Revision of Boletus section Appendiculati (Boletaceae) in Bulgaria with a key to the Balkan species

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Abstract: The paper presents the results from the taxonomic revision of Boletus section Appendiculati in Bulgaria. Descriptions are provided based on Bulgarian specimens for the 5 species of the section: Boletus appendiculatus, B. fechtneri, B. fuscoroseus, B. regius, and B. subappendiculatus. The priority of the name B. fuscoroseus against B. pseudoregius is briefly discussed. A dichotomous key for the determination of members is also included.

Key words: Basidiomycetes, Boletales, boletes, Bulgaria, fungal diversity

Introduction
Section Appendiculati Konrad & Maubl. ex Lannoy & Estadès is a well defined entity in the genus Boletus L., members of which are found throughout the northern hemisphere (Singer, 1986). It is characterised by the more or less developed reticulum on the stipe and concolourous yellow and often blueing tubes and pores as well as by the flesh, which may be blueing or not, but which is always mild tasting and in many species is somewhat pinkish tinted in the stipe base. The members of this section share some characters with section Calopodes Fr. emend. Lannoy & Estadès; the latter, however, are easily distinguished on the basis of their very bitter taste, caused by the presence of calopins and cyclocalopins (Hellwig et al., 2002). Recent molecular research suggests that the genus Boletus, even in its current strict sense, is likely a heterogeneous consortium and further studies are likely to lead to major changes in the generic concept of this group in the future (Watling, 2009). Should this happen, it will certainly affect the status of Appendiculati; this section is even now sometimes preliminarily paired with Calopodes in a separate subgenus with the provisional name Suillellus (Watling & Hills, 2005), a disputable decision as the type species of the genus Suillellus Murrill is Boletus luridus Schaeff. : Fr. (Murrill, 1909).

Most of the European representatives of this grouping have been treated controversially even in the not so distant past but recent molecular research supports the recognition of 5 species: Boletus appendiculatus Schaeff., B. fechtneri Velen., B. regius Krombh., B. fuscoroseus Smotl. [= B. pseudoregius (Huber) Estadès], and B. subappendiculatus Dermek, Lazebnicek & Veselský (Marques & Muñoz, 2006). Further confusion arises from the attempts to apply known European names to North American bolete collections and vice versa, with the application of Boletus speciosus Frost for B. fuscoroseus being a notable example. The disadvantages of

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this “conservative” approach have recently been demonstrated by molecular studies in another section of the genus (Arora, 2008) and it seems that *Appendiculati* is also in desperate need of a world-wide revision using traditional and molecular techniques.

Although various records of different *Appendiculati* are available throughout Bulgarian mycological literature dating back to the beginning of the 20th century (Assyov & Denchev, 2004; Assyov & Gyosheva, 2010; Denchev & Assyov, 2010), no local taxonomic treatment of this group has been attempted so far, either in Bulgaria or in any of the Balkan countries, where different *Appendiculati* have been found and where intensive research on this genus is going on (Zervakis et al., 1998; Karadelev et al., 2006; Perić & Perić, 2006; Lukić, 2009; Sesli & Denchev, 2009; Demirel et al., 2010; Doğan et al., 2012).

### Materials and methods

Bolete samples were collected in different parts of the country between 2002 and 2009. Air dried specimens of the boletes are preserved in the Mycological Collection at the Institute of Biodiversity and Ecosystem Research in the Bulgarian Academy of Sciences (SOMF). Revision was attempted for older findings kept in the same collection and in the mycological section of the Herbarium of the University of Agriculture - Plovdiv (SOA).

The new collections are documented with colour photographs and appropriate field notes. Colour notations in the descriptions below refer to Kornerup and Wanscher (1978) or the British Fungus Flora Colour Chart (HMSO, 1969), the latter abbreviated as “BFF.” All colours have been recorded under daylight. The colour terms in the key refer to common colour names rather than colour chart entries. Macroscopic colour reactions were tested on fresh basidiomata with KOH 10%, NH₄OH 10%, and FeSO₄ 10%. Microscopic features were observed in 5% KOH and tap water and always measured in water at a magnification of ×1000. All preparations were made from dried samples. Squash slides for observation of basidia and cystidia were made from thin sections of the hymenophore. Sections of pileipellis were prepared as recommended by Ladurner and Simonini (2003). Spore preparations were made by submerging small pieces of hymenophore in mounting medium for approximately 30 s to release the spores. From each specimen, 50 random, normally developed, mature basidiospores were measured. Measurement values for basidiospores are presented below in the following manner: (min-) mean ± s (-max). Spore volume (Vm) was calculated according to the formula $V_m = \frac{4}{3}\pi(1/2S_w)^2.1/2S_l$ where $S_l$ refers to spore length, $S_w$ indicates spore width, and the result is estimated to an integer number (Breitenbach & Kränzlin, 1991). Iodine reaction was ascertained by using Melzer’s solution (Kirk et al., 2001) on dried samples following the procedure described by Ladurner and Simonini (2003). The results of the reaction are noted in the descriptions in the abbreviated form “MR.” In the notations of the macroscopic and microscopic colour reactions, the lack of colour change is noted as “0.”

