

***Boletus marekii*, a new species with truncate spores from  
the *Boletus chrysenteron* group**

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*Boletus marekii*, a new species which was found in northwestern Bohemia (Czech Republic), is described. This species, belonging to the *Boletus chrysenteron* group (*Boletus* subgen. *Xerocomus*), is characterised mainly by its xerocomoid appearance, red-coloured, soon coarsely rimose-areolate pileus and smooth, truncate spores. Characters distinguishing *Boletus marekii* from other species of this group, e.g. *Boletus armeniacus*, *Boletus rubellus*, *Boletus porosporus*, *Boletus fennicus*, *Boletus ripariellus* and *Boletus declivatum*, are discussed. A new combination, *Boletus fennicus*, is proposed.

**Key words:** *Boletus marekii* spec. nov., *Boletus* subgen. *Xerocomus*, *Boletaceae*, Czech Republic

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Je popsán *Boletus marekii* (hřib Markův), nový druh, který byl objeven v severozápadních Čechách. Tento druh, náležící do skupiny druhu *Boletus chrysenteron* (*Boletus* subgen. *Xerocomus*), je charakterizován hlavně svým xerocomoidním vzhledem, červeně zbarveným, brzy hrubě políčkovitě rozpukaným kloboukem a hladkými, na vrcholu uťatými výtrusy. Jsou diskutovány znaky odlišující *Boletus marekii* od jiných druhů této skupiny, např. *Boletus armeniacus*, *Boletus rubellus*, *Boletus porosporus*, *Boletus fennicus*, *Boletus ripariellus* a *Boletus declivatum*. Je navržena nová kombinace: *Boletus fennicus*.

#### INTRODUCTION

In 1992, during field research of the mycoflora of the Doubravská hora hill near the town of Teplice in north-western Bohemia (Czech Republic), the second author found a small xerocomoid bolete with a conspicuously bright red pileus. Other fruit bodies of this bolete were later found by him repeatedly at the same site in the course of several following seasons. Long-time observations and detailed study of collected material showed that this bolete has several constant distinctive features. Finally, the present authors came to the conclusion that this bolete is a new, hitherto undescribed species.

## MATERIALS AND METHODS

Macroscopic characters of the bolete described below were studied on fresh fruit bodies found at the type locality in the years 1992, 1994, 2001, 2003, 2005 and 2006. Some of the studied fruit bodies have been deposited in the private herbarium of the first author and in the National Museum, Prague (herbarium PRM).

Microscopic characters were examined predominantly on dried material. Sections from dried specimens were revived both in Melzer's reagent and in a 3–10 % solution of ammonium hydroxide (NH<sub>4</sub>OH) with or without Congo Red. The spore surface was examined with a scanning electron microscope (SEM).

Meaning of some abbreviations used in this paper: BRNM = herbarium of the Moravian Museum, Brno; JŠ = private herbarium of J. Šutara; NNR = National Nature Reserve; PLA = Protected Landscape Area.

## RESULTS

***Boletus marekii* Šutara et Skála spec. nov.**

Habitu aliquatenus revocat *Boletum armeniacum*. Pileus 25–50(–60) mm latus, primum hemisphaericus, dein convexus vel pulvinatus, a juventute rubro tinctus, exempli gratia aurantio-ruber, vivide ruber, carmineus, vinoso-ruber vel obscure ruber, in centro raro tamquam leviter griseolo pulverulentus. Margo pilei saepe pallidior, pallide flavus vel roseus. Pileipellis sicca, velutina, mox conspicue rimoso-areolata, palisadodermate formata. Incrustatio hypharum palisadodermatis tenuis. Tubuli adnati vel leviter depressi iuxta stipitem et saepe dente decurrentes, 5–8 mm longi, flavi. Pori concolores, in maturitate angulati et satis magni (circa 1 mm). Tubuli et pori tactu leviter caerulescentes vel pallide caeruleo-virescentes. Sporae leves, subfusioideae, truncatae, (10,5–)12,5–15(–19) × (4,5–)5,2–6,2(–7,5) μm. Stipes subaequalis, 30–50 × 6–15 mm, subtiliter flocculoso granulatus, non reticulatus, pallide flavus vel albido-flavidus, nonnumquam leviter longitudinaliter striatus, in parte media interdum tinctu sordide rubello, sordide rubello-brunneolo vel vinoso-rubello. Basis stipitis tomentosa, albida vel pallide sordide flavida. Caro pallide flavida, intra partem mediam stipitis interdum vinoso-rubella et intra basem stipitis plerumque pallide flavo-brunneola, fracta leviter caerulescens. Sapor mitis, odor inconspicuus.

