

Two new *Crypthonia* species and a new *Syncesia* from Chapada do Araripe, Ceará, NE Brazil (Ascomycota: Arthoniales), with a key to *Crypthonia*

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Abstract: Two new species of the small genus *Crypthonia* are described from the Chapada do Araripe, an isolated table mountain in the state of Ceará, in NE Brazil. Both share the thallus and ascoma organization with the other known species of the genus, and are mainly characterized by differences in ascospores and chemistry. *Crypthonia lichexanthonica* A. A. Menezes, M. Cáceres & Aptroot has 7-septate ascospores and contains lichexanthonone in the thallus, and *C. submuriformis* A. A. Menezes, M. Cáceres & Aptroot has (sub)muriform ascospores and also contains lichexanthonone, but only in the ascigerous areas. A key to all known species of the genus *Crypthonia* is provided, in which *Crypthonia olivacea* Frisch & G. Thor is newly reported from Argentina. The new species *Syncesia byssolomoides* A. A. Menezes, M. Cáceres & Aptroot is described from the same area. It also has a thin byssoid thallus, but differs by the narrowly fusiform ascospores and by containing psoromic acid. It differs from all *Syncesia* species by the absence of carbonization and the presence of psoromic acid. The epiphytic lichen flora in this Caatinga forest area is dominated by crustose lichens, with *Graphis* and *Polymeridium* as the most speciose genera.

Key words: Arthoniaceae, corticolous, lichens, lichexanthonone, Roccellaceae, taxonomy

Accepted for publication 11 May 2013

Introduction

The Chapada do Araripe is an isolated table mountain located at the confluence of the borders of Ceará, Pernambuco and Piauí States. The Araripe plateau, with an altitude range of 870–980 m (Siebra *et al.* 2011), comprises at least four different vegetation types, including rainforest patches and also areas of Caatinga, with Cerrado and Cerradão forests (Sampaio *et al.* 1981).

The epiphytic lichen flora in this Caatinga forest area is dominated by crustose lichens,

with *Graphis* and *Polymeridium* as the most speciose genera. The Caatinga is a lichen-rich vegetation because of its open structure. The angiosperm diversity is high (Ribeiro-Silva *et al.* 2012), but the lichen diversity of this biome is still largely unexplored (Cáceres 2007).

The genus *Crypthonia* was recently described (Frisch & Thor 2010) to accommodate species of Arthoniaceae somewhat similar to *Coniarthonia* but with a felty to byssoid thallus. So far 11 species are known in the genus, all with clavate to fusiform, 1–4-septate ascospores.

Two undescribed species of this genus were recently found on Chapada do Araripe in Brazil. Both share the thallus and ascoma organization with the other known species of the genus. They are mainly characterized by their ascospores and chemistry. *Crypthonia lichexanthonica* has 7-septate ascospores and contains lichexanthonone, and *C. submuriformis*

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has (sub)muriform ascospores and also contains lichexanthone, but only in the ascigerous areas. A further new species is described from the same area. It has a similar thallus but narrowly fusiform ascospores, and it contains psoromic acid; it belongs to the genus *Synnesia*. A revised key to all species of the genus *Crypthonia* is provided.

Material and Methods

Identification and descriptive work was carried out in Itabaiana, Universidade Federal de Sergipe, using a Leica EZ4 stereomicroscope and a Leica DM500 compound microscope, and also in Soest using an Olympus SZX7 stereomicroscope and an Olympus BX50 compound microscope with interference contrast, connected to a Nikon Coolpix digital camera. Sections were mounted in tap water, in which all measurements were also taken. The specimens from this study are preserved in ISE. The chemistry of the type specimens was investigated by thin-layer chromatography (TLC) using solvent A (Orange *et al.* 2001).

The Species

Crypthonia lichexanthonica A. A. Menezes, M. Cáceres & Aptroot sp. nov.

Mycobank No.: MB 802584

Crypthonia with lichexanthone and 7-septate ascospores 15–19 × 6.0–7.5 µm.

Type: Brazil, Ceará, Chapada do Araripe, on bark of tree, c. 900 m alt., May 2012, K. A. de Jesus & A. A. Menezes (ISE 15898—holotype).

(Fig. 1)

Thallus crustose, byssoid, surface finely granular to felty, not corticate, dull, pale glaucous grey, closely appressed, without hypothallus, surrounded by a white to brown byssoid prothallus. Hyphae c. 2 µm wide, incrustated with hyaline crystals. *Algae* trentepohlioid, 7–12 µm diam.

