no relevant material from the type collection site is available for designation of the epitype until now.

Hygrophorus capreolarius is generally accepted as a distinct species. The current concept (Bon 1992, Candusso 1997, Breitenbach & Kränzlin 1991) of the taxon agrees well with the characters in Kalchbrenner's protologue and illustration: the flesh is not turning yellow, and gills and whole fruitbody have darker purple colours.

Hygrophorus hypothejus var. ***mendax*** Kalchbr., Icon. Select. Hymenom. Hung. 3: 43, 1875.

Lectotype. – Kalchbrenner, Icon. Select. Hymenom. Hung. 3: pl. 27, fig. 3, 1875 (the copy in the library of the Institute of Botany, Bratislava); designated here.

Original collecting site – "In colle pinifero Werpusch, prope Olaszinum, ad margines graminosas lucorum. Oct."

Epitype. – Slovakia, Hnilecké vrchy Mts., locality Suchá near Spišské Vlachy, alt. 580 m, N48°54'44" E20°48'04"[4], Q 7090 d, terrestrial in litter and among grass under *Pinus sylvestris*, flysh, 28 Oct 2004, S. Adamčík, V. Kučera, P. Lizoň, S. Ripková (SAV); designated here.

Accepted name – *Hygrophorus hypothejus* (Fr.) Fr., Epicr. Syst. Mycol., p. 324, 1838 var. *hypothejus*.

Description of the epitype (Figs. 4–5).

Pileus 22–47 mm, broadly campanulate or hemisphaerical when young, with involute margin, soon convex to plane, mature depressed or not and with or without low umbo in the centre, surface innately radially fibrillose, centre smooth, shining when wet, viscid to greasy, not hygrophanous, margin grapefruit yellow, grayish brown to yellowish brown (4C5, 5E4, 5F5), centre brown to dark brown (6E4 to 6F4). – Stipe 30–65 × 3–10 mm, cylindrical or narrowly clavate, base usually narrowed, mature with indistinct ring zone, above ring zone dull yellow to wax yellow (3B4 to 3B5), below ring zone viscid and concolorous with pileus, pastel yellow to light yellow (3A4, 4A4), sometimes with orange flush, base paler, stuffed. – Lamellae 2.5–6 mm wide, L = 28–36, l = 1–3, shortly decurrent, edge entire, ivory white, cream to light orange (4A3, 4B3, 5A5). – Spore print white. – Spores (7) 7.2–8.2 (8.8) × (4) 4.5–5 (5.4) µm, av. 7.7 × 4.8 µm, Q = (1.4) 1.5–1.8 (1.9), av. Q = 1.6,

[4] World Geodetic System 1984

ellipsoid to ovoid, sometimes oblong, hyaline, thin-walled. Basidia 4-spored. – Cystidia absent. – Gill trama bilateral. – Pilleipellis a trichoderm consisting of erect, loosely interwoven, occasionally diverticulate or branched hyphae, with intracellular olivaceous-brownish pigment, not incrusted or only on basal part; hyphae in the subpellis with incrusted pigment, 3–8 µm wide. Terminal cells of pileipellis hyphae cylindrical, slender, (40) 50.5–125.5 (190) × (3.5) 4–6 (7) µm, av. 88 × 5 µm. – Context of pileus pseudoparenchymatic, hyphae not incrusted. – Clamp connections in all tissues.

Typification

The only available part of original material for selecting the type is the illustration by Kalchbrenner (1875) (plate 27, fig. 3) that was selected as the lectotype (Fig. 2). During excursions at the type locality we made several rich collections of *Hygrophorus hyphothejus*, but the morphotype with hemispherical and not depressed pileus was not re-collected there. However, in nearby valley Suchá dolina we made a rich collection of *H. hypothejus* including also basidiomata similar to those described by Kalchbrenner. It was selected as the epitype of *H. hypothejus* var. *mendax*.