*Boletus marekii* differt: – a *Boleto armeniaco* sporis truncatis et aliquatenus latoribus, – a *Boleto fennico* sporis levibus, pileo non modo in margine, sed etiam in centro conspicue rimoso-areolato, carne et hymenophore minus caerulescenti atque habitatione alia, – a *Boleto porosporo* pileipelle rubro tincto, incrustatione hypharum palisadodermatis pilei tenuiore atque superficie stipitis non cinerascenti.

**Holotypus:** Bohemia boreo-occidentalis, ad urbem Teplice, in clivo austro-occidentali collis „Doubravská hora”, in silva frondosa (*Quercus robur*, *Acer platanoides*, *Acer pseudoplatanus* et *Fraxinus excelsior*), 11.VII.2005, leg. E. Skála et E. Fujdiak. Holotypus in herbario Musei Nationalis Pragae (PRM 857255) et isotypus in herbario privato J. Šutara (JŠ 4433/b) asservatur.

**Etymology:** in honour of Antonín Marek (1912-1980), amateur mycologist that was engaged in the popularisation of mycology and in research of the mycoflora of the north-western part of Bohemia.

**Pileus** at first hemispherical, then convex to pulvinate, 25–50(–60) mm wide, with pellis red-coloured from youth, e.g. orange-red, bright red, carmine, but also wine-red or dark red, rarely as if slightly greyish powdered in the centre. Pileus margin mostly lighter, pale yellow or rose-pink. Surface dry, matt, when young velutinous, without a fibrillose aspect under a hand-lens, soon cracking near the margin and then becoming conspicuously rimose-areolate overall, exposing the pale yellowish context in the cracks.

**Tubes** 5–8 mm long, adnate to slightly depressed around the stipe and often shortly decurrent with a tooth, initially light yellow, then vivid yellow, later olivaceous yellow. Pores concolorous with tube-sides, in age angular and relatively large (about 1 mm) as in other species of the *Boletus chrysenteron* group. Both tubes and pores stain slightly blue or pale blue-greenish when bruised.

**Stipe** nearly equal, 30–50 × 6–15 mm, light yellow to whitish yellowish, sometimes slightly longitudinally striate, in the middle part at times with a dirty reddish, dirty red-brownish or vinaceous reddish tint; surface with very minute floccose granules, non-reticulate. The floccose granules are more or less concolorous with the background – yellowish on the yellowish parts of the stipe and reddish or brownish on the parts which are reddish or brownish. Stipe base covered with a whitish to pale dirty yellowish tomentum. Partial veil and annulus absent.

**Context** in the pileus pale yellowish, above tubes more yellow, in the upper and middle part of the stipe pale yellowish, but in the middle part sometimes also wine-reddish and in the lower third usually pale yellow-brownish, when cut slightly bluing, particularly above the tubes and in the upper half of the stipe. Taste mild, smell inconspicuous.

**Pileipellis** a palisadoderm composed of parallel or subparallel, anticlinally and densely arranged hyphae whose terminal elements reach the same (or approximately the same) level. The hyphae consist of chains of cells which are short to moderately long, subellipsoid or nearly cylindrical, often somewhat constricted at the septa, (5–)8–17(–21) µm wide, containing a dissolved, almost hyaline, pale yellowish content, sporadically also with a granular, honey-brown substance in Melzer's reagent. Terminal cells (10–)20–40(–60) × (6–)8–15 µm, mostly tapered towards an obtusely rounded top, less often nearly ellipsoid or shortly sub-

cylindrical. When young the palisadodermal hyphae are smooth, later the walls of some palisadodermal elements become faintly roughened with a weak incrustation. This incrustation (particularly when observed in Melzer's reagent) is distinctly weaker and finer than in *B. porosporus*, *B. chrysenteron* and some other species of this group. Thickness of the anticlinally arranged palisadoderm varies in the range (150–)200–350(–450)  $\mu\text{m}$  according to age and according to location on the pileus. During growth the initially continuous palisadoderm gradually breaks up into fragments as the pileus gradually expands. Pileus trama composed of loosely interwoven, filamentous or somewhat broadened, 5–16  $\mu\text{m}$  wide, non-amyloid hyphae with dissolved or granular, pale yellowish to honey-brown content in Melzer's reagent.