The species concept follows Muñoz (2005) and Marques and Muñoz (2006). Further references to important literature and selected iconography are listed under every species. The distribution in Bulgaria follows the division of the country as accepted in Assyov and Denchev (2004). The general distribution in Europe is summarised as well as possible and is presented with 2-letter abbreviation codes of the countries following the standard ISO-3166 of the International Organization for Standardization.

Abbreviations are used throughout the text for the collectors’ names as follows: AT - A. Tosheva; BA - B. Assyov; CB - C. Borisova; CH - C. Hinkova; CS - C. Stefanov; DS - D. Stoykov; GS - G. Stoicheva; IA - I. Assyova; MD - M. Drumeva; MG - M. Gyosheva; ML - M. Lacheva; PM - P. Mihov; PP - P. Panov; and VC - V. Chalukov.

### Results

**Section Appendixulati** Konrad & Maubl. ex Lannoy & Estadès

Key to species

1 - Context blueing considerably when exposed to air; pores blueing when bruised; mean basidiospore length/width ratio <3 .......................... 2
1 - Context when exposed to air unchanging or almost so (extremely weak and patchy blueing reaction might sometimes occur in parts of the pileus); pores not blueing when bruised, but often darkening instead; mean basidiospore length/width ratio >3 ........................................... 4

2 - Pileus silvery grey, greyish, whitish, beige, or ochraceous, usually not tinted pinkish, or occasionally with pinkish areas towards the margin .................................................. B. fechtneri

2 - Pileus pinkish, dingy pink, or beige to ochraceous with prominent pinkish or reddish tint, or pale to dark brown .......................................................... 3

3 - Pileus pinkish, dingy pink, or beige to ochraceous with pinkish or reddish tint .......... B. fuscoroseus

3 - Pileus pale to dark brown without pinkish tints .. ................................................................................. B. appendiculatus

4 - Pileus pink, pinkish red to reddish; associated with broadleaf trees ............................ B. regius

4 - Pileus beige, ochraceous to yellowish ochraceous; associated with conifers ...... B. subappendiculatus

*Boletus appendiculatus* Schaeff. (Figure 1).

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*Boletus appendiculatus* Schaeff., Fung. Bav., 4: 86 (1774); *Dictyopus appendiculatus* (Schaeff.) Quél., Enchiridion, p. 160 (1886); *Tubiporus appendiculatus* (Schaeff.) Ricken, Vademecum, p. 215 (1918).


Icons: Schaeffer (1774: Table 130; Lectotypus! cf. Singer 1967), Kallenbach (1926: Table 31), Blum (1962: Table 10, Figure 1), Leclair and Essette (1969: Table 39), Pilát and Dermek (1974: Table 50), Engel et al. (1983: Table 14), Alessio (1985: Table 12), Breitenbach and Kränzlin (1991: 53, Figure 4), Galli (1998: 177), Šutara et al. (2009: 121).

**Pileus** up to 20 cm in diameter, at first hemispherical, then convex or plano-convex, rarely flat or slightly depressed, initially dry and finely felt, later smooth or finely cracked, sometimes in very old specimens and in wet weather slightly viscid, hazel, cognac, cocoa brown, dark brown, agate, fawn brown, reddish brown, mahogany, madeira, liver brown (6-8EF5-7, 7E4); unchanging when bruised. **Stipe** up to 15 × 3.5 cm, at first subspherical or ovoid, later club-shaped, or cylindrical, tapering towards the base, usually rooting, yellowish white, pale yellow

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Figure 1. Basidioma of *Boletus appendiculatus* (collection SOMF 27408).
to light yellow (1A2-4, 2A2-3), sometimes gradually
discolouring in places or entirely to dingy white or
dingy yellowish, sometimes towards the middle with
pale red, pastel red, dull red, greyish red, brownish red,
red, or brownish violet area or band (10-11CD4-8, 9-10AB3-5), at least in the upper half but most often
entirely covered with fine concolourous or whitish
network; stipe surface blueing when bruised.