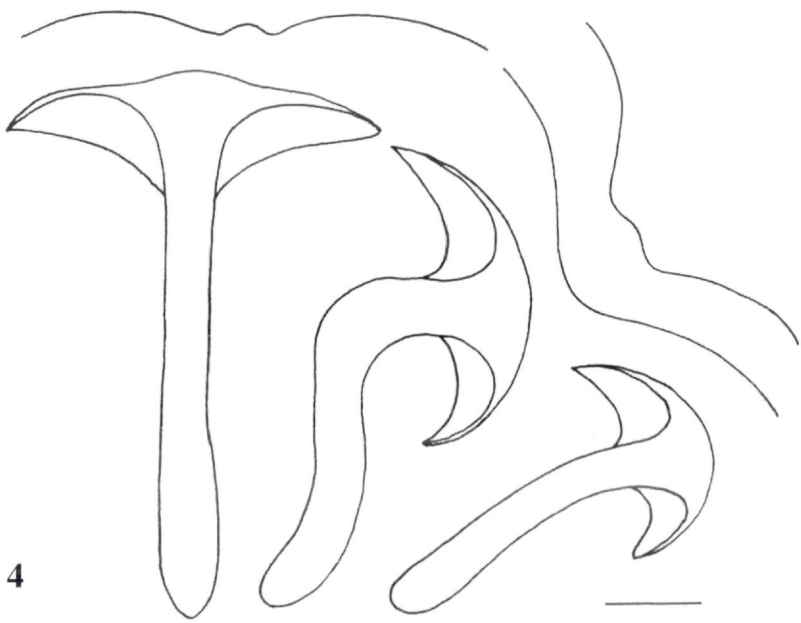


Fig. 4. *Hygrophorus hypothejus* (epitype of var. *mendax*). Longitudinal sections through basidiomata. Bar 10 mm.

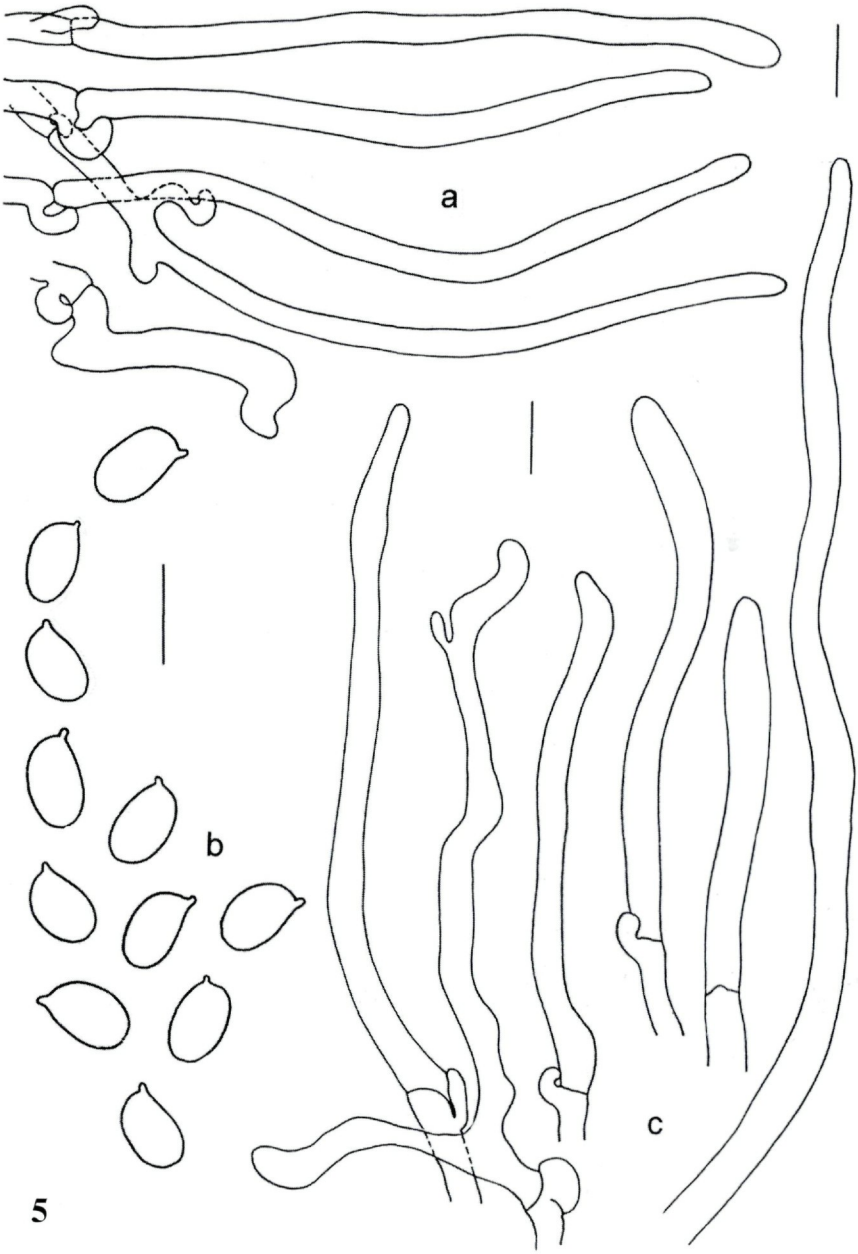


Fig. 5. *Hygrophorus hypothejus* (epitype of var. *mendax*). – **a, c.** Terminal cells of pileipellis hyphae from the cap margin. – **b.** Spores. Bars 10 µm.