Hymenophoral trama in a fully developed state has a structure intermediate between the boletoid and phylloporoid type. This intermediate trama type is best developed in middle-aged or somewhat younger (but not very young) fruit bodies. In very young developmental stages this tramal structure is not yet developed sufficiently and, on the other hand, in a mature or overmature stage it changes into a structure resembling the phylloporoid or a subregular type (for further information concerning the development of the hymenophoral trama in the *Boletaceae*, see Šutara 2005). Lateral strata in the fully developed state slightly divergent, slightly gelatinous, somewhat lighter and somewhat more loosely arranged than the mediostratum, with hyphae 5–15  $\mu\text{m}$  wide, not touching each other. Distance between the hyphae of the lateral stratum in transverse sections is (1–)2–4(–7)  $\mu\text{m}$ . Mediostratum readily staining with Congo-Red, densely arranged, with hyphae 3–9  $\mu\text{m}$  wide, touching each other. Basidia clavate or subcapitate, mostly 4-spored, 26–48(–53)  $\times$  11–15  $\mu\text{m}$ , often with a conspicuous, granular content, sometimes also with small globules. Pleurocystidia scattered, smooth and thin-walled, fusiform or elongate fusiform, rarely almost lageniform, 30–52  $\times$  6.5–14  $\mu\text{m}$ . Cheilocystidia similar to the pleurocystidia, smooth and thin-walled, fusiform or elongate fusiform, rarely almost lageniform, 33–54  $\times$  7–14  $\mu\text{m}$ .

Spores smooth, subfusoid, with a distinct suprahilar depression in profile, in maturity mostly truncate to slightly depressed at apex, (10.5–)12.5–15(–19)  $\times$  (4.5–)5.2–6.2(–7.5)  $\mu\text{m}$ , Q (length/width ratio) = (1.9–)2.2–2.7(–3.0), yellow or brownish in Melzer's reagent. Spore-print not obtained (probably brownish and possibly also with an olivaceous tint as in many other species of the *B. chrysenteron* group).

An essential part of the stipe is covered with a gradually fragmenting caulohymenium with scattered fertile caulobasidia which produce truncate spores as the basidia of the hymenophore. Caulobasidia 25–46(–52)  $\times$  11–15  $\mu\text{m}$ , clavate or subcapitate, mostly 4-spored, often with a granular content, sometimes also with small globules. Caulocystidia 36–73  $\times$  7–15(–19)  $\mu\text{m}$ , smooth and thin-walled, fusiform, elongate fusiform, fusiform-ventricose or lageniform, some-



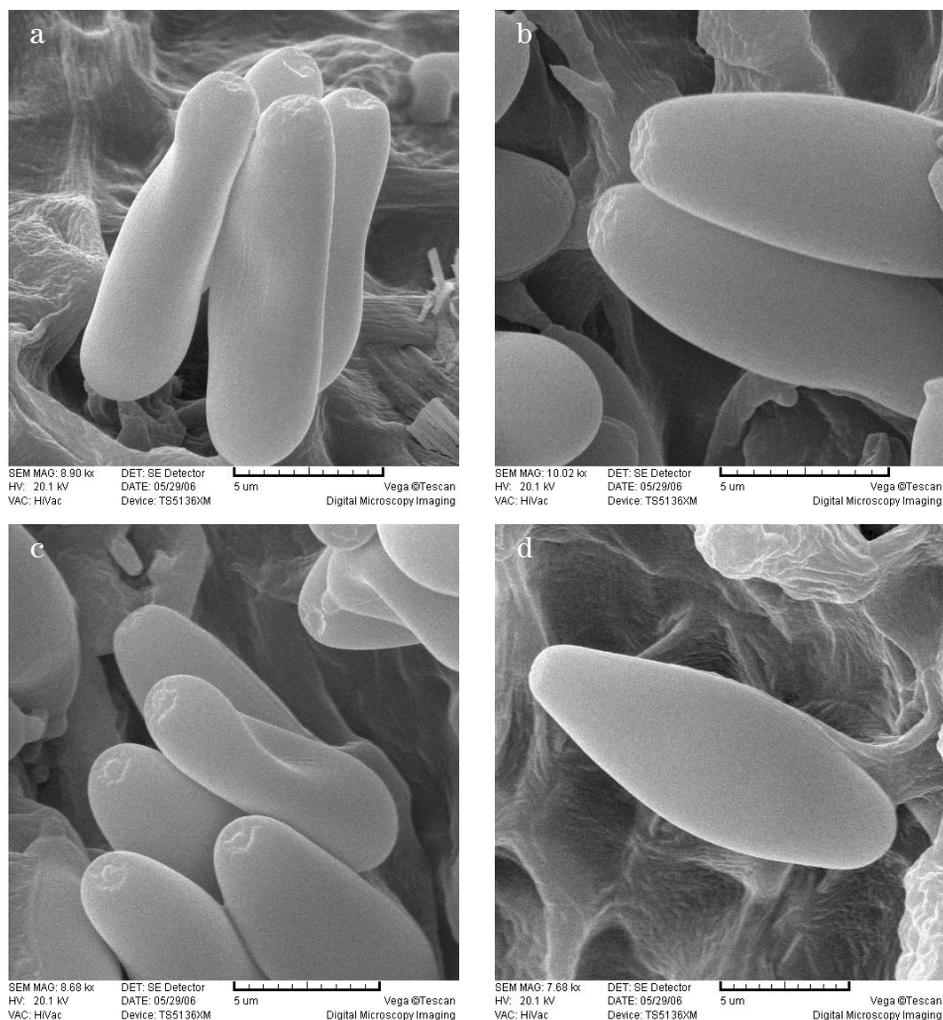
**Fig. 1.** *Boletus marekii*. North-western Bohemia (Czech Republic), near the town of Teplice, Doubravská hora hill, 11 July 2005 leg. E. Skála and E. Fujdiak (PRM 857255, holotype; and JŠ 4433/b, isotype). Photograph by E. Skála.