**Context**
lemon or sulphur yellow (BFF 55, 54) or whitish, in
the stipe base pinkish, dirty salmon to clay pink (BFF
45, 30); blueing when exposed to air (about BFF 71)
predominantly in the cap and in the uppermost part of
the stipe. **Tub es** initially lemon yellow (BFF 54), later
with gradually developing olive tint; blueing when
injured. **Pores** concolourous with the tubes; blueing
when bruised. **Odour** not distinctive. **Taste** not
distinctive.

**Basidiospores** 9-11.4 ± 0.8)-15.0 × 3.5-
(4.4 ± 0.1)-5.5 μm, length/width ratio 2-(2.6 ± 0.2)-
3.5, spore volume 63-(114 ± 7.4)-185 μm³ (n = 250),
with 1-3 large oil drops. **Basidia** 4-spored, clavate, 28-
42 × 7-12 μm. **Cystidia** 32.5-54 × 9-15 μm. **Pileipellis**
a trichodermium of interwoven septate hyphae; cells
hyaline or somewhat ochraceous, finely incrusted;
terminal cells usually slightly swollen and rounded
towards the apex. **Macrochemical reactions:** NH₄OH
(pileus - BFF 20, context - BFF 30), KOH (pileus - BFF
19, 20, context - BFF 30), FeSO₄ (pileus - 0, context -
BFF 65), MR (0). **Microchemical reactions:** MR (0).

**Habitat, ecology, phenology:** xerothermic or
mesophytic broadleaf forests, associated with oaks
(*Quercus* spp.), often on limestone, 0-900 m. June-
September.

**Distribution in Bulgaria:** Southern Black Sea
coast, Western Forebalkan, Znepole region, Western
Sredna Gora Mts. Previously reported also from the
Northern Black Sea coast and Tundzha Hilly Region
(Dencev & Assyov, 2010), but no voucher specimens have been seen yet to substantiate those records.

**General distribution:** Europe (AT, BA, BE, BG,
CH, CZ, DE, DK, EE, ES, FR, GB, GR, HR, HU, IE, IT,
LT, ME, MK, NL, NO, PT, RO, RS, RU, SE, SI, SK, UA;
apparently more common in south). Reported also
from Asia and North America but extra-European
collections might require further study.

**Specimens examined:** Southern Black Sea coast:
along the track between Perla Estate and Maslen Nos Cape, under *Quercus cerris* L., 07.06.2008, BA
(SOMF 27408); Eastern Forebalkan: in the vicinity of
Koman chalet below Terziisko village (Troyan distr.),
under *Quercus frainetto* Ten., 07.06.2002, BA (SOMF
25371); in the vicinity of Golyama Zhelyazna village
(Troyan distr.), under *Quercus* sp., 10.07.2003, DS
(SOMF 27442); ibid., 30.06.2004, DS (SOMF 27437);
Eastern Sredna Gora Mts: Zelenikovo village (Plovdiv
distr.), in a broadleaf woodland (*Carpinus orientalis*
Mill., *Fraxinus* sp.) at the sheep barn at the end of the
village, 13.08.2002, GS & ML (SOMF 27240).

**Boletus fechtneri** Velen. (Figure 2).

*Boletus fechtneri* Velen., Česke houby, 4/5: 704
(1922). — *B. appendiculatus* ssp. *pallescens* Konrad,
Bull. Soc. Mycol. France, 45: 73 (1929); *B. pallescens*
(Konrad) Singer, Ann. Mycol., 34: 416 (1937); *Tubiporus
appendiculatus* var. *pallescens* (Konrad) Imler, Bull.
Soc. Mycol. France, 66: 201 (1950); *Boletus
appendiculatus* var. *pallescens* (Konrad) Kühner &

*B. aestivalis* sensu Kallenb., Die Röhrlinge, p. 139
(1926) non Fr., Epicr. Syst. Mycol., p. 422 (1838), nec
*Tubiporus aestivalis* Paulet, Traité Champ., p. 371
(1835).