The original description of *H. hypothejus* var. *mendax* (Kalchbrenner 1875) includes only a single character which is different from the typical variety: convex to ovoid, not depressed pileus: "pileus nempe haud e convexo depressus sed potius petasiformis, i.e. semiovatus, superne parum deplanatus". Other characters included in the original description are in the range of variability of the typical variety as described in literature (e.g. Arnolds 1990, Candusso 1997). Kalchbrenner mentioned, that he has considered this taxon for several years to be a distinct species, but collections with intermediate basidiomata prompted him to treat it as variety.

According to both our observations and Kalchbrenner's note in the original description, the shape of the pileus is a character variable among a single collection and it is not suitable for delimitation of a taxon. Therefore, we consider the variety *mendax* as identical with the nominal variety of *H. hypothejus*.

Hygrophorus lucorum Kalchbr., Icon. Select. Hymenom. Hung. 2: 35, 1874.

Lectotype. – Kalchbrenner, Icon. Select. Hymenom. Hung. 2: pl. 19, fig. 4, 1874 (the copy in the library of the Institute of Botany, Bratislava); designated here.

Original collecting site. – "Per juga elata montium prope Olaszinum Scepusii, locis graminosis subapricis, praesertim sub Laricibus juvenilibus et ad silvarum margines ericetosas. Not omni anno et paucis modo Locis obvius, sed ubi nascitur, ingenti plerumque copia adest. Szept. Okt."

Epitype. – Slovakia, Hnilecké vrchy Mts., locality Suchá near Spišské Vlachy, alt. 460 m, N48°54'44" E20°48'04", Q 7090d, terrestrial in litter under *Larix decidua*, flysh, 28 Oct 2004, S. Adamčík, V. Kučera, P. Lizoň, S. Ripková (SAV); designated here.

Accepted name. – *Hygrophorus lucorum* Kalchbr.

Specimens examined. – SLOVAKIA: Hnilecké vrchy Mts., near cemetery close to the village of Ol'še, alt. 480 m, N48°55'53" E20°39'38", Q 7089d, terrestrial in litter under *Larix decidua*, flysh, 28 Oct 2004, S. Adamčík, V. Kučera, P. Lizoň, S. Ripková (SAV, fig. 5); Hornádska kotlina basin, Natural reserve Travertínová kopa Sobotisko, alt. ca. 550 m, N48°59'56" E20°47'07", Q 7090b, terrestrial among grasses under *Larix decidua* and *Pinus sylvestris*, on calc-tuff, 29 Oct 2004, S. Adamčík, V. Kučera, P. Lizoň, S. Ripková. (SAV).

Description of the epitype (Figs. 6–7).

Pileus 20–36 (–67) mm, broadly campanulate when young, soon convex to plane, first with broad low umbo, later depressed and often without umbo (when mature), margin inflexed, not striate, surface innately radially fibrillose, centre smooth, viscid to greasy when wet, not hygrophanous, young with white flocculose remnants, margin

yellowish white (3A2), towards centre pale yellow (3A3), in the centre light yellow (3A5-3A6) and sometimes with more orange tint (4A3–4A5). – Stipe 39–86 × 4–11 (15) mm, cylindrical and tapering towards base, base sometimes fusiform or subradicant, connected by veil with margin of pileus when young, fibrillose below ring zone (veil soon disappearing), above the ring zone white to yellowish white (3A2), below the ring zone viscid, pale yellow to light yellow (3A3–4A3), concolorous with pileus, later with indistinct ring zone, hollow, sometimes stuffed. – Lamellae 2–5 (7) mm wide, L = 34–42, l = 1–3, shortly decurrent, edge entire, mature greyish yellow (4B3–4B4). – Spore print white. – Spores (6.4) 7–8.2 (9.4) × (4.3) 4.5-5.1 (5.5) µm, av. 7.6 × 4.8 µm, Q = (1.4) 1.5–1.7 (2), av. Q = 1.6, ellipsoid to ovoid, sometimes oblong, hyaline, thin-walled. – Basidia 39–50 × 7–8 µm, 4-spored, rarely 1- to 2-spored. – Cystidia absent. – Gill trama bilateral. – Pilleipellis a trichoderm consisting of erect, loosely interwoven hyphae with intracellular yellowish pigment, not incrusted; hyphae in the subpellis intricately interwoven, with incrusted pigment, (3) 4–6 µm wide, often anastomosing. Terminal cells of pileipellis hyphae from the cap margin cylindrical, slender, (55) 59–117 (198) × 2.5–3.5 (4) µm, av. 88 × 3 µm; terminal cells of pileipellis hyphae from the cap centre cylindrical, but shorter as at the margin, (23) 33.5–59.5 (77) × 3–4 (4.5) µm, av. 46.5 × 3.5 µm. – Context of pileus pseudoparenchymatic, hyphae not incrusted and 4–15 µm wide. – Clamp connections in all tissues.