**Fig. 2.** *Boletus marekii*. Doubravská hora hill (type locality), 25 July 2001 leg. E. Skála (JŠ 4435).



**Fig. 3.** *Boletus marekii*. Doubravská hora hill (type locality), 28 Aug. 1994 leg. E. Skála. Photographs 2 and 3 by E. Skála.



**Fig. 4.** Spores of *Boletus marekii*: **a** – material collected 11 July 2005 (PRM 857255, holotype); **b**, **c** – material from 4 Aug. 2003 (JŠ 4434); **d** – material from 25 July 2001 (JŠ 4435). SEM microphotographs by V. Procházka.

times with a long neck. Stipe base infertile, covered with a tomentum loosely entangled of filamentous, (2–)3–6(–7) µm wide hyphae. A lateral stipe stratum was not found in most specimens. Only in two examined fruit bodies this layer was developed in a very reduced form at the apex of the stipe. This reduced lateral stratum was very thin (not thicker than 20–30 µm) and somewhat loosely arranged,

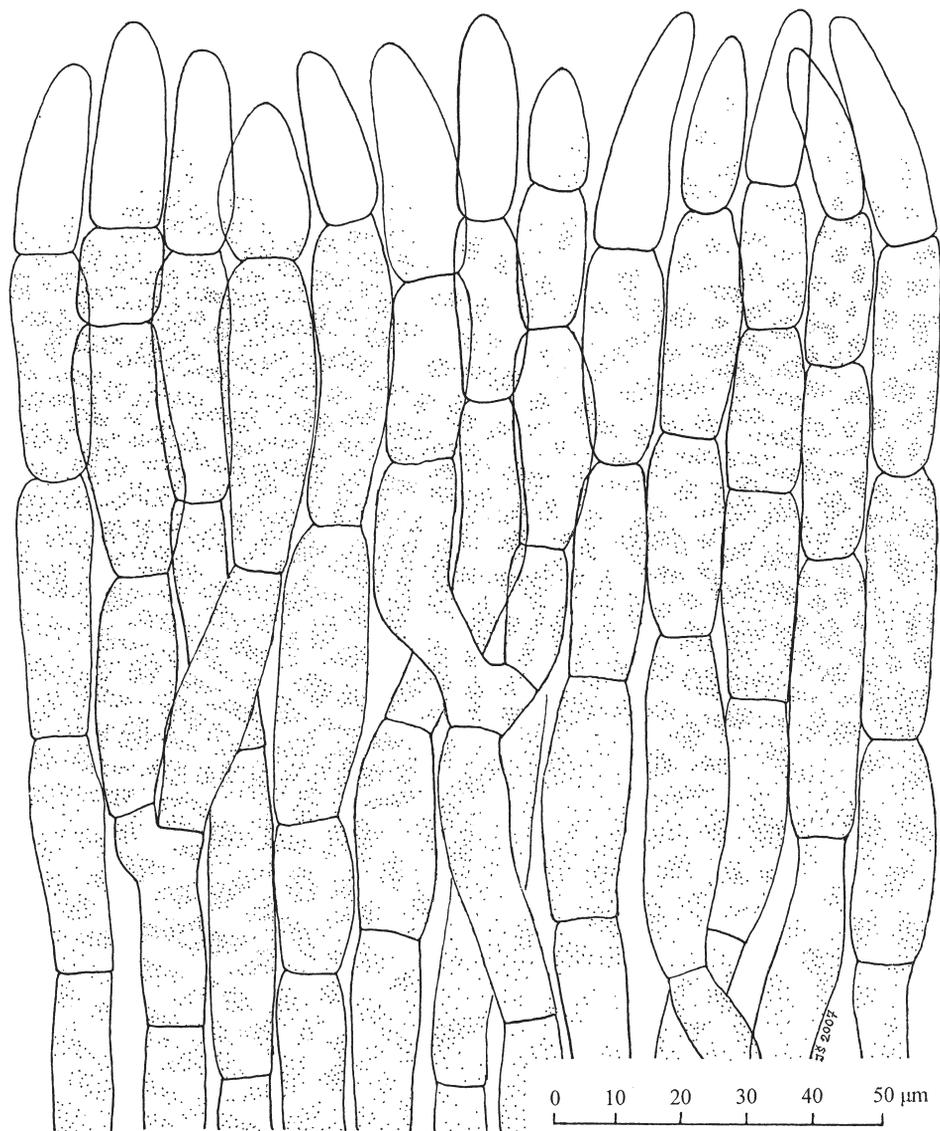
but not gelatinised (for the meaning of the term ‘lateral stipe stratum’, see Šutara 2005). Stipe trama composed of hyphae 4–21 µm wide, densely and more or less regularly arranged, parallel or subparallel with stipe axis, non-amyloid, almost hyaline