



Studies on *Boletellus* sect. *Boletellus* in Brazil and Guyana

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Abstract

Boletellus cremeovelosus (Boletaceae), a species that shows complete absence of reddish/pinkish tints on basidiome from the beginning with fully/soft squamules on pileus, is described from the state of Pernambuco, in Northeast Brazil. We also revised exsiccates of *B. ananas* var. *ananas* and *B. ananas* var. *minor*. Regarding to the presence of thick-walled cheilocystidia in the paratype of the last variety, we conclude that represent an immature basidiome of *B. ananas* var. *crassotunicatus*, representing a new record from South America.

Key words – Agaricomycetes – Boletales – Neotropic – taxonomy

Introduction

Boletellus Murrill (Boletaceae) was described for accommodate all boletoid taxa with tubular hymenophore and longitudinally ribbed basidiospores (Murrill 1909, Singer 1986). Actually, boletes are infrequently referred from Northeast Brazil. Singer (1961, 1964), Singer et al. (1983), Oliveira & Sousa (1995, 1996, 2002), Barbosa-Silva et al. (2017) and Magnago et al. (2017) are works citing members of this group, but rarely *Boletellus*. Actually, only three taxa of this genus are reported from Brazil: Singer et al. (1983) described from Amazon region *B. ananas* var. *minor* Singer; and *B. lepidospora* E.-J. Gilbert and *B. pustulatus* (Beeli) E.-J. Gilbert were reported by Neves & Capelari (2007) from the state of Pernambuco, but these taxa were collected in the state of Paraíba (Oliveira & Sousa 1995).

Here we describe a new species of *Boletellus* collected from Atlantic Forest fragment of the state of Pernambuco, representing the first record of the genus for this state and revision of authentic materials of *B. ananas* var. *ananas* and *B. ananas* var. *minor* from Guyana and Amazonas.

Materials & Methods

Collections were undertaken from “Usina São José (7°50’20’’S e 35°00’10’’ W), which is covered by variously sized Atlantic Forest fragments ranging from the smallest 12 ha to the largest 380 ha (Alves-Araújo et al. 2008, Trindade et al. 2008). There occur 826 trees species belonging to 379 genera and 112 families, with Leguminosae (all subfamilies), Poaceae, Cyperaceae, Euphorbiaceae, Rubiaceae, Asteraceae, Myrtaceae, Melastomataceae, Araceae, Malvaceae,

Apocynaceae, Sapindaceae and Sapotaceae the most diverse (Alves-Araújo et al. 2008, Melo et al. 2011).

Color codes follow Online Auction Color (2004). Microscopic observations were made from material mounted in 3% KOH and Congo red solutions. Measurements and statistics are based on 50 spores. Abbreviations include L(W) ± SD = average basidiospores length (width) with standard deviation, Q = the length: width ratio range as determined from all measured basidiospores, and Qm ± SD = the Q value averaged from all basidiospores measured with standard deviation. The holotype is deposited at JPB (Thiers 2017).

Taxonomy

Boletellus cremeovellus Barbosa-Silva & Wartchow, sp. nov.

Figs 1–9

MycoBank: MB823691; Facesoffungi number: FoF03896

Etymology – From Latin ‘cremeus’ (cream) and ‘vellus’ (veil). Regarding to cream colored velar remnants on pileus.

Diagnosis – *Boletellus cremeovellus* differs from all other taxa of section *Boletellus* in the complete lack of pink, red, lavender or purple tints on the basidiome and the fluffy/soft squamules pileus, on which they are more or less pyramidal/erect at centre then turning more flattened towards the margin.

