

New records of *Agaricus* (*Agaricaceae*) for Bulgaria

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Abstract. The current article presents information about six species of *Agaricus* recorded for first time in Bulgaria: *A. albosericeus*, *A. fissuratus*, *A. maskae*, *A. moelleri*, *A. pseudoprattensis*, and *A. tenuivolvatus*.

Key words: *Agaricus*, Bulgaria, chorological data, conservation value, new taxa

Introduction

The genus *Agaricus* has not been object of taxonomical development in Bulgaria. Serious research on the taxonomy of the genus in the country has been carried out since 2002. However only chorological data and brief morphological descriptions of forty-two species from the genus have been published so far (Stoichev & Lacheva 2002; Lacheva 2004; Lacheva & Stoichev 2004).

This study presents information about the macro- and micromorphological features of six species of *Agaricus* recorded for the first time in Bulgaria, as well as chorological data for their distribution throughout the country. Three species, *A. fissuratus*, *A. maskae*, and *A. tenuivolvatus*, are very rare for Europe.

Materials and Methods

The specimens studied were collected during the period 2002–2006 in the following floristic regions: Danubian Plain, Stara Planina Mts, Valley of Strouma River, Pirin Mts, Rila Mts, Sredna Gora Mts, Rhodopi Mts, Thracian Plain, and Toundzha hilly region (Fig. 1).

Basidia, cheilocystidia, and basidiospores of the examined specimens were observed and measured by light microscopy. The microscopic features were studied on semipermanent slides mounted in lactophenol. Schäffer reaction was used. The measurements of microstructures are given in the form: min-max (mean ± 1 standard deviation). The drawings were made from the Bulgarian samples. The chorological information includes data about the sum-ups carried out. The chorological map of the occurrence of each of the species in

the country, have been depicted using the program software dSOA (Stoyanov 2003).

For taxon identification, Essette's (1964), Wasser's (1980, 2002), and Cappelli's (1984) works were consulted.

Specimens are kept in the Herbarium Collection of the Agricultural University (SOA) in Plovdiv.

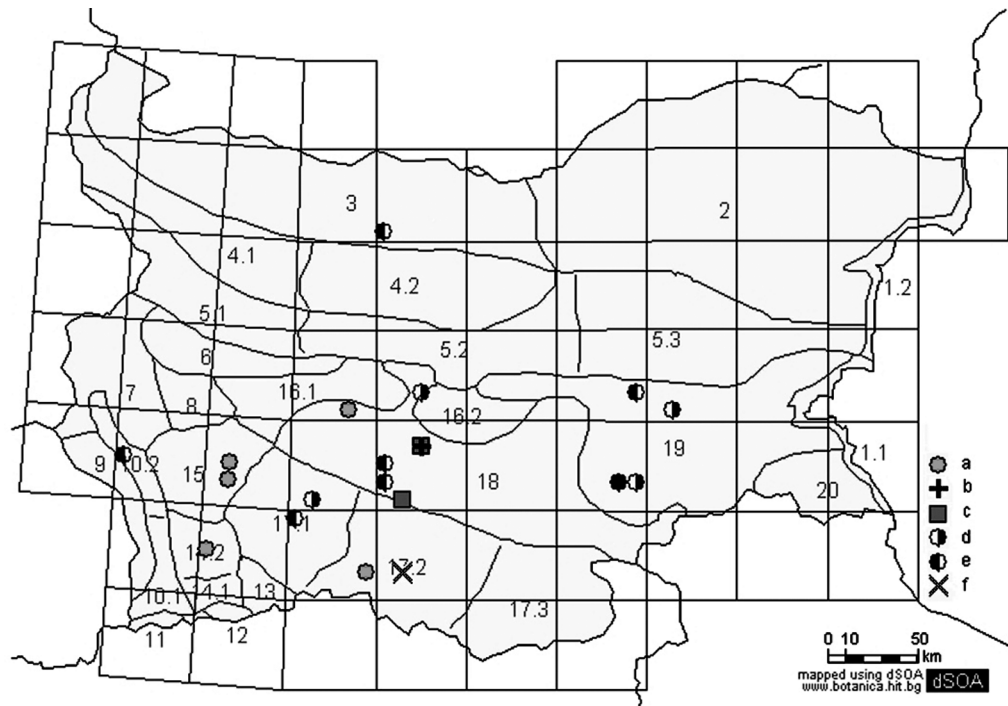
Species recorded for the first time in Bulgaria