or pale yellowish in Melzer’s reagent. Trama of both pileus and stipe composed of a monomitic hyphal system with generative hyphae which are thin-walled, exceptionally with walls very slightly thickened (up to 0.6 µm). Clamp connections not found in the fruit body.

Locality and habitat: Czech Republic, north-western Bohemia, less than 1 km from the eastern margin of the town of Teplice, southwest-facing slope of Doubravská hora hill, marginal part of a deciduous, predominantly oak forest, on soil with neutral soil reaction (geological bedrock is phonolite) in fallen leaves under high trees of *Quercus robur* and small, young trees of *Acer platanoides*, *Acer pseudoplatanus* and *Fraxinus excelsior*, alt. 286 m, 12 July 1992, 28 Aug. 1994, 25 July 2001, 4 Aug. 2003 leg. E. Skála (JŠ 4434, 4435), 11 July 2005 leg. E. Skála and E. Fujdiak (PRM 857255, holotype; JŠ 4433/b, isotype; and JŠ 4433/c), 14. Aug. 2006 leg. E. Skála, J. Šutara and E. Fujdiak (JŠ 4311). In addition to the above-mentioned trees, the following plants were found at the locality: *Cornus mas*, *Ribes grossularia*, *Symphoricarpos rivularis*, *Hedera helix* and *Cephalanthera alba*.