Literature: Velenovský (1922), Kallenbach (1926),
Singer (1967), Leclair and Essette (1969), Pilát and
Dermek (1974), Engel et al. (1983), Alessio (1985),
Breitenbach and Kränzlin (1991), Knudsen (1992),
Galli (1998), Lannoy and Estadès (2001), Muñoz
(2005), Marques and Muñoz (2006), Knudsen and
Taylor (2008), Šutara et al. (2009), Kibby (2011).

Figure 2. Basidiomata of *Boletus fechtneri* (collection SOMF
25384).
Pileus up to 20 cm in diameter, at first hemispherical, later convex to flat-convex, rarely flat or slightly depressed, dry, smooth, occasionally slightly viscid in very old basidiomata, pale grey, grey, ash grey to yellowish grey (1-2B1-2, 4-5B1-2); surface not blueing when bruised. Stipe up to 15 × 3.5 cm, initially subhymenial or ovoid, later club-shaped, sometimes cylindrical or tapering towards the base, sometimes rooting, yellowish white, pale yellow to light yellow (1A2-4, 2A2-3), rarely discolouring in places or entirely covered with fine, concolourous or whitish network; surface blueing when bruised or handled. Context lemon yellow, lemon chrome (BFF 54, 53), or yellowish white, in the stipe base pale dingy rose, dirty salmon, or clay pink (BFF 45, 39, 30); blueing (BFF 71) mostly in the cap and in the upper part of the stipe, when exposed to air. Tubes at first lemon yellow (BFF 54), later with olive tint; blueing when injured. Pores concolourous with the tubes, blueing when bruised. Odour indistinctive. Taste slightly acid. Basidiospores 9-(11 ± 1)-15 × 3.5-4.3 ± 0.3-5.5 μm, length/width 2-(2.6 ± 0.2)-3.4, spore volume 54-(115 ± 20.7)-201 μm³, (n = 250). Basidia 4-spored, clavate, 27-48 × 9-13 μm. Cystidia 46.5-58 × 9-15 μm. Pileipellis trichodermium of interwoven septate, yellowish or hyaline, finely incrusted hyphae. Terminal cells mostly rounded or sometimes tapering towards the apex. Macrochemical reactions: NH₄OH (pileus - BFF 20, context - BFF 12), KOH (pileus - BFF 19, context - BFF 12), FeSO₄ (pileus - 0, context - BFF 63), MR (0). Microchemical reactions: MR (0).

Habitat, ecology, phenology: xerothermic or xeromesothermic broadleaf forests, associated with oaks (Quercus spp.) or sweet chestnut (Castanea sativa Mill.), often on limestone, 0-900 m. June-September.

Distribution in Bulgaria: Western Forebalkan, Belasitsa Mt, Western Sredna Gora Mts, Central Rhodopi Mts, and the Thracian Plain. Older records are available also from the Southern Black Sea coast, Znepole Region, and Western Rodopi Mts (Denchev & Assyov, 2010); these are however not substantiated by voucher specimens in public mycological collections.

General distribution: Europe (AT, BE, BG, CH, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IT, LT, LU, ME, MK, NL, PL, RO, RS, RU, SE, SI, SK, UA; apparently more common in south), North Africa (MA). Reported also from Asia - IL (Binyamin, 1975) but, as evident from the illustration published in this work, at least part of the Israeli records will appear to belong to B. pulchrotinctus Alessio.

Specimens examined: Eastern Forebalkan: Koman locality (Troyan distr.), under Quercus frainetto, 07.06.2002, BA (SOMF 25269, 25270, 25384, 27042); Vlaskovska Mahala at Golyama Zhelyazna village (Troyan distr.), 01.09.2002, DS (SOMF 27427, 27428); ibid., 08.09.2002, DS (SOMF 27429, 27430); Belasitsa Mt: along the road between Belasitsa chalet and Kongur chalet, under Castanea sativa, 22.09.2009, BA & IA (SOMF 27892); Western Sredna Gora Mts: in the vicinity of Drangovo village (Plovdiv distr.), in a mixed oak forest, 10.08.2002, GS & ML (SOMF 27043); Central Rhodopi Mts: in a mixed forest (pine and beech) at Studenets Resort, 04.06.1975, GS (SOA, s.n.); Thracian Plain: between Nadezhd and Ostar Kamak villages (Harmanli distr.), under Quercus sp., 21.06.2005, DS (SOMF 27425, 27426).