Agaricus albosericeus Rauschert, Nova Hedwigia 54(1-2): 213, 1993 [*nom. nov.* for *A. aestivalis* (F.H. Møller) Pilát]. — *A. aestivalis* (F.H. Møller) Pilát, Acta Mus. Nat. Prag. 7B(1): 13, 1951 [*nom. illeg.* non *A. aestivalis* Schumach., 1803].

Figs 2, 8

Pileus 5–13.5 µm in diam, with thick flesh in the center, spherical in early age, later hemispherical, up to plano-convex, flat in the center, white to whitish with a straw-yellow hue margin light grey with a brown-violet hue, silky-fibrillose, strongly yellowing when touched to straw-yellow. Margin thin, involute, then straight, expanded, with or without fragments of the partial veil. **Lamellae** free, thin, crowded, pink with greyish tinge, pink-red, then brown with dark, fertile edge. **Hymenophoral trama** regular, then irregular. **Basidia** 22.5–32.5 × 6.5–9 (26.5±0.01 × 8.5±0.02) µm, clavate, four-spored. Sterigmata 3 µm. **Cheilo- and pleurocystidia** absent. Spore print brown. **Basidiospores** 6.5–8.5 × 4–6 (7.3±0.01 × 4.6±0.01) µm, ovate, ellipsoid-ovate, brown with 1–2 refractive droplets, with lateral hilum. **Stipe** 4–9 × 1–3 µm, central, cylindrical, slightly tapering at the apex, often with bulbous base, silky-fibrillose, white, whitish, later whitish grey, with a pink shade above the ring, hollow. Strongly yellowing when touched. **Ring** in the upper part of

Fig. 1. Map of distribution of the species: a – *Agaricus albosericeus*, b – *A. fissuratus*, c – *A. maskae*, d – *A. moelleri*, e – *A. pseudoprattensis*, f – *A. tenuivolvatus*



the stipe, thin, nodding, often falling, white, grayish white, with glabrous upper surface and cottony lower one cotton-like coating. **Flesh** white, slightly pinkish at cut of the stipe. Schäffer reaction positive.

Specimens examined: Pirin Mts (northern), near Bunderitsa Hut, under *Picea abies*, 5 Oct 2002, ML (SOA 50 291); Rila Mts, near Grunchar Hut, of a *Picea abies* forest, 22 Aug 2004, ML (SOA 50 292); near Zavrachitsa Hut, of a *Picea abies* forest, 20 Aug 2002, ML (SOA 50 293); in the Treshtenik area, near a *Picea abies* forest, 21 Aug 2004, ML (SOA 50 294); Sredna Gora Mts, Plovdiv distr., above the village of Krustevich, in an oak forest, 3 Oct 2002, ML & G. Stoichev (SOA 50 295); Rhodopi Mts (central), in a *Picea abies* forest above Mougla village, Devin region, 30 Sep 2004, ML (SOA 50 296).

Distribution: Europe (Norway, Switzerland, Denmark, the United Kingdom, France, Germany, Czech Republic, Slovakia, Ukraine, Hungary, Russia, and Bulgaria), Asia (Israel, Uzbekistan).