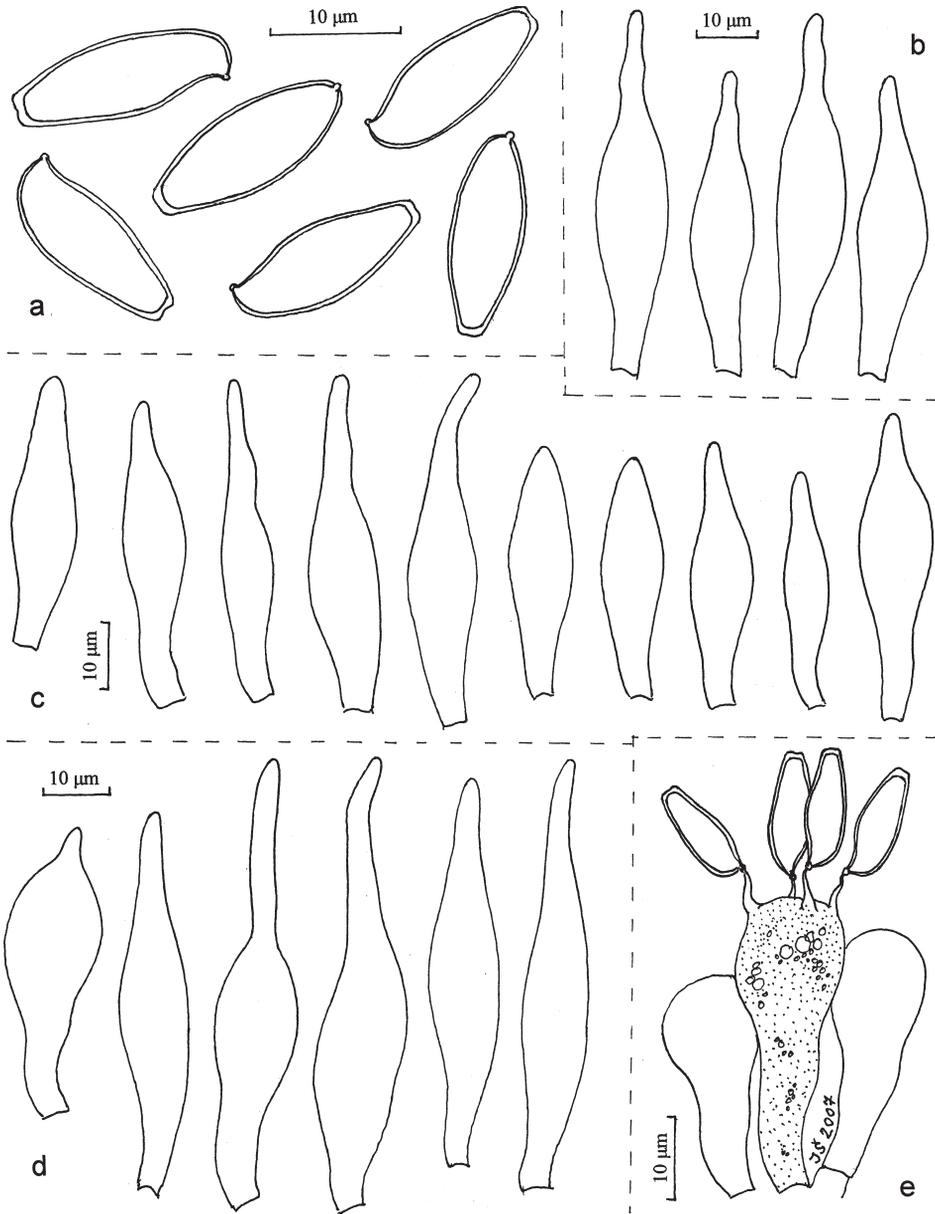
#### DISCUSSION

Characteristic features of *Boletus marekii* can be summarised as follows: fruit bodies relatively small, of a xerocomoid appearance; pileipellis red-coloured from youth, e.g. orange-red, bright red, carmine to dark red, soon cracking and then coarsely rimose-areolate over the entire pileus surface, consisting of a palisadoderm with weakly incrustated hyphae; both tubes and pores yellow, slightly bluing or pale blue-greening when injured, pores in maturity relatively large (about 1 mm); spores smooth and truncate; stipe light yellow to whitish yellowish, in the middle sometimes dirty reddish, dirty red-brownish or wine-red-dish; context in the pileus and upper half of the stipe pale yellowish, when cut slightly bluing. This species can be easily recognised by its red-coloured pileipellis and the truncate, smooth spores. Such a combination of characters is quite exceptional, not occurring in any other species of the *Boletaceae*.

*B. marekii* belongs to *Boletus* L. subgen. *Xerocomus* (Quél.) Maubl. and macroscopically is rather similar to some species of the *B. chrysenteron* group, particularly *Boletus armeniacus* Quél., *Boletus ripariellus* (Redeuilh) Watling and *Boletus fennicus* (Harmaja) Šutara, partly also *Boletus porosporus* (Imler) ex Watling, *Boletus rubellus* Krombh. and a reddish form of *Boletus declivitatum* (C. Martin) Watling.



**Fig. 5.** *Boletus marekii*. Palisadoderm on the pileus (PRM 857255, holotype). Some of palisadodermal cells have a roughened, faintly incrustated surface. This incrustation is weaker and finer than in *Boletus porosporus* and some other species of the *Boletus chrysenteron* group. Del. J. Šutara.