Boletus fuscoroseus Smotl. (Figures 3-4).


Pileus up to 20 cm in diameter, at first hemispherical, later convex to flat-convex, violet brown, greyish red, brownish red, or dull red (10E6-7, 10F6, 10D4-6, 10-11C4, 10B3-4), sometimes discolouring to beige (4C3), but at least partly with somewhat pinkish tint; surface dry, sometimes cracked, not blueing when bruised or handled; margin appendiculate. Stipe up to 10 × 3 cm, cylindrical or club-shaped, sometimes tapering towards the base, at least in the upper part yellowish white, pale yellow to light yellow (1A2-4, 2A2-3), in the lower 1/2 or 1/3 pink, pale red, pastel red, or dull red (11A4-5, 9-10AB3-5), rarely high red, madder red, or cherry (11AB7-8) or occasionally pinkish brown, or with similarly coloured band, at least in the upper half with well developed concolourous or reddish or rusty network; surface blueing when handled. Context whitish in the pileus, lemon yellow in the stipe (BFF 54, 53), dirty salmon to clay pink (BFF 45, 30) in the stipe base, blueing (BFF 71) mostly above the tubes when exposed to air. Tubes up to 1.5 cm long, lemon yellow (BFF 54), later with olivaceous tint, blueing when injured. Pores concolourous with the tubes, blueing when bruised. Odour in young fruit bodies not distinctive, later medicinal, of tempera paints, or resembling smoked meat, and of chicory when dried. Taste not distinctive to slightly acid. Basidiospores 10-(12.6 ± 0.6)-14.5 × 4-(4.6 ± 0.2)-5.5 μm, length/width ratio 2.2-(2.7 ± 0.1)-3.2, spore volume 86-(142 ± 19)-214 μm³ (n = 400), with 1-3 large oil drops. Basidia 4-spored, clavate, 26-34 × 9-15 μm. Pileipellis trichodermium of interwoven septate yellowish slightly incrusted hyphae; terminal cells rounded towards the apex. Macrochemical reactions: NH₄OH (pileus - BFF 13, context - 9H), KOH (pileus - BFF 11, 13, context - BFF 47), FeSO₄ (pileus - 0, context - 0), MR(0). Microchemical reactions: MR(0).

Habitat, ecology, phenology: xerothermic or mesothermic broadleaf forests, associated with oaks (Quercus spp.), 0-800 m. June-September.

**General distribution:** Europe (AT, BE, BG, CH, CZ, ES, FR, GB, GR, HR, HU, IT, ME, MK, RO, RS, SI, SK; more or less widespread but apparently absent in north and probably under-recorded), Asia Minor (TR).

**Specimens examined:** Southern Black Sea coast: in a mixed oak forest (*Quercus frainetto, Q. cerris*) along the track between Perla Estate and Maslen Nos Cape, under *Q. cerris*, 15.06.2004, BA (SOMF 25262); ibid., 17.06.2005, BA (SOMF 27432-27434); Eastern Forebalkan: in Graduvitsa locality in the vicinity of Golyama Zhelyazna village, in a mixed oak forest, 10.07.2004, DS (SOMF 25503, 25504); above Golyama Zhelyazna village, in a mixed oak forest, 18.07.2004, DS (SOMF 27435, 27436); Western Stara Planina MtS: in the vicinity of Vojnyagovtsi village (Sofia distr.), under *Quercus* sp., 24.07.2005, DS (SOMF 25473); Eastern Stara Planina MtS: in a broadleaf woodland, Kaynika locality above Omurtag town, 14.08.1975, GS & MD (SOMF 12401); Sofia Region: Lyulin Mt, between Manastirski Livadi locality and the chapel, 26.07.2005, BA (SOMF 25276); ibid., 30.07.2005, BA (SOMF 25277, 25278); ibid., 04.09.2005, BA (SOMF 27431); Eastern Rhodopi MtS: in an oak forest, Glumovski Kanton locality along the road between Ivaylovgrad and Krumovgrad towns, 08.07.1977, CH & MD (SOMF 13032); in an oak forest in Kara Yolu locality in the vicinity of Knizhovnik village, 08.07.1977, CH & MD (SOMF 13056).