BASIDIOME medium size, solitary or in cluster with very young. PILEUS ranging to 70 mm diameter, plane slightly depressed, pale beige (darker than OAC 813) with shade of cream (OAC 857); surface squamose with more or less fluffy/ soft pyramidal/erect at centre turning more flattened toward margin, with beige (OAC 777) or sometime brownish (OAC 776) tips; margin entire and strongly appendiculate projecting about 3 mm, thick, soft; context 12 mm thick near centre, pale then immediately changing to dark greenish blue (OAC 159) after sectioned, lemon yellow (OAC 896) then slowly darkening in KOH. HYMENOPHORE tubulose, free, greenish (OAC 848) then olive (OAC 832 or 838) quickly changing to dark bluish green (OAC 194) when injured; tubes ranging to 6 mm long, mostly hexagonal 1–2 (–3) mm in diam., more elongate nearest the stipe; dark reddish brown (OAC 705) in KOH. STIPE: 88 × 20 mm, tapering downward to near bulb, uniformly cream (OAC 857) with brownish spots (OAC 770) some hours after handling, surface longitudinally fibrillose; context fleshy, solid, cream (OAC 815), unchanging with handling but turning lemon yellow (896) with KOH. ODOR and TASTE not performed.

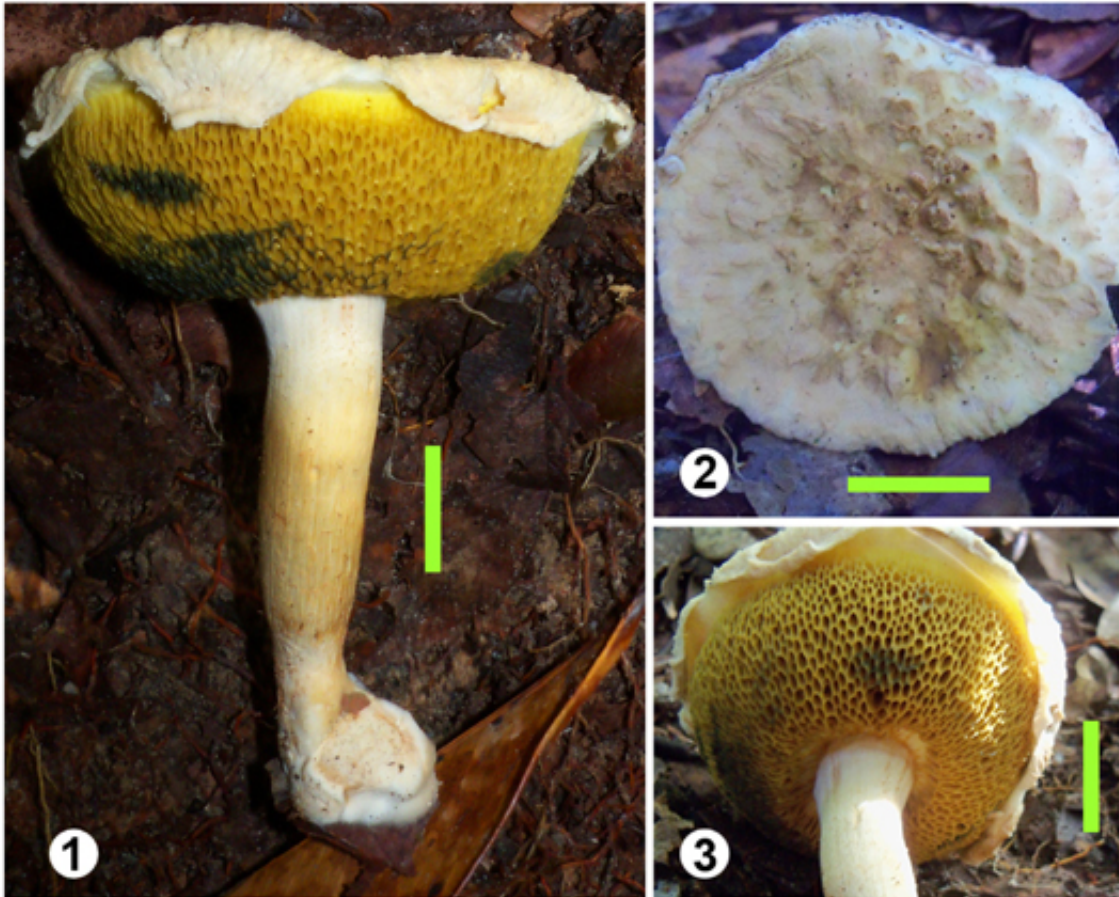
BASIDIOSPORES (15.1–)15.8–20.4(–20.9) × (6.1–)6.6–9.2(–9.7) μm, L = 18.5 ± 1.37 μm, W = 7.7 ± 0.92 μm, Q = (1.91–)1.96–3.11(–3.25), Qm = 2.44 ± 0.28, subfusoid, inamyloid, pale mealeous in KOH, thin-walled, longitudinally ribbed sometimes dichotomously forked, converging at