**Fig. 6.** *Boletus marekii*: **a** – spores; **b** – cheilocystidia; **c** – pleurocystidia; **d** – caulocystidia; **e** – two caulobasidioles with one caulobasidium bearing almost fully developed, distinctly truncate spores. Del. J. Šutara.

*B. armeniacus* differs from *B. marekii* mainly in its non-truncate and somewhat narrower spores whose width is according to our observations (4–)4.5–5.7(–6.3)  $\mu\text{m}$  and according to other authors (4–)4.5–5.5(–6)  $\mu\text{m}$  (Redeuilh 1990), 4–5(–6)  $\mu\text{m}$  (Engel et al. 1996), 4–5.5(–6)  $\mu\text{m}$  (Lannoy and Estades 2001), (3.8–)4.8  $\pm$  0.41(–6.3)  $\mu\text{m}$  (Ladurner and Simonini 2003) and 5–5.8  $\mu\text{m}$  (Watling and Hills 2005). There are also certain differences between *B. armeniacus* and *B. marekii* in the macroscopic appearance of their pileus surface and stipe ornamentation. In *B. armeniacus* the pileipellis cracks more minutely and in the central part of the pileus it often remains almost or entirely unbroken. The stipe ornamentation of *B. armeniacus* is mostly formed by minute, vividly red floccose granules on a yellow or pale yellowish background. In *B. marekii* such a conspicuous colour contrast between the red granular particles and the yellow background of the stipe surface has not been observed.

*Boletus rubellus* is distinguished from *B. marekii* by the following characters: its spores are not truncate; its pileipellis is only (60–)80–150(–180)  $\mu\text{m}$  thick, composed of hyphae which are merely 4–10(–14)  $\mu\text{m}$  wide; its pileus surface does not crack under normal conditions and the stipe ornamentation is usually formed by minute red granules on a yellowish background as in *B. armeniacus*.

*Boletus porosporus* differs from *B. marekii* mainly in its olive-ochraceous, grey-brown, olivaceous brown to deep brown pileipellis and microscopically in a coarser incrustation of the hyphae of the palisadoderm on the pileus. Observations of the present authors suggest that there is also a certain difference between *B. marekii* and *B. porosporus* in the coloration of the stipe. One of typical characters of *B. porosporus* is that the surface of its stipe has a tendency to change colour with age to grey, olive-grey, dirty brownish grey or even blackish grey. In *B. marekii* such a colour change has so far not been observed. In one exceptional case the stipe surface of one old fruit body of *B. marekii* was brown, but this brown stipe surface, which had a granular aspect, was distinctly different from the predominantly grey, almost smooth surface of the stipe of *B. porosporus*.

*Boletus fennicus* differs from *B. marekii* in the following aspects: its spores have a longitudinally striate surface; the pileus cracks near the margin but at the centre it usually remains unbroken; hymenophore and context stain more intensely blue on touch; the stipe is more deep red, having the same red colour as the pileus; it usually occurs at sites with nitrogen-rich soils, mostly under *Betula* and *Alnus* (Harmaja 1998 and 1999, Peintner et al. 2003, Ladurner and Simonini 2003, Antonín and Vágner 2006).

*Boletus ripariellus* is well distinguished from *B. marekii* mainly by its spores, which are not truncate, have a longitudinally striate surface and are distinctly narrower, merely (4–)4.5–5.2(–5.8)  $\mu\text{m}$  broad. In contrast to *B. marekii*, *B. ripariellus* has often a red-spotted stipe and prefers humid habitats under deciduous

trees, especially *Populus*, *Alnus*, *Quercus* and *Salix* (Redeuilh 1997, Peintner et al. 2003, Ladurner and Simonini 2003).

*Boletus declivitatum* (= *Xerocomus quercinus* H. Engel et T. Brückner nom. inval.) differs from *B. marekii* in the following features: its spores are not truncate; the context in the stipe base is carrot-coloured; the pileipellis cracks only rarely and is brown-grey, brown, brown-orange, sometimes with pink or reddish hues, but never so bright red as in *B. marekii* (Engel et al. 1996, Watling 2004, Watling and Hills 2005).

#### MATERIAL OF THE OTHER SPECIES EXAMINED

##### ***Boletus armeniacus***

Czech Republic: Štáhlavice near Plzeň, 23 Sept. 1983 leg. J. Valter, det. Z. Pouzar (JŠ 2629). – Dam of fish-pond Staroborský rybník near Strakonice, 28 Aug. 1987 leg. F. Vavřík, det. E. Skála (JŠ 4451). – Bulgaria: Primorsko, 15 June 2005 leg. M. Vacková, det. J. Šutara (JŠ 4123). – Near NNR Ropotamo, 20 June 2006 leg. and det. J. Šutara (JŠ 4284, 4285).