Ascigerous structures rounded to elongate or slightly lobate and flattened, 0.3–0.7 × 0.4–1.5 mm wide, central part (disc) white to cream, margin white. *Interascal filaments* densely anastomosing and curled, c. 1.0–1.5 mm wide. *Hymenium* densely incrustated with hyaline crystals, hydrophobic, without gelatine, IKI+ pale blue (hemiamyloid). *Asci*

clavate, 45–55 × 12–15 µm, thick-walled, sometimes visible from above as pale brownish spots in the ascigerous structures. *Ascospores* 8 per ascus, hyaline, 7-septate, broadly fusiform, 15–19 × 6.0–7.5 µm, lumina ellipsoid, IKI+ reddish brown (dextrinoid), wall c. 1.0–1.5 µm thick, ends rather rounded.

Pycnidia not observed.

Chemistry. Thallus and ascigerous structures UV+ yellow, C–, P–, K–. TLC: lichexanthone.

Ecology and distribution. On smooth bark of trees in Caatinga forest. Known only from Brazil.

Discussion. This species differs from all known species of *Crypthonia* (Frisch & Thor 2010) by the presence of lichexanthone. This substance occurs in some other *Arthoniales*, especially in the related genus *Cryptothecia*. It differs from the following species by the ascospores, which are only transversely septate. The species is very close in aspect to some other species of *Crypthonia*, such as *C. bisepitata* (Aptroot & Wolseley) Frisch & G. Thor and the species described below, and can only be differentiated when chemistry and internal structures are examined. The thallus is thinner than that of most other *Crypthonia* species, and as a consequence a distinct hypothallus is not discernible.

Crypthonia submuriformis A. A. Menezes, M. Cáceres & Aptroot sp. nov.

Mycobank No.: MB 802585

Crypthonia with lichexanthone in the ascigerous areas but not in the thallus, and submuriform (4–)7 × 0–1-septate ascospores 18–21 × 7–8 µm.

Type: Brazil, Ceará, Chapada do Araripe, on bark of tree, c. 900 m alt., 24 January 2011, A. A. Menezes 701 (ISE—holotype).

(Fig. 2)

Thallus crustose, byssoid, not corticate, dull, pale glaucous green, c. 0.1 mm thick, closely appressed, without a distinct hypothallus but buff to brownish where in contact with the bark, surrounded by a white byssoid prothallus up to 2 mm wide. Hyphae c. 2 µm