**Note.** In the past this bolete was erroneously referred to in the European mycological literature as *B. speciosus*, a confusion that was apparently introduced by Singer (1967) and then followed by the European authorities since (see references above). *B. speciosus* is a North American species and as far as known to the author there is currently no firm evidence that it occurs in Europe. The name *B. pseudoregius* is used for this fungus in most of the recent European treatments (e.g., Muñoz, 2005; Watling & Hills, 2005; Marques & Muñoz, 2006). Having studied the original description of *B. fuscoroseus*, the author of this paper finds that it corresponds well to the above described entity, except for the spore dimensions, which are similar but not exactly the same as those presented above. However, this discrepancy might derive from many factors, e.g., the number of the spores measured, the choice of spores to be measured, differences of the optics used, etc. An English translation of the original description and Smotlacha's remarks is provided below.

As indicated by Šutara and Špinar (2006) and later also by Šutara et al. (2009), it appears that *B. fuscoroseus* is an older name for the same species which has priority over *B. pseudoregius*. *B. fuscoroseus* is effectively published and Smotlacha (1912) provided in his publication a Czech description of the new species, satisfying the requirements of ICBN (McNeill et al., 2007) for valid publication. There is one more matter that needs to be mentioned with regard to this name: When introducing his *B. fuscoroseus*, Smotlacha added immediately after it the statement “Smotlacha 1910.” The author is not aware of the existence of any earlier publication of Smotlacha where this name appears. The notation of “1910” might be possibly explained by the fact that Smotlacha’s manuscript was prepared for publication in 1910, as inferred from the dating in its introduction, although the lecture was presented on the session held on 13.01.1911, as can be seen from the notice on the second title of the journal and as apparent from the dating below the title on page 1 of the paper [“Submitted on 13.01.1911”]. In addition, there are different considerations about the actual date of Smotlacha’s publication. On the title page of separata it is explicitly noted “Vydáno dne 30. Června 1911” (Printed on 30.06.1911). On the title page of the journal itself (issue 1911), however, the dating is “1912.” Therefore, the year of publication is to be considered as 1912.

The English translation of the original description is as follows: “Pileus at first hemispherical, later expanded, 10–20 cm wide, coloured brownish with pinkish tint. Tubes at first short, later elongating, 1–1 ½ cm long, at first decurrent, later connected with the stipe [adnate], yellow with small rounded pores, [the latter] coloured as the tubes, blue-green when bruised. Spores pale brownish, 10 μ[m] long, 3–4 μ[m] wide. Stipe 8–16 cm long, solid, initially ovoid, ventricose swollen at the base, tapering towards the apex, entirely [covered] with well-defined network, in the upper part blue-green, when bruised, later darkening. Context compact, yellow-white, blueing when damaged. — *B. fuscoroseus* shows similarity with the preceding species [*Boletus regius* and...
Boletus aereus in group “Duri]. It is distinguished [from both of these] by its swollen stipe, tubes at first decurrent, also from B. regius by the blueing context and tubes, [and] from B. aereus by the colour of the pileus. By the taste and the character of the context it is similar to those 2 species; it is edible and valuable. I have collected it for the first time in August 1909 in the forest Žernově u Holic under oaks. I sent 2 fruit bodies to Prof. Velenovský for specimen. Locals call it růžovník” (Smotlacha, 1912: 47-48).

Boletus regius Krombh. (Figures 5-6).


Icons: Krombholz (1831: Fasc. 2, Table 7; Lectotypus! cf. Singer, 1967), Kallenbach (1926: Table 9, Table 14, Figures 1-2), Bresadola (1931: Table 922), Pilát and Dermek (1974: Table 53), Engel et al. (1983: Table 16), Alessio (1985: Table 14), Galli (1998: 181), Muñoz (2005: 699-701, Figure 52a-e; Table 49), Ľutara et al. (2009: 129).