##### ***Boletus declivitatum***

Czech Republic: At the foot of Mt. Milešovka, 23 July 1988 leg. J. Biber et al., det. E. Skála and J. Šutara (JŠ 4455–4459). – Teplice, Písečný vrch hill, 22 July 2001 leg. and det. J. Šutara (JŠ 4454). – Teplice, Doubravská hora hill, 23 June 2002, 6 Aug. 2003, 23 July 2005 and 19 Aug. 2005 leg. and det. E. Skála and J. Šutara (JŠ 4133, 4206–4210, 4460–4462). – Olšinky near Ústí nad Labem, 29 July 2002 leg. and det. M. Kříž, rev. J. Šutara (JŠ 4452).

##### ***Boletus fennicus***

Czech Republic: Brno-Útěchov, 9 July 2000 leg. A. Vágner, det. V. Antonín (BRNM 693777).

##### ***Boletus porosporus***

Czech Republic: Kaňkov hill near Bílina, 26 June 1979, 29 July 1980, 19 Aug. 1981, 9 Sept. 1983, 15 Aug. 1984 leg. and det. J. Šutara (JŠ 016, 248–250, 1626–31, 2189, 2802). – Teplice, Doubravská hora hill, 2 July 1996, 2 July 2005 leg. and det. E. Skála and J. Šutara (JŠ 4131, 4464). – Near NNR Vršíček, not far from Kostomlaty pod Milešovkou, 2 Sept. 1985 leg. L. Vlček and 28 June 1990 leg. J. Zimmermann, det. J. Šutara (JŠ 3096, 3253–55). – Kletečná hill near Velemín, 5 July 1984 leg. J. Biber, det. J. Šutara (JŠ 4463). – Sedlecký Špičák hill near Hrádek nad Nisou, 10 July 1982 leg. L. Vsetečka, det. J. Šutara (JŠ 2021). – NNR Rakovec near Jedovnice, 10 July 1981 leg. F. Pavlík, det. J. Šutara (JŠ 1703).

***Boletus ripariellus***

Czech Republic: Braňany not far from Bílina, 1 and 5 Aug. 1979, 16 Aug. 1981, 12 Sept. 1981, 1 Sept. 1982 leg. and det. J. Šutara (JŠ 008, 011, 052, 1624, 1806, 2043-62). – Near NNR Vršíček, not far from Kostomlaty pod Milešovkou, 25 Aug. 1979, 4 Sept. 1979 leg. and det. J. Šutara (JŠ 205, 721). – Bílina, 28 Aug. 1985 leg. P. Skuthan, det. J. Šutara (JŠ 4466). – Slovakia: Near NNR Chotínské piesky, 16 Sept. 1998 leg. and det. J. Šutara (JŠ 4440-49).

***Boletus rubellus***

Czech Republic: PLA Třeboňsko, close to Holenský potok, not far from Holná fish-pond, 25 Aug. 1983 leg. K. Dobrovanský and 27 Aug. 1983 leg. J. Šutara, det. J. Šutara (JŠ 2321-25, 2327, 2353-54, 2371-77). – Velvěty near Teplice, Sept. 1992 and 17 Oct. 1995, leg. and det. V. Zíta (JŠ 4465, 4469-71). – Kněževy, not far from Rakovník, 29 July 2001, leg. V. Bazika, det. J. Šutara et al. (JŠ 4468). – Choceň, 8 Aug. 1998 leg. and det. O. Jindřich (JŠ 4467). – PLA Třeboňsko, NNR Stará řeka, 2 Oct. 2006 leg. and det. J. Šutara et al. (JŠ 4405).

NEW COMBINATION

*Boletus fennicus* was at first described as a *Boletellus* (Harmaja 1999) and later transferred to *Xerocomus* (Ladurner and Simonini 2003). As the first author of this contribution is convinced that the delimitation and circumscription of *Xerocomus* is very unclear and therefore the position of *Xerocomus* as a separate genus is not yet satisfactorily and completely solved (see Šutara 2005: 31-33), he proposes the following new combination:

***Boletus fennicus*** (Harmaja) Šutara comb. nov.

Basionym: *Boletellus fennicus* Harmaja, *Karstenia* 39: 37, 1999.

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