poles, usually adaxially ventricose; sometimes with one or two large guttules. BASIDIA 43–50 × 12–17 μm, clavate, hyaline to pale in KOH, 4-occasionally 3-sterigmate; sterigmata short up to 2 μm long. SUBHYMENIUM mostly with interwoven short hyphae 3.5–7 μm, hyaline in KOH, sometimes appearing subcellular. PLEUROCYSTIDIA 45.4–93 × 5.1–12 μm, ventricose-lageniform, subventricose-lageniform to sublageniform, mostly narrow with a long neck mostly >50 μm long, pale yellowish to almost colorless in KOH, thin-walled, sometimes with oil-drop, scattered. CHEILOCYSTIDIA 34.5–97 × 4–11.5 μm, similar to pleurocystidia in shape, colorless in KOH, thin-walled, sometimes with oil-drop, abundant at tube edge. HYMENOPHORAL TRAMA boletoid, i.e. divergent, central stratum up to 20 μm wide with hyphae 3.5–8 μm wide, that slightly diverging ranging to 13 μm wide. PILEIPELLIS trichodermial, multiseptate cylindrical elements mostly suberect, pale yellow in KOH, terminal cells 9.5–14 μm wide, cylindrical, clavate to broadly clavate, oleiferous hyphae frequent 4–14 μm wide; pileal appendiculate edge with terminal elements similar to those of the rest of pileipellis; oleiferous hyphae also found, but less frequent. PILEUS TRAMA strongly interwoven, hyphae 3.5–16 μm wide, hyaline in KOH; oleiferous hyphae very common 4–11 μm wide. STIPITIPPELLIS trichodermial palisade, multiseptate cylindrical elements, hyaline to faint slightly yellowish in KOH, terminal cells cylindrical, clavate to cylindric-