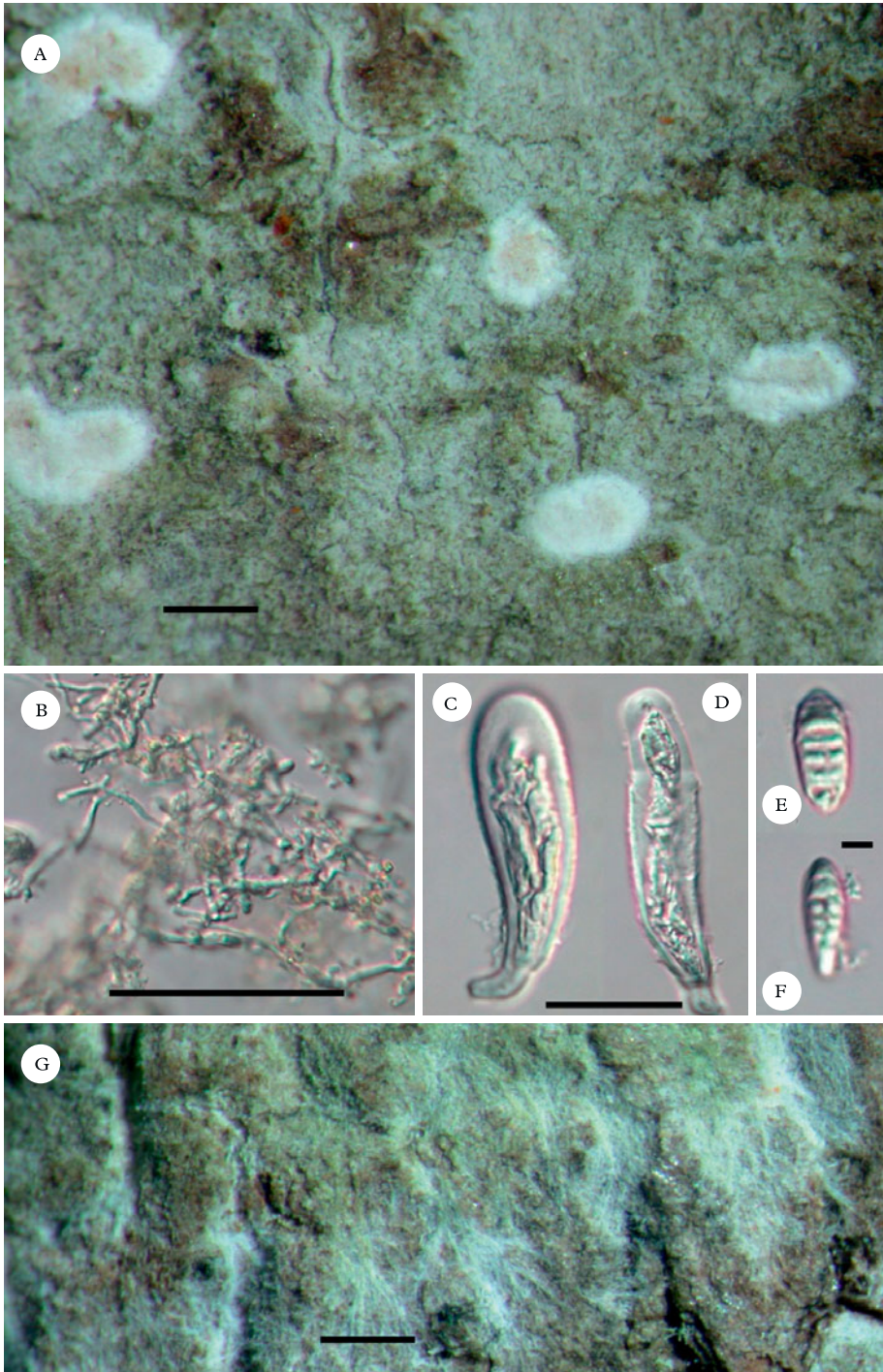


FIG. 1. *Crypthonia lichexanthonica*, holotype. A, habitus; B, hyphae; C, ascus; D, ascus with opened exoascus and still intact endoascus; E & F, ascospores; G, prothallus. Scales: A & G = 0.5 mm; B–D = 20 μ m; E & F = 5 μ m. In colour online.