Typification

Neither Kalchbrenner (1874) nor later authors (Arnolds 1990, Bon 1992, Candusso 1997) have selected the type of *H. lucorum*. The only available part of original material is the illustration: fig. 3 on plate 19 in Kalchbrenner's Icones (Kalchbrenner 1874) which was selected and designated here as the lectotype (Fig. 3).

Kalchbrenner described the type collecting site as "per juga elata montium prope Olaszinum Scepusii". Spišské Vlachy (in Latin Olaszinum) is situated in a basin and the closest mountains are south to the village. Also local names of hills and valleys south of Spišské Vlachy correspond to local names of sites mentioned in Kalchbrenner's publications (Kalchbrenner 1865, 1868, 1873, 1874, 1875, 1877). Therefore, we selected the collection from the locality Suchá south of Spišské Vlachy as epitype (interpretative type).

Our observation of the macroscopic characters of *H. lucorum* agrees with the protologue and illustration by Kalchbrenner (1874), as well as with recently published descriptions (Breitenbach & Kränzlin 1991, Arnolds 1992, Bon 1992, Candusso 1997).

Fig. 6. *Hygrophorus lucorum* (epitype). Longitudinal sections through basidiomata. Bar 10 mm.

Descriptions of the pileipellis structure vary in literature. Although Arnolds (1990) and Bon (1992) described the pileipellis as ixocutis, their descriptions differ in details. Arnolds described cylindrical terminal cells and Bon more or less clavate ones. Our description corresponds better with that of Arnolds: we have observed only cylindrical terminal cells. Arnolds mentioned "minutely incrusting pigment on part of the hyphae". This character corresponds with our observations: the terminal part of hyphae lacks any incrustation. The latter appears only in the subpellis and was not seen on hyphae of the pileus trama.

Description of spore size and shape are also very different in literature (Tab. 1). Arnolds (1990) and also Breitenbach & Kränzlin