clavate, 5–16 μm wide. STIPE TRAMA hyphae longitudinally oriented, interwoven, 4–14 μm wide, hyaline in KOH; oleiferous hyphae 3–14 μm wide, common. CLAMP CONNECTIONS absent.

Known distribution – known from type locality.

HABITAT – Solitary or clustered together a very young basidiomes on base of living trunk of *Coccoloba* sp. from Atlantic Forest fragment of Pernambuco. Melo et al. (2011) referred to 10 species of this genus in the region: *C. almifolia* Casar., *C. confusa* R.A. Roward, *C. declinata* (Vell.) Mart. *C. leavis* Casar., *C. lucidula* Benth., *C. marginata* Benth., *C. mollis* Casar., *C. ochreolata* Wedd., *C. parimensis* Benth. and *C. striata* Benth.

Material examined – Brazil, Pernambuco, Igarassu, Usina São José, Mata da Cruzinha, 28 May 2010, F. Wartchow 23/2010 (JPB 63210 holotypus hic designatus).



Figs 1–3 – *Boletellus cremeovulosus* (holotype). 1 Basidiome in side view. 2 Pileus surface. 3 Hymenophore. – Bars = 20 mm.

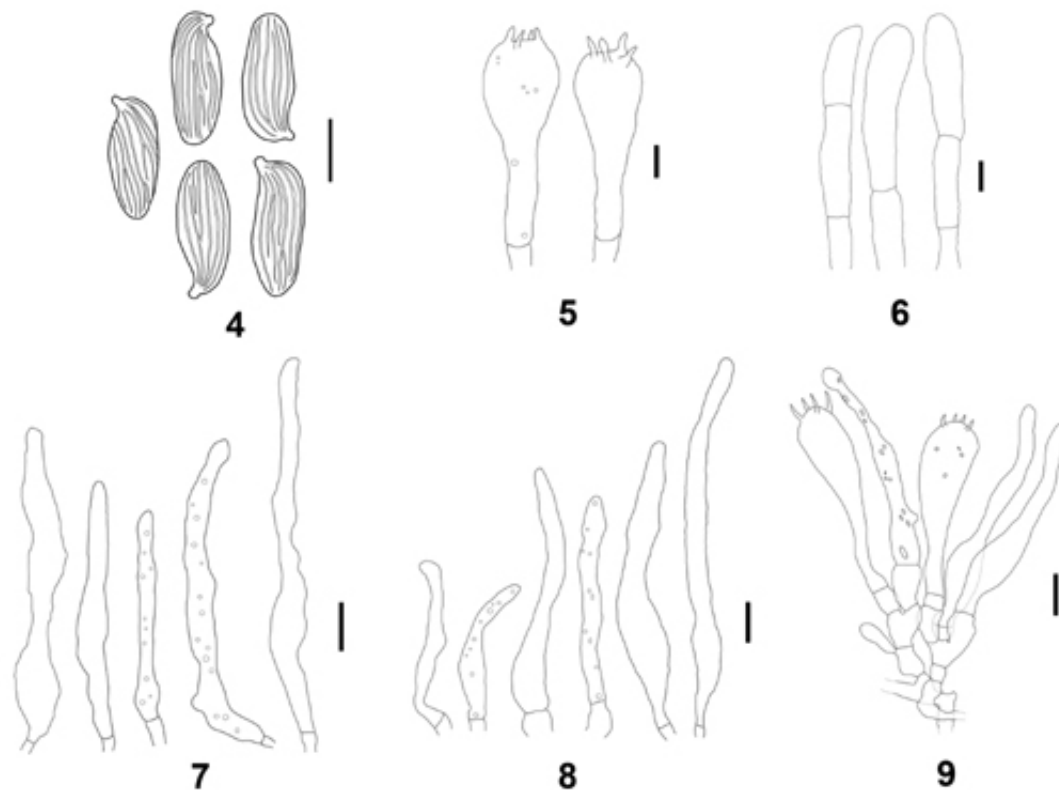
Notes – *Boletellus cremeovulosus*, due its dry squamose pileus with appendiculate margin and basidiospores $>16 \mu\text{m}$ long longitudinally ribbed is placed in the sect. *Boletellus* (Singer 1986, Halling et al. 2015). Among taxa of this group, Halling et al. (2015) used successfully the features of the scales on pileus surface for species concept. Following this concept, our new species is well characterized by the complete lack of pink, red, lavender or purple tints on the basidiome and the fluffy/soft squamules pileus, on which they are more or less pyramidal/erect at centre then turning more flattened toward margin.

There are other seven species of this group and only *B. dissilens* (Corner) Pegler & T.W.K. Young from Australia, Malaysia and Singapore from also share in lack of reddish tons. However it differs in the lacking scales, on which it is matted subtomentose breacking in felt like patches and rare brown low squamules, but it is not truly squamose or squamulose (Halling et al. 2015).

All other six species primarily differ in the reddish tones on basidiome, but also can be segregate in the features of the pileal squamules as follow:

Boletellus ananas (M.A. Curtis) Murrill from Florida to Colombia differs in the appressed to recurved squamules and more squarrose at centre (Singer 1945, Thiers 1963, Singer 1970, Singer et al. 1992, Ortiz-Santana et al. 2007, Mayor et al. 2008); *B. ananiceps* (Berk.) Singer has squamules confined to a portion that is beneath an overlying of fine superficial layer of hyphae that gains the paler red to pink color (Halling et al. 2015); *B. deceptivus* Halling & Fechner is coarsely squamose that are deep red with whitish or paler ochraceous tips; and *B. emodensis* (Berk.) Singer presents fine scales from the beginning (Halling et al. 2015).

Sato & Hattori (2015) also presented a species concept for this group that also described reddish taxa. However, the morphology of the scales of pileus surface is interesting to point here. *Boletellus aurocontextus* Hirot. Sato also shows squamulose to verrucose scales, often rimulose to rimulose-areolate at maturity showing bright yellow to lemon yellow context through a gap of scales; and *B. areolatus* Hirot. Sato with first tomentose to floccose with thin scaly patches, then coarsely cracking into large and small areas with tomentose, floccose to appressed thin scaly patches.