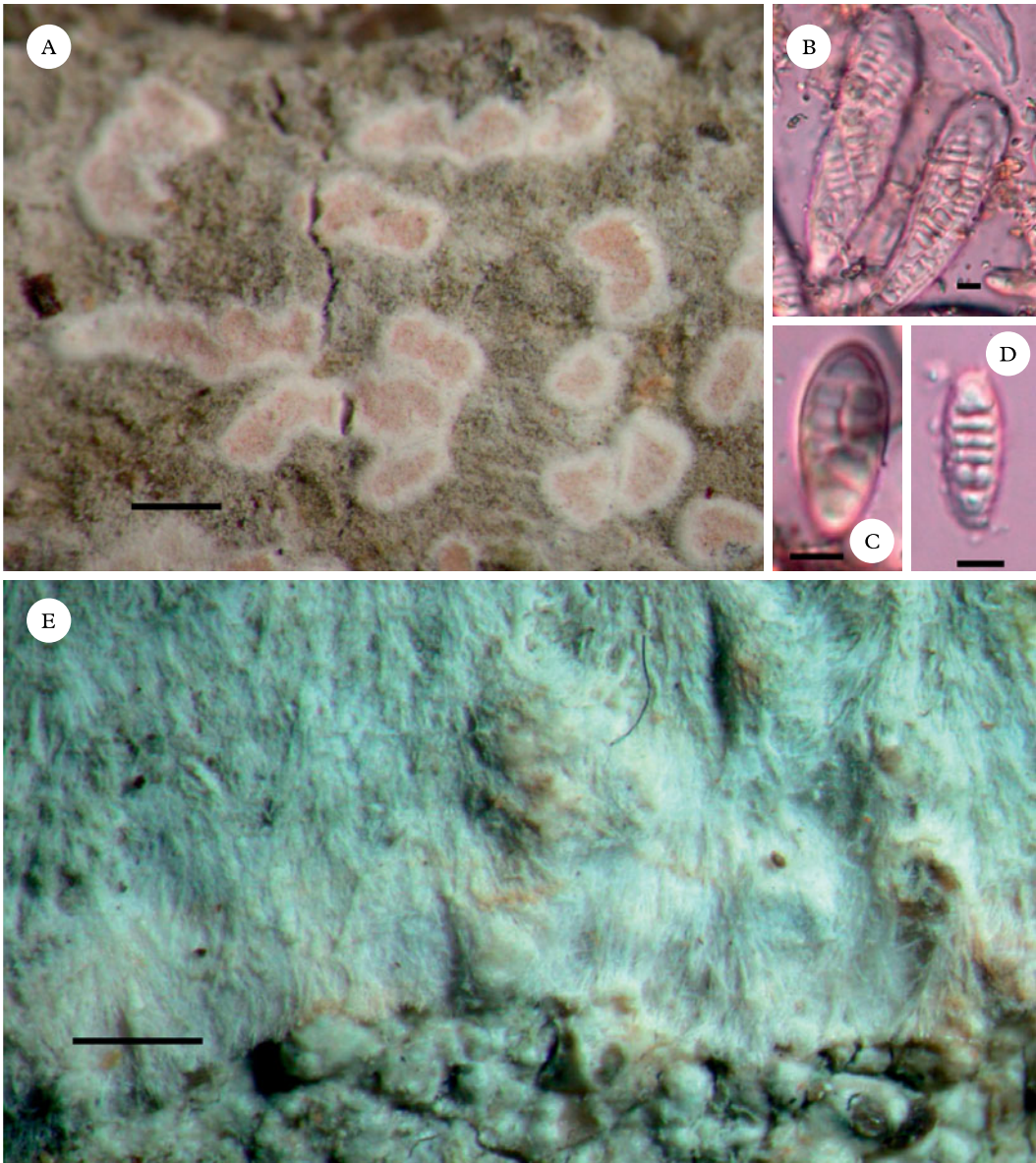


FIG. 2. *Crypthonia submuriformis*, holotype. A, habitus; B, asci; C & D, ascospores; E, prothallus. Scales: A & E = 0.5 mm; B = 10 μ m; C & D = 5 μ m. In colour online.

wide, incrustated with hyaline crystals. *Algae* trentepohlioid, 7–10 μ m diam.

Ascigerous structures slightly raised, rounded to lobate or elongated but usually with irregular outline, solitary or in loose groups, 0.4–

0.9 mm diam., surface mauve, flattened, margin byssoid, white. *Interascal filaments* densely anastomosing and curled. *Hymenium* pallid brown by incrustated crystals, hydrophobic, without gelatine, IKI+ pale blue

(hemiamyloid); *epihymenium* pale brown; *hypothecium* hyaline; *excipulum* hyaline, byssoid. *Asci* numerous, clavate, with 8 irregularly arranged ascospores which react IKI+ reddish (dextrinoid), $60\text{--}75 \times 18.0\text{--}22.5 \mu\text{m}$, at the top sideways up to $6 \mu\text{m}$ thick. *Ascospores* hyaline, submuriform ($4\text{--}7 \times 0\text{--}1$ -septate, $18\text{--}21 \times 7\text{--}8 \mu\text{m}$, fusiform, ends rounded, end lumina initially largest, ultimately small (after the last divisions), wall *c.* $1 \mu\text{m}$ thick.

Pycnidia not observed.

Chemistry. Thallus UV–, C–, P–, K–; ascigerous areas UV+ yellow, C–, P–, K–. TLC: lichexanthone (only in the ascigerous areas).

Ecology and distribution. On smooth bark of trees in Caatinga forest. Known only from Brazil.

Discussion. This species differs from all known species of *Crypthonia* by the submuriform ascospores (Frisch & Thor 2010), and from all species in the genus, with the exception of *C. lichexanthonica*, by the presence of lichexanthone; in this species it is restricted to the ascigerous areas, while it occurs in the thallus in *C. lichexanthonica*. The species is very close in aspect to some other species of *Crypthonia*, such as *C. biseptata* (Aptroot & Wolseley) Frisch & G. Thor and the species described above, and can be differentiated only when chemistry and internal structures are examined. The thallus is thinner than that of most other *Crypthonia* species, and as a consequence a distinct hypothallus is not discernible, although the contact area with the bark is usually pigmented. The presence of species with (sub)muriform ascospores in genera in which all other known species have only transversely septate ascospores is not surprising, and a phenomenon now known in many phylogenetically well-circumscribed lichen genera.