Agaricus fissuratus (F.H. Møller) F.H. Møller, Friesia 4(3): 204, 1952. Figs 3, 9

Pileus 5-10 μm in diam, with thick flesh, spherical in early age, hemispherical, later plano-convex to flat, with or without a tip in the center, silky-fibrillose, sulphur-yellow to straw-yellow, darker in the center, radially cracked with age, often with ochre fibrillose squames on a paler background. Lemon-yellow when touched. Margin thin, involute, cracked, with or without fragments of the partial veil. **Lamellae** free, thin, crowded, pink when young, pink-red, then brown with pale, sterile edge. **Hymenophoral trama** regular, then irregular. **Basidia** 25-30 \times 7.5-10 (27 \pm 0.08 \times 8.8 \pm 0.05) μm , clavate, four-spored. Sterigmata 3-3.5 μm . **Cheilocystidia** 20-

30 \times 5-12 (25 \pm 0.26 \times 10.5 \pm 0.02) μm , clavate, bottle-shaped, ovate, inamyloid. **Pleurocystidia** absent. Spore print brown. **Basidiospores** 7-8.5 \times 4.5-5.5 (8 \pm 0.01 \times 5 \pm 0.02) μm , ovate, ellipsoid-ovate, brown with several refractive droplets, with lateral hilum. **Stipe** 5-10 \times 2-2.5 cm, central, cylindrical, short, enlarged at the base, not bulbous, hollow, white, glabrous above the ring, silky-fibrillose under it, often with light-ochre cotton-like coating. **Ring** broad, separating, later falling, white, yellowish cotton-like coating along the periphery. **Flesh** white, slightly pinking at cut of the lower part of the stipe, with almond smell. Schäffer reaction positive.

Specimen examined: Thracian Plain, Plovdiv distr., above Stryama village, in a meadow along the Stryama River Valley, 29 Sep 2004, G. Stoichev (SOA 50 314).

Distribution: Europe (Germany, Denmark, Italy, Russia, Ukraine, and Bulgaria), Africa (Morocco).

Agaricus maskae Pilát, Česká Mykol. 8(4): 165, 1954.