Figs 4–9 – *Boletellus cremeovelosus* (holotype). 4 Basidiospores. 5 Basidia. 6 Terminal elements of pileipellis. 7 Pleurocystidia. 8 Cheilocystidia. 9 Basidia, pleurocystidia and subhymenium. – Bars = 10 μ m.

Boletellus ananas var. *ananas* (M.A. Curtis) Murrill, Mycologia 1, 10. 1909
Macroscopy of Guyanese material in Mayor et al. (2008).

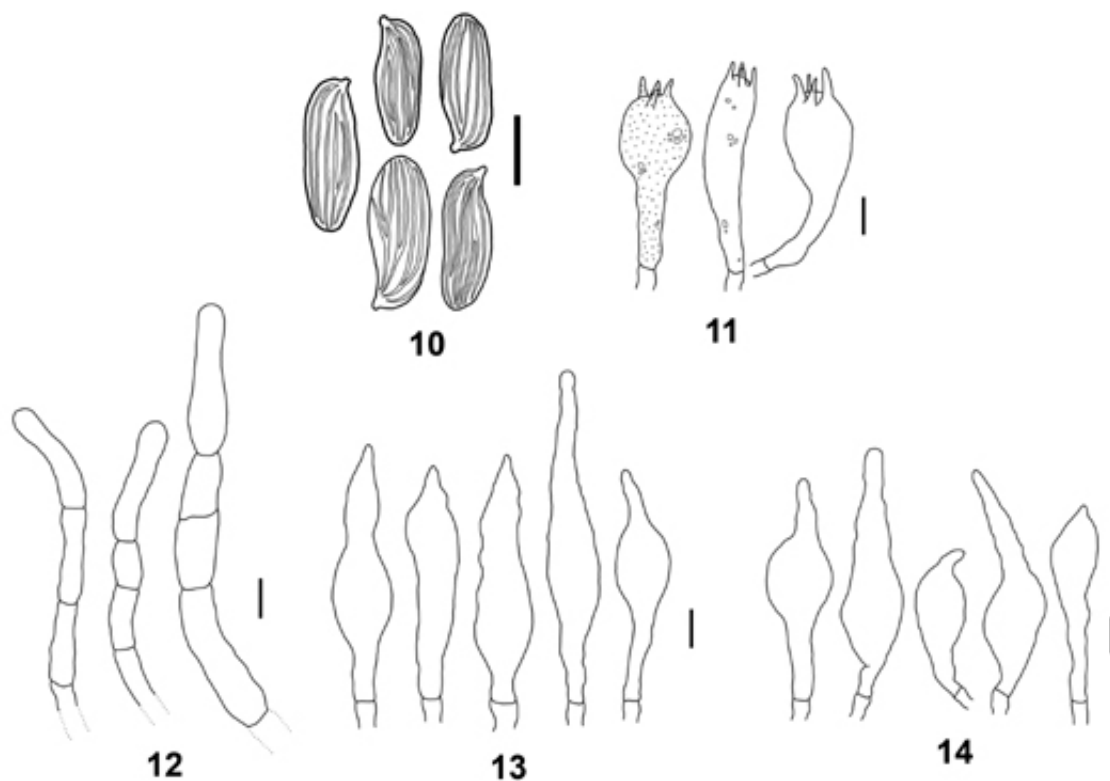
Figs 10–14

BASIDIOSPORES (17.5–)18–24(–24.5) \times (6.5–)7–9(–9.5) μ m, L= 21.2 \pm 1.25 μ m, W= 7.9 \pm 0.63 μ m, Q = (2.16–)2.30–3.00(–3.07), Qm = 2.68 \pm 0.18, subfusoid, inamyloid, melleous in KOH, sometimes with one to multiguttulate, occasionally also with refractive contents, wall slightly thickened 0.5–1 μ m, longitudinally ribbed, occasionally bifurcating, converging at poles. BASIDIA 31.1–56 \times 10.7–20.5 μ m, clavate to cylindrical-clavate (less frequent), hyaline in KOH, sometimes with little guttules and refractive contents, 4-sterigmate. PLEUROCYSTIDIA 46–92 \times 8–22 μ m,

ventricose-rostrate, ventricose-ampullaceous, fusoid-ampullaceous to fusoid-mucronate or subventricose-mucronate, thin-walled, hyaline in KOH, frequent. CHEILOCYSTIDIA $31.6\text{--}77 \times 7.7\text{--}20.5 \mu\text{m}$, similar in shape and color to pleurocystidia, however also presents occasionally cylindrical hyphal projections in the tubes edge, thin-walled. HYMENOPHORAL TRAMA boletoid, i.e. divergent, hyphae with $3.6\text{--}17 \mu\text{m}$ wide, gelatinized, pale to hyaline in KOH, presence of the oleiferous hyphae. PILEIPELLIS trichodermial with cylindrical and multiseptate elements interwoven, anticlinally to erect, faint yellowish to hyaline in KOH, terminal cells cylindrical with obtuse apex, $6\text{--}10 \mu\text{m}$ wide. PILEUS TRAMA strongly interwoven, hyphae $3\text{--}14 \mu\text{m}$ wide, hyaline in KOH, gelatinized, presence of the oleiferous hyphae. STIPITIPPELLIS trichodermial palisade, multiseptate cylindrical elements, faint yellowish to melleous in KOH, terminal cells cylindrical, clavate to slightly clavate, $6.5\text{--}11.5 \mu\text{m}$ wide. STIPE TRAMA longitudinally oriented, interwoven, hyphae $3.5\text{--}18 \mu\text{m}$ wide, hyaline in KOH, presence of the oleiferous hyphae. CLAMP CONNECTIONS absent.

Known distribution – Belize, Colombia, Costa Rica, Dominican Republic, Guatemala, Guyana, Mexico, Panama and United States of America (Curtis 1848, Murrill 1909, Singer 1945, Singer 1970, Singer et al. 1983, Singer et al. 1992, Flores Arzú & Simonini 2000, Ortiz-Santana et al. 2007, Mayor et al. 2008, Flores Arzú et al. 2012).

Material examined – Guyana, Region 8, Potaro-Siparuni, Pakaraima Mountains, 4 km southwest of Potaro base camp near *Dicymbe* plot 3, 18 May 2001, Henkel 8168 (HSU); 0.75 km west of Potaro base camp, 3 June 2005, Henkel 8833 (HSU).



Figs 10–14 – *Boletellus ananas* var. *ananas*. 10 Basidiospores. 11 Basidia. 12 Terminal elements of pileipellis. 13 Pleurocystidia. 14 Cheilocystidia. – Bars = $10 \mu\text{m}$.

Notes – The material was referred as having red-pink squamose (wooly squamules) pileus, marginal veil, bluing hymenophore and pileus context when injured; large basidiospores ($< 16 \mu\text{m}$) longitudinally ribbed with cross-striae on the ridges and spirally encrusted hyphae in the marginal appendiculate veil and stipe context (Mayor et al. 2018). This description is similar to other authors about the taxon (Singer 1945, Thiers 1963, Singer 1970, Smith & Thiers 1971, Singer et al. 1983,

Singer 1986, Singer et al. 1992, Ortiz-Santana et al. 2007, Halling et al. 2015). *Boletellus cremeovulosus* differs from the Guyana material in the pale beige with shade of cream and complete absence of reddish/pinkish tints on basidiome, and the fluffy/soft squamules. We can also consider two other features: the stipe context of *B. cremeovulosus* is unchanging while *B. ananas* var. *ananas* it slowly turns blue (Mayor et al. 2008: 394). *Boletellus cremeovulosus* also presents slightly shorter basidiospores, with (15.1–)15.8–20.4(–20.9) μm , $L = 18.5 \pm 1.37 \mu\text{m}$ and $Q_m = 2.44 \pm 0.28$, comparing to *B. ananas* var. *ananas* with (17.5–)18–24(–24.5) μm , $L = 21.2 \pm 1.25 \mu\text{m}$ and $Q_m = 2.68 \pm 0.18$.

We also observed an interesting difference in relation to cystidia size between our analysis and Mayor et al. (2008). Although they reported pleurocystidia smaller than 50 μm long, we found pleurocystidia 46–92 and cheilocystidia 31.6–77 μm long. *Boletellus cremeovulosus* presents somewhat longer pleurocystidia 45.4–93 and cheilocystidia 34.5–97 μm , but different in the shape (narrow ventricose-lageniform, subventricose-lageniform to sublageniform).

In relation the macrochemical reaction *B. cremeovulosus* in presence of KOH on pileus and stipe context turn lemon yellow while *B. ananas* var. *ananas* presents orange-yellow on pileus context and burgundy to orange on stipe context (Mayor et al. 2008: 395).

Boletellus ananas* var. *crassotunicatus Singer, Beih. Nova Hedw. 77, 152. 1983. Figs 15–19

According to Singer et al. (1983: 152), this variety differs from *B. ananas* var. *ananas* in the presence of thick-walled cheilocystidia 35.5–70 \times 7.5–11 μm and wall 1.2–3.7 μm .

BASIDIOSPORES (13–)13.5–20.5(–21) \times 5–7(–8) μm , $L = 16.3 \pm 2.34 \mu\text{m}$, $W = 5.9 \pm 0.71 \mu\text{m}$, $Q = (2.14–)2.25–3.73(–3.82)$, $Q_m = 2.78 \pm 0.55$, subfusoid, inamyloid, color melleous in KOH, with low ribs, thin-walled, sometimes with guttules, rare. BASIDIA 25.5–71 \times 4–12.5 μm , 4-sterigmate, elongated-clavate, cylindric-clavate to clavate, hyaline to colorless (mostly) to light brown (few) in KOH, sometimes with guttules and densely packed refractive contents, rare. PLEUROCYSTIDIA 35.5–70 \times 7.5–11 μm , fusoid-mucronate, fusoid-ampullaceous, subfusoid-ampullaceous to subventricose-mucronate, light yellow, dull melleous to hyaline in KOH, thin-walled, some presents refractive contents and guttules, rare. CHEILOCYSTIDIA 26–65 \times 7–11 μm , fusoid-mucronate, subventricose-mucronate, some presents refractive contents and guttules, thin-walled but few fusoid with thick-walled (1.5 μm), dull melleous in KOH, rare. HYMENOPHORAL TRAMA boletoid, i.e. slightly divergent, 3–7 μm wide, yellowish to hyaline in KOH. PILEPELLIS trichodermial with elements slightly interwoven to anticlinal, sometimes multiseptate, yellowish, pastel yellowish, bright yellowish, light yellow to hyaline in KOH, terminal cells 4.5–11 μm wide, cylindrical (mostly) to cylindric-clavate with mucronate apex. PILEUS TRAMA interwoven, 2.5–7 μm wide, have gelatinized appearance, slightly yellowish to hyaline in KOH, abundant presence of the oleiferous hyphae. STIPITPELLIS trichodermial palisade, multiseptate elements cylindrical, pastel yellowish to hyaline in KOH, terminal cells cylindrical to clavate, 5–11.5 μm wide. STIPE TRAMA hyphae longitudinally oriented, interwoven, 2.5–7 μm wide, yellowish to slightly pale yellowish in KOH, abundant presence of the oleiferous hyphae. CLAMP CONNECTIONS absent.

Known distribution – Nicaragua, Panama (Singer et al. 1983) and now Brazil.

Material examined – Brazil, Amazonas, Estrada Manaus-Caracará, km 45, 5 May 1980, Singer B 12137 (INPA 102047, paratype! of *B. ananas* var. *minor*).

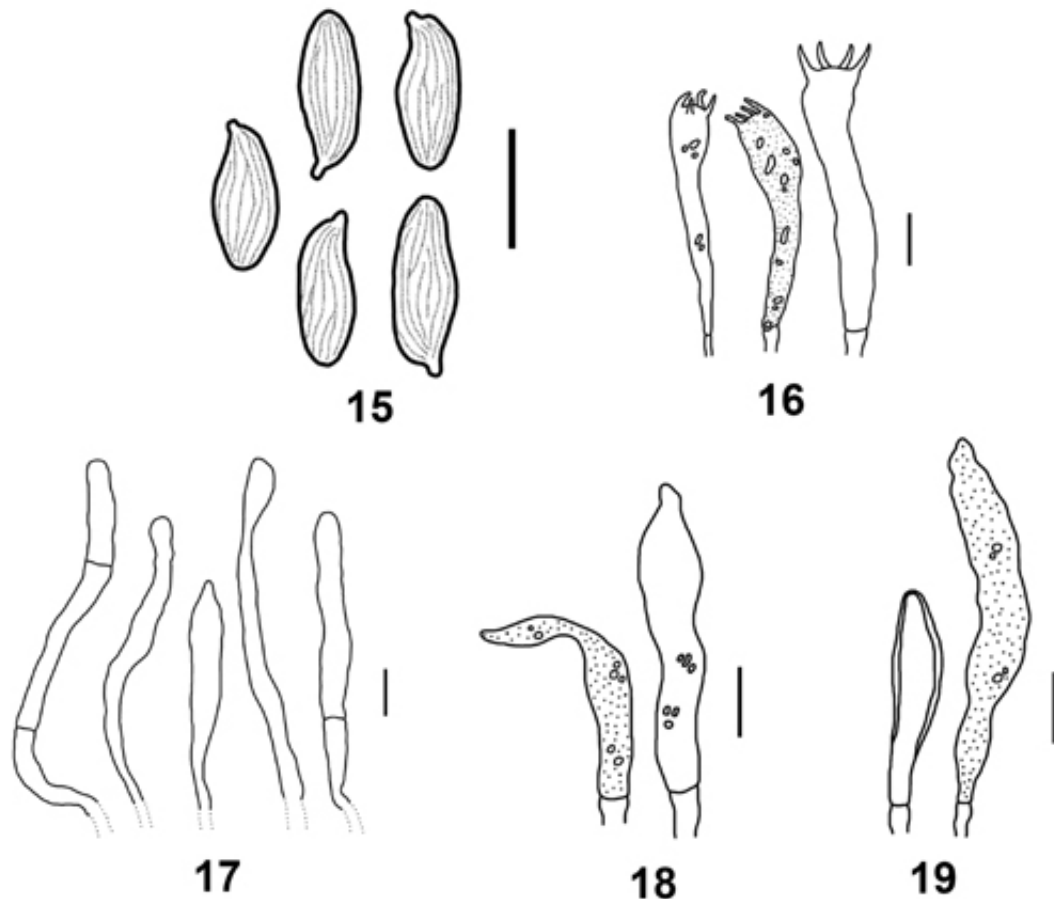
Notes – *Boletellus ananas* var. *minor*, from Brazil and Nicaragua and was described as having small size of basidiomes (15–30 mm pileus and 4–8 mm wide stipe), narrow basidiospores 5.5–7.5 μm , absence of thick-walled cystidia and pores slightly smaller and less angular (Singer et al. 1983: 153).

The material examined here differs from *B. ananas* var. *ananas* and *B. cremeovulosus* in the smaller basidiome (pileus 10 mm and stipe 33 \times 6 mm in dried state), narrower basidiospores 5–7(–8) μm with less prominent ribs, and some thick-walled cheilocystidia to 1.5 μm thick.

However, we observed that the paratype analyzed here is in very young stage of development, i.e. the pileus closed and the veil attached in the stipe, hymenophore scarce and not

fully developed, and few basidiospores and basidia. The cystidia were somewhat difficult to observe, however some thick-walled cheilocystidia were found.

The occurrence of thick-walled cheilocystidia was a surprise to us. It is a key feature of *B. ananas* var. *crassotunicatus* Singer from Nicaragua and Panama, which was referred with many or all cheilocystidia thick-walled (Singer et al. 1983: 152). As stated above, the material was very young and the hymenophore not exposed. Apparently Singer did not analyze it under microscope and gave the name '*minor*' due small size of the basidiome. Since really immature, and the occurrence of thick-walled cheilocystidia, it corresponds a young material of *B. ananas* var. *crassotunicatus*. Regarding to narrow basidiospores, which is one of the features of var. *minor*, it occurred due immature state of the exsiccate.



Figs 15–19 – *Boletellus ananas* var. *crassotunicatus*. 15 Basidiospores. 16 Basidia. 17 Terminal elements of pileipellis. 18 Pleurocystidia. 19 Cheilocystidia. – Bars = 10 μ m.

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