Additional specimens seen. **Brazil:** Ceará: Chapada do Araripe, on bark of tree, *c.* 900 m alt., 2011, *A. A. Menezes* 8164, 8170, 8228, 8230, 8296, 8362, 8380, 8415 (all ISE).

***Syncesia byssolomoides* A. A. Menezes, M. Cáceres & Aptroot sp. nov.**

Mycobank No.: MB 801922

Syncesia with psoromic acid, hyaline hypothecium, absence of carbonization and slender 3-septate ascospores $45\text{--}50 \times 4.0\text{--}5.5 \mu\text{m}$.

Type: Brazil, Ceará, Chapada do Araripe, on bark of tree, *c.* 900 m alt., May 2012, *A. A. Menezes* (ISE 15897—holotype).

(Fig. 3)

Thallus crustose, byssoid, not corticate, dull, pale glaucous green, *c.* 0.1 mm thick, surrounded by a brown byssoid prothallus line. Hyphae *c.* $3 \mu\text{m}$ wide, incrustated with hyaline crystals. *Algae* trentepohlioid, $5\text{--}10 \mu\text{m}$ diam.

Ascomata apothecioid, raised, rounded to lobate, solitary or in loose groups, 0.2–0.6 mm diam., surface pale brown, flattened, slightly white pruinose, margin byssoid, white. *Interascal filaments* branched pseudoparaphyses. *Hymenium* hyaline, IKI+ blue (amyloid); *epihymenium* pale brown; *hypothecium* hyaline; *excipulum* brownish inside, outside hyaline and byssoid. *Asci* numerous, clavate, with 8 irregularly arranged ascospores which react IKI+ reddish (dextrinoid), $60\text{--}75 \times 15\text{--}25 \mu\text{m}$, at the top sideways up to $5 \mu\text{m}$ thick. *Ascospores* hyaline, 3-septate, narrowly clavate, $45\text{--}50 \times 4.0\text{--}5.5 \mu\text{m}$, curved, ends rounded.

Pycnidia not observed.

Chemistry. Thallus and ascigerous structures UV–, C–, P+ yellow, K–. TLC: psoromic acid.

Ecology and distribution. On smooth bark of trees in Caatinga forest. Known only from Brazil.

Discussion. This species differs from all 22 currently known species of *Syncesia* by the hyaline hypothecium, a complete absence of carbonization and the presence of psoromic acid (Tehler 1997; Sipman 2009; Ertz *et al.* 2010; Joshi *et al.* 2011; van den Boom *et al.* 2011). Superficially, it somewhat resembles a *Byssoloma* because of the byssoid ascoma