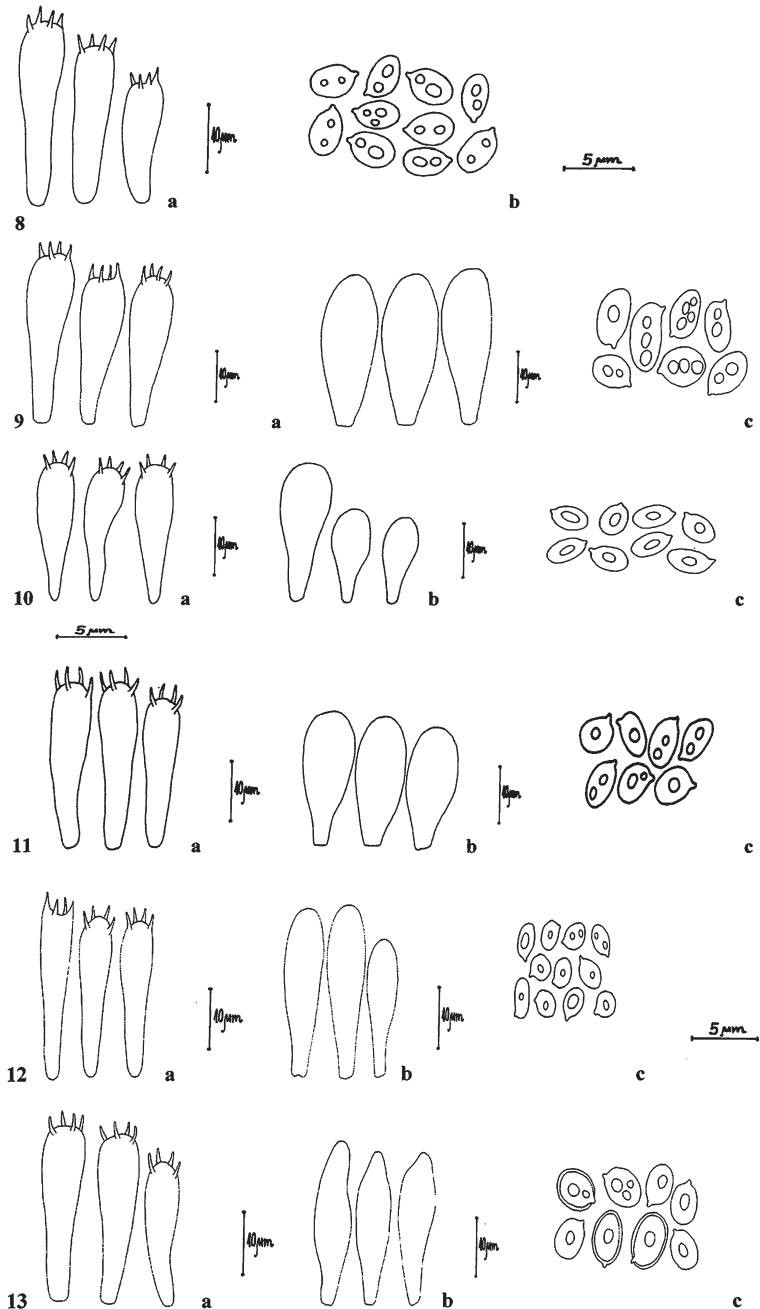
Figs 4, 10

Pileus 5-15 μm in diam, with thick flesh, hemispherical in early age, later plano-convex to flat, sometimes with a hollow in the center, grayish white to grayish ochre, darker in the center, later grayish brown, sometimes with stuck grey-brown squames, with age cracked with brick-like squames on a pale background. Yellowing when touched. Margin strongly involute, then patent, often with fragments of the partial veil. **Lamellae** free, thin, crowded, pink, pink-brown, then dark brown, with a pale sterile edge. **Hymenophoral trama** regular, then irregular. **Basidia** 23-25 \times 7-8.5 (24 \pm 0.03 \times 7.8 \pm 0.01) μm , four-spored, clavate. Sterigmata 3.5-4 μm . **Cheilocystidia** 20-31 \times 7.5-10 (25 \pm 0.23 \times 8.7 \pm 0.06) μm , clavate, spindle-shaped, inamyloid. **Pleurocystidia** absent. Spore print dark brown. **Basidiospores** 7-8.5 \times 5-5.5 (7.7 \pm 0.03 \times 5.2 \pm 0.01)



Figs 2-7. Basidiomata. 2. *Agaricus albosericeus*. 3. *A. fissuratus*. 4. *A. maskae*. 5. *A. moelleri*. 6. *A. pseudopratensis*. 7. *A. tenuivolvatus*

Figs 8-13. Microscopic features (a – basidia, b – cheilocystidia, c – basidiospores). 8. *Agaricus alboericeus*. 9. *A. fissuratus*. 10. *A. maskae*. 11. *A. moelleri*. 12. *A. pseudopraetensis*. 13. *A. tenuivolvatus*. Bars = 5 µm for basidiospores, and 10 µm for basidia and cheilocystidia



µm, light brown, ellipsoid, ellipsoid-ovate, with refractive droplets, with lateral hilum. **Stipe** central, cylindrical, white, glabrous above the ring, squamose-fibrillose under it, sometimes enlarged at the base, with or without rhizomorphs. Ochre-brown when touched. **Ring** in the upper part of the stipe, broad, whitish, nutating with the time, glabrous in its upper surface, with a cotton-like coating in its lower one. **Flesh** white, slightly pinking at cut of the stipe, reddening above the lamellae, with a pleasant mushroom smell. Schäffer reaction positive.

Specimens examined: Rhodopi Mts (central), Plovdiv distr., Brestnik village, in a meadow under *Robinia pseudoacacia*, 10 Sep 2002, G. Stoichev (SOA 50 337), 2 Sep 2004, G. Stoichev

(SOA 50 338); Thracian Plain, in a meadow near Stryama village, Plovdiv distr., 25 May 2005, ML (SOA 50 339).

Distribution: Europe (Denmark, Italy, Russia, Ukraine, Hungary, Czech Republic, and Bulgaria).

Agaricus moelleri Wasser, Novosti Sist. Nizsh. Rast., 13: 77, 1976.

Figs 5, 11

Pileus 5-10 µm in diam, with thick flesh, hemispherical, bell-shaped, later plano-convex to flat, black-brown, black in the center, light to the periphery, fibrillose-squamose. Margin thin, even, undulated with time, often with fragments of the partial veil. **Lamellae** free, thin, crowded, whitish, with age dark brown with a pale sterile edge. **Hymenophoral trama**

regular, then irregular. **Basidia** 17.5-22 × 4.5-6.5 (19.7±0.04 × 5.6±0.02) µm, four-spored, clavate. Sterigmata 2-2.5 µm. **Cheilocystidia** 12-25 × 8-13 (18±0.40 × 10±0.02) µm, ovale, pear-shaped. **Pleurocystidia** absent. Spore print dark brown. **Basidiospores** 4.2-5.7 × 2.8-4.5 (5±0.01 × 3.5±0.04) µm, brown, ellipsoid, with refractive droplets, with lateral hilum. **Stipe** 5-10 × 0.8-1.5 cm, central, cylindrical, often twisted at the base, white, silky-fibrillose. Yellowing when touched. **Ring** in the upper part of the stipe broad, separating. **Flesh** white, strongly yellowing to orange-yellow when cut at the stipe base, slightly rosaceous above the lamellae, with carbolic acid smell. Schäffer reaction positive.

Specimens examined: Sredna Gora Mts, between Banya and Hisarya towns, under *Prunus spinosa*, 23 Oct 2002, ML & G. Stoichev (SOA 50 443); Rhodopi Mts (western), Mt Batak, Tsigov Chark area, in a meadow a forest of *Picea abies* and *Pinus sylvestris*, close to Batak Dam, 16 Aug 2002, ML (SOA 50 444); Rhodopi Mts (central), near Dedovo village, Plovdiv distr., in a grassy clearing in a *Fagus sylvatica* forest, 25 Sep 2002, G. Stoichev (SOA 50 445); Toundzha hilly region, Bakadzhiha, Yambol distr., in a meadow near a mixed deciduous forest of *Carpinus orientalis* and *Acer campestre*, 29 Sep 2002, ML (SOA 50 446); Golyam Manastir village, Topolovgrad region, in a meadow under deciduous trees, 2 Oct 2002, ML (SOA 50 447); Choukarovo village, Topolovgrad region, Mandrata area, in a mixed forest of *Fraxinus oxycarpa*, *Quercus rubra*, and *Pinus nigra*, 2 Sep 2004, ML (SOA 50 448).

Distribution: Europe (Denmark, Russia, Ukraine, Hungary, Czech Republic, Switzerland, and Bulgaria), Asia (Israel), Africa (Marocco).

Agaricus pseudoprattensis (Bohus) Wasser, Ukrainys'k. Bot. Zhurn. 33(3): 250, 1976. Figs 6, 12

Pileus 3.5-5.5 µm in diam, with thick flesh, hemispherical in early age, later plano-convex to flat, with a hollow in the center, white, cream white to grayish brown, darker in the center, cracked with light brown squames on a whitish background. Margin involute, then straight, fibrillose, with fragments of the partial veil. **Lamellae** free, thin, crowded, pink, grayish pink, then pinkish red to dark brown, with pale, sterile edge. **Hymenophoral trama** regular, then irregular. **Basidia** 17.5-23 × 4-6 (19±0.04 × 5.4±0.02) µm, four-spored, clavate. Sterigmata 2.5-3 µm. **Cheilocystidia** 16-25.5 × 5.5-10.5 (18±0.06 × 8.2±0.05) µm, clavate. **Pleurocystidia** absent. Spore print brown. **Basidiospores** 4-5 × 3-4.2 (4.5±0.01 × 3.5±0.02) µm, ovate to ellipsoid, brown, smooth, with lateral hilum. **Stipe** 3.5-5 (-6) × 0.7-2 cm, central, cylindrical, narrowed at the base, white, with pink hues above the ring, hollow, with a rhizomorph at the base, yellowing and later reddening when touched. **Ring** in the upper part of the stipe, sometimes in the middle thick, narrow, patent, often lined along the periphery, white, with or without a brownish silky-fibrillose coating, yellowish when touched. **Flesh** white, first lemon-yellow at the stipe base when cut, then red-brown to dark wine red in the whole context, with a slight smell of carbolic acid or iodine. Schäffer reaction positive.

Specimens examined: Danubian Plain, Kailuka Park, Pleven, under deciduous trees, 16 Jul 2002, ML (SOA 50 417); Strouma River Valley, in a pasture with *Dichanthium ischaemum*, *Poa bulbosa*, and *Chrysopogon gryllus*, along the Strouma River, around Nevestino village, Kyustendil distr., 17 Jul 2004, ML (SOA 50 418); Rhodopi Mts (western), Rakitovo, Pazardzhik distr., in a meadow, 26 Sep 2002, ML (SOA 50 419); Thracian Plain, Kadievo village, Plovdiv distr., in a plantation of *Populus nigra*, 1 Nov 2002, ML & G. Stoichev (SOA 50 420); Benkovski village, Plovdiv distr., in a meadow with *Eryngium campestre*, 24 Oct 2004, ML (SOA 50 421); Toundzha hilly region, in the park of the Sliven Spa Center, under *Paliurus spina-christi*, 10 Oct 2002, ML & G. Stoichev (SOA 50 422); Mt Sakar, Svetlina village, Topolovgrad region, Roubin Kamuk area, in a meadow under *Populus nigra*, 10 Sep 2002, ML (SOA 50 423).

Distribution: Europe (Italy, Ukraine, Hungary, and Bulgaria), Asia (Israel).

Agaricus tenuivolvatus (F.H. Møller) F.H. Møller, Friesia 4(3): 204, 1952. Figs 7, 13

Pileus 8-12 µm in diam, oval in early age, hemispherical, later plano-convex to flat, with or without depressed center, sulphur-yellow, dark yellow with age, silky-fibrillose, whitish to light ochre with cottony-fibrillose squames. Margin involute, then straight, with fragments of the partial veil. **Lamellae** free, thin, crowded, light, pink, then grayish pink to light brown with pale, sterile edge. **Hymenophoral trama** regular, then irregular. **Basidia** 26-30 × 8-9 (27±0.06 × 8.5±0.30) µm, four-spored, clavate. Sterigmata 2.5-3 µm. **Cheilocystidia** 9.5-11 × 3.5-5.5 (10±0.04 × 4.5±0.45) µm, bottle-shaped, inamyloid. **Pleurocystidia** absent. Spore print dark brown. **Basidiospores** 5.5-6.5 × 4-4.5 (6±0.01 × 4.2±0.01) µm, ovate, broadly-ovate to spherical with 1-2 refractive droplets, with lateral hilum. **Stipe** 10-13 × 25-30 cm, central, cylindrical, with bulbous base, hollow, with grayish pink shades above the ring, yellowish under it, ochre-yellow with age, with small, whitish, fibrillose squames from the universal veil; unchanging touched at the base. **Ring** in the upper part of the stipe broad, thin, later pendulous, glabrous in its upper surface, and a whitish cottony-fibrillose coating in its lower one. **Flesh** white, yellowing when cut in the stipe apex, later with pinkish tinges, with almond-like smell. Schäffer reaction positive.

Specimen examined: Rhodopi Mts (central), Momchilovtsi village, Smolyan region, near a *Picea abies* forest, 17 Oct 2004, ML (SOA 50 343).

Distribution: Europe (Denmark, Italy, Hungary, and Bulgaria).

Conclusion

The distribution of three species, *A. fissuratus*, *A. maskae*, and *A. tenuivolvatus*, newly recorded for Bulgaria appears to be limited. These species may have a conservation value that could warrant their inclusion in the *Red List of fungi in Bulgaria* (Gyosheva et al. 2006) in the next update.

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