Pileus up to 17 cm in diameter, at first hemispherical, later convex, flat-convex, or rarely almost flat, initially dry, somewhat felty, later smooth, sometimes slightly viscid in very old basidiomata, greyish rose, geranium, aurora, greyish red, or medium madder red (10-11BC4-7), sometimes with darker spots (10D6-7), towards the margin paler, pink, pinkish white, reddish grey, or pale red (10-11AB2-3), occasionally somewhat yellowish; not blueing when bruised. Stipe up to 9 × 3.5 cm, initially ovoid, later club-shaped, cylindrical or tapering towards the base, pale yellow, pastel yellow, sulphur yellow, or sun yellow (1-2A3-5), after drying or in places where eaten by animals often with irregular red to blood red (BFF 41, 42) or purple (BFF 40) spots, entirely or at least in the upper part with fine concolourous or whitish network; surface not blueing when bruised. Context lemon yellow (BFF 54) to lemon chrome (BFF 53), sometimes in the base of the stipe dingy salmon (BFF 45) to clay pink (BFF 30); not blueing when exposed to air, when dried in places often with scarlet red spots (BFF 43). Tubes at first lemon yellow (BFF 54), later with somewhat olive tint, not blueing when injured. Pores concolourous, not blueing when bruised. Odour not distinctive. Taste not distinctive.
Basidiospores 10.5-12.8 ± 1.4)-16 × 3-(4.1 ± 0.2)-5 μm, length/width ratio 2.7-(3.3 ± 0.1)-4.3, spore volume 63-(121 ± 14.6)-181 μm³ (n = 250). Basidia 4-spored, clavate, 29-42 × 8-15 μm. Cystidia 34-52.5 × 7-14.5 μm. Pileipellis trichodermium of interwoven septate, hyaline or ochraceous yellow, not incrusted cells; terminal cells rounded at the apex.

Macrochemical reactions: NH₄OH (pileus - BFF 11, context - 8G), KOH (pileus - BFF 11, context - BFF 49), FeSO₄ (pileus - 0, context - BFF 68), MR(0).

Microchemical reactions: MR (0).

Habitat, ecology, phenology: xerothermic and mesothermic broadleaf forests, associated with oaks (Quercus spp.) or sweet chestnut (Castanea sativa), possibly also with beech (Fagus spp.), 0-1000 m. May-September.

Distribution in Bulgaria: Stara Planina Mts, Znepole Region, Sofia Region, Belasitsa Mt, Western Sredna Gora Mts, Central and Eastern Rhodopi Mts. Recorded also from the Southern Black Sea coast and Vitosha Region (Assyov & Denchev, 2004), but no voucher specimens have been seen that support those records.

General distribution: Europe (more common in south, absent in the far north - AT, BA, BE, BG, CH, CZ, DE, ES, FR, GB, GR, HR, HU, IT, ME, MK, PO, PT, RO, RS, RU, ?SE, SI, SK, TR, UA, NL), Asia. Reported from North America (US, MX) but molecular research is desperately needed to resolve the status of the American collections.

Specimens examined: Western Stara Planina Mts: in an oak forest in the vicinity of Barzia village, 06.2002 (s.d.), CB (SOMF 25398); Central Stara Planina Mts: in a mixed deciduous forest (beech and hornbeam) above H.G. Danovo village, 14.08.1976, GS (SOA, s.n.); Eastern Stara Planina Mts: Mokrenski Prohod pass between Mokren and Gradets villages (Sliven distr.), in an oak forest, under Quercus cerris, 28.08.2004, BA (SOMF 27929); in the vicinity of Kotel town, 11.08.2004, MZ; in the vicinity of Sliven town, 01.08.2004, MZ; Znepole region: Konyavska Mt, in an oak forest above Zhedna village, 15.06.1993, MG (SOMF 21804); Sofia Region: Lyulin Mt, along the track in Derivol locality, under Quercus sp., 19.07.2005, BA & IA (SOMF 25469, 25470); ibid., 09.09.2005, BA & IA (SOMF 25501); Belasitsa Mt: above Belasitsa village (Petrich distr.), under Castanea sativa, 18.05.2004, BA (SOMF 25258); Western Sredna Gora Mts: Verinsko village, at the margins of an oak forest, 10.06.1992, PM (SOMF 27409); in the vicinity of Gabra village, under Gabra village, under Quercus cerris, 24.06.2004, BA (SOMF 25259, 27419-27421); at Krushovitsa village, under Quercus cerris, 24.06.2004, BA (SOMF 27424, 27930); broadleaf forest in vicinity of Vakarel town, 10 June 1972, PP (SOMF 10464); mixed oak forest, Lozenska Mt, CS (SOMF 88); Central Rhodopi Mts: at Dedovo village, s. d., GS (SOA, s.n.); Eastern Rhodopi Mts: in an oak forest in Genchov Zavoy locality between Ivaylovgrad and Krumovgrad villages, 28.05.1977, CH, VC & MD (SOMF 13044).

Note. Weak and patchy bluing reaction of the context is said to occur sometimes in this species, which generally has unchanging flesh, clearly separating it from the slightly similar B. fuscoroseus. It has not been evidenced yet in Bulgarian collections.

Boletus subappendiculatus Dermek, Lazebnicek & Veselský (Figures 7-8).


Figure 7. Basidiomata of Boletus subappendiculatus (collection SOMF 27673) (photo I. Assyova).

Pileus up to 8 cm in diameter, at first hemispherical, later convex to flat-convex, rarely flat or slightly depressed, dry or sometimes slightly viscid when old, smooth, fibrillose or finely cracked, brownish orange, sunburn, cinnamon, light brown (5C3-4, 6D4-5, 7D4-6), buff, or clay buff (BFF 32, 52); surface unchanging when bruised; margin appendiculate.

Stipe up to 13 × 5.5 cm, at first subspherical or ovoid, later club-shaped or sometimes cylindrical, sometimes rooting, yellowish white, pale yellow, or pastel yellow (1A2-4, 2A2-3), rarely discolouring in places or entirely to whitish or brownish, sometimes in the middle or in the upper 1/3 with reddish white, pale red, or brownish orange zone (9-10A2-3, 7C7-8), at least in the upper half or most often entirely covered with fine, concolourous, white, yellowish, rusty orange, orange, or orange-red reticulum; stipe surface unchanging when bruised. Context lemon yellow (BFF 54), straw, or whitish (BFF 50, 78), but then under the pileipellis, above the tubes and under the stipe surface sulphur yellow, lemon yellow, or lemon chrome (BFF 53-55), in the stipe base often dirty salmon (BFF 45) to clay pink, vinaceous buff, or clay buff (BFF 30-32); not blueing when exposed to air. Tubes at first lemon yellow (BFF 54), later yellow with olivaceous tint, unchanging when damaged. Pores at first lemon yellow (BFF 54), later yellow with olivaceous tint, sometimes in old basidiomata rusty spotted, darkening and not blueing when bruised. Odour not distinctive. Taste not distinctive. Basidiospores 9.5-(12.2 ± 1.2)-15 × 3-(3.8 ± 0.2)-4.5 μm, length/width ratio 2.4-(3.3 ± 0.1)-4.3, spore volume 50-(92 ± 18)-149 μm³ (n = 200). Basidia 4-spored, clavate, 30-39.5 × 7-10 μm. Cystidia 35.5-45 × 8-10.5 μm. Pileipellis trichodermium of interwoven, septate, sometimes branched, yellowish, finely incrusted hyphae; most terminal cells cylindrical with rounded apex. Macrochemical reactions: NH₄OH (pileus - BFF 41, context - BFF 30), KOH (pileus - BFF 41, context - BFF 30), FeSO₄ (pileus - 0, context - BFF 65), MR (0). Microchemical reactions: MR (0).

Habitat, ecology, phenology: coniferous or mixed forests in the upper mountain belt, associated with spruce (Picea abies (L.) Karst.) or fir (Abies alba Mill.), 1200-1700 m. July-August.

Distribution in Bulgaria: Northern Pirin Mts, Rila Mts.

General distribution: Europe (in areas where the associated trees are present, but needs further clarification - AT, BG, CH, CZ, DE, ES, GB, GR, FR, IT, ME, NO, PO, RS, SI, SK) and Asia Minor (TR); see Assyov and Gyosheva (2010) for further comments.

Specimens examined: Northern Pirin Mts: ca. 1 km below Banderishka Polyana locality above Bansko town, ca 1770 m, under Abies alba, 26.08.2009, BA (SOMF 27904); Rila Mts: Kirilova Polyana locality, along the track to Suhoto Ezero lake, ca. 1460 m, under Abies alba, 28.07.2002, BA (SOMF 27913); ibid., under Picea abies, 15.07.2008, AT (SOMF 27044); ibid., under Picea abies, 24.07.2009, BA & IA (SOMF 27673, 27674); Preslapa locality above Mechit chalet above Govedartsi village, 1647 m, under Picea abies, 01.08.2008, MG (SOMF 27045); Generaliska Pusija locality above the village of Raduil, 1355 m, under Picea abies and Fagus sylvatica L., 04.07.2009, MG (SOMF 27671).

Note. Some literature sources suggest that the context of the pileus of B. subappendiculatus might occasionally show some very light and patchy blueing. Such a peculiarity has not been seen yet in any of the studied Bulgarian collections, although some of the
known localities offered the possibility to examine a great number of fresh basidiomata. This event is not impossible but is most probably very rare.

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