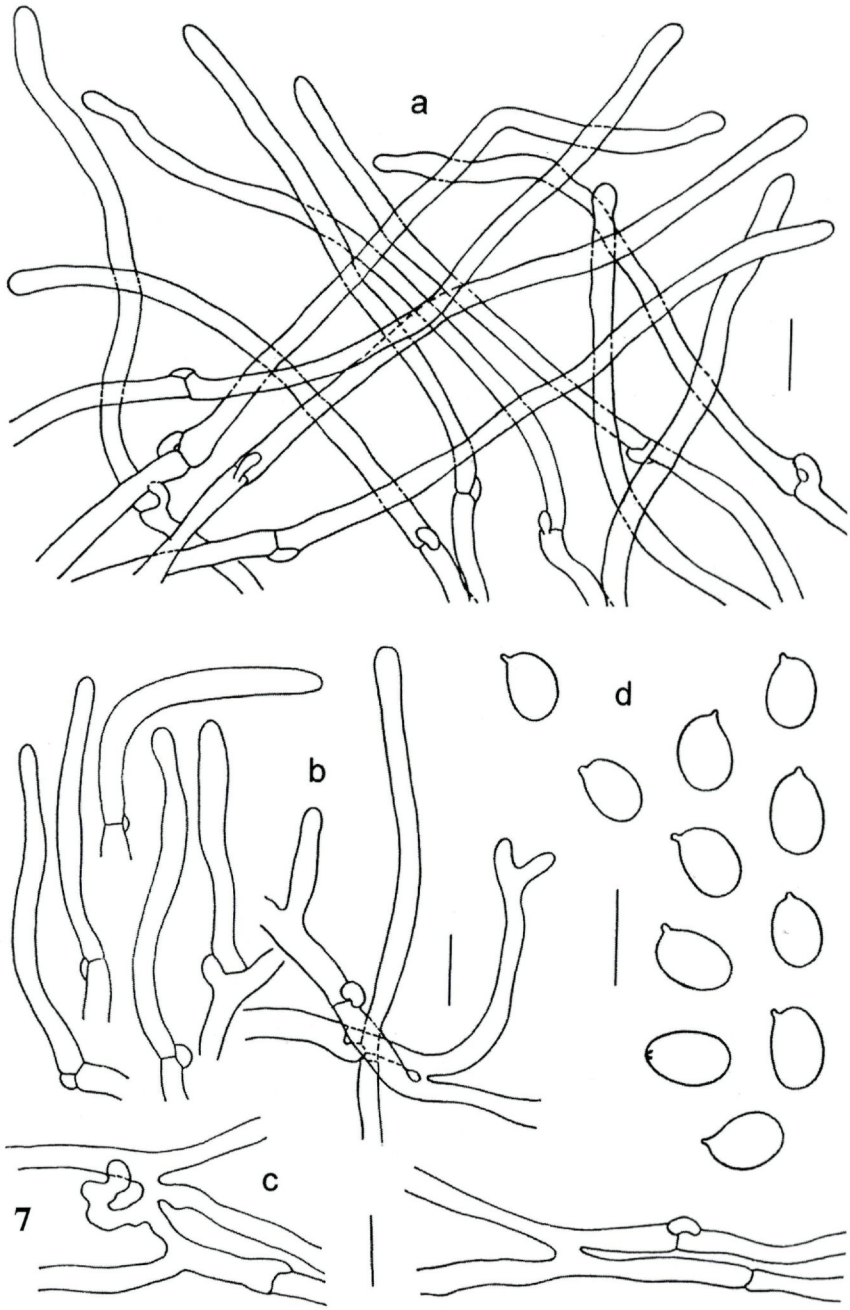


Fig. 7. *Hygrophorus lucorum* (epitype). – **a.** Terminal cells of pileipellis hyphae from the cap margin. – **b.** Terminal cells of pileipellis hyphae from the cap centre. – **c.** Anastomozing hyphae in the subpellis. – **d.** Spores. Bars 10 µm.

(1991) described a similar range of spore size as in our collections but Arnolds mentioned mostly an oblong spore shape. Bon (1992) and Candusso (1997) described larger ellipsoid or ovoid spores. According to our observations, spores in a single collection are very variable and both distinctly oblong and distinctly ovoid spores are present. Moreover, we have observed also differences among different collections: spores from the epitype are mostly ovoid, whereas in both collections from the Natural reserve Travertínová kopa Sobotisko and Ol'še the spores are mostly oblong. All our collections are in the range of variability described by Arnolds.

Tab. 1. – *Hygrophorus lucorum*. Comparison of spore size and shape according to different authors and collections. (av. = on average; n.d. = no data available; SAV = collections by S. Adamčík, V. Kučera, P. Lizoň, S. Ripková)

Reference	Size (μm)	Quotient	Shape
Arnolds (1990)	6.5–9.0 × 4.0–5.5	(1.6) 1.7–1.9 (2)	oblong, rarely ellipsoid
Bon (1992)	8.0–9.0 × 5.0–6.0	n.d.	ellipsoid or inverted ovoid
Breitenbach & Kränzlin (1991)	6.8–9.5 × 4.5–5.3	1.4–1.9	ellipsoid
Candusso (1997)	7.2–9.0 × 5.0–6.0	1.4–1.5	ellipsoid, ovoid, plum-shaped
Epitype (SAV)	7.0–8.2 × 4.5–5.1 (av. 7.6 × 4.8)	1.5–1.7 (av. 1.6)	mostly ovoid, rarely oblong
Ol'še (SAV)	7.1–8.1 × 3.9-4.5 (av. 7.6 × 4.2)	1.7-1.9 (av. 1.8)	oblong, ovoid or ellipsoid
Nat. res. Travertínová kopa Sobotisko (SAV)	7.3–8.4 × 4.0–4.5 (av. 7.9 × 4.2)	1.7–2.0 (av. 1.9)	mostly oblong

Hygrophorus lucorum is a species clearly delimited by its pale yellow colour, viscid surface, and association with *Larix*. We believe that the description of material collected in the area of the type locality significantly improves the understanding of variability and delimitation of this species.

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