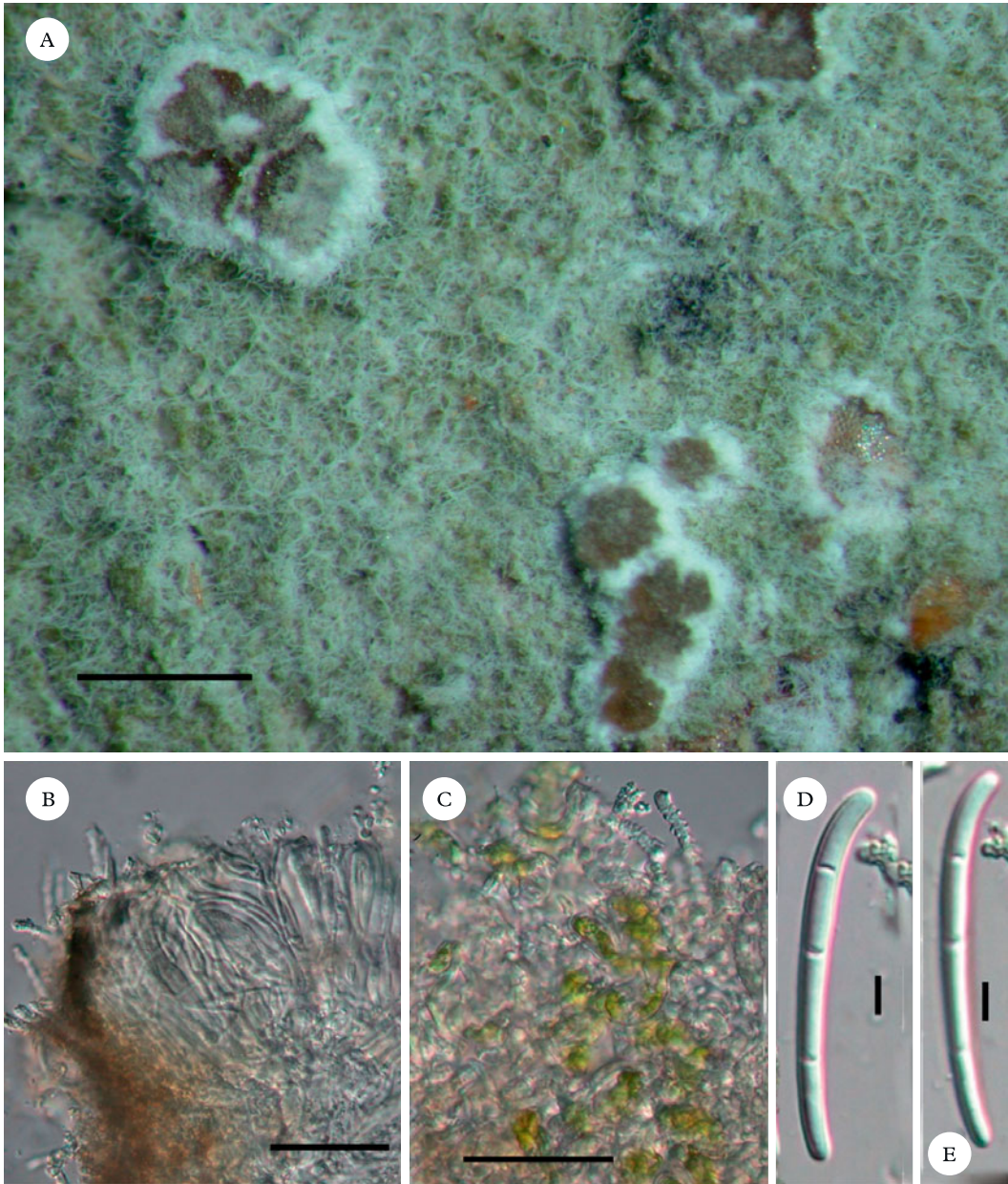


FIG. 3. *Syncesia byssolomoides*, holotype. A, habitus; B, section through ascoma zone; C, algae and hyphae; D & E, ascospores. Scales: A = 0.5 mm; B = 50 μ m; C–F = 5 μ m. In colour online.

margins, but differs, for example, in the byssoid thallus. It is with some hesitation that this new species is described here in the genus *Syncesia*, because the presence of a

dark brown to black, nearly carbonized hypothecium is prominent in all described species. However, this seems to be the only major difference between the new species and some other species in the genus.

Revised world key to the species of *Crypthonia*

- 1 Thallus with pseudoisidia 2
Thallus without pseudoisidia 4
- 2(1) Thallus with norstictic acid; pantropical **C. mycelioides**
Thallus with psoromic acid 3
- 3(2) Hypothallus green; ascomata and ascospores unknown; neotropical **C. albida**
Hypothallus olive-brown; ascomata often present, ascospores 1-septate; palaeotropical
. **C. palaeotropica**
- 4(1) Ascospores submuriform or transversely 7-septate; with lichexanthone 5
Ascospores transversely 1–3-septate; without lichexanthone 6
- 5(4) Ascospores submuriform; Brazil **C. submuriformis**
Ascospores transversely 7-septate; Brazil **C. lichexanthonica**
- 6(4) Ascospores 1-septate 7
Ascospores (1–)2–3-septate. 10
- 7(6) Hypothallus lemon yellow; Ivory Coast **C. citrina**
Hypothallus olive-brown or green 8
- 8(7) Thallus with unknown compounds; hypothallus olive-brown; ascospores 10–14 μm
long; Philippines **C. polillensis**
Thallus with psoromic acid; hypothallus and ascospores variable 9
- 9(8) Hypothallus green; ascospores 7.5–10.0 μm long; Brazil **C. brevispora**
Hypothallus olive-brown; ascospores 11–14 μm long; Reunion . **C. vandenboomii**
- 10(6) Thallus with rugulosin; Tanzania **C. bella**
Thallus with gyrophoric or psoromic acid 11
- 11(10) Thallus with gyrophoric acid; hypothallus reddish brown; thallus dark olive-green;
Brazil (also in NE Argentina: Misiones, Puerto Iguazú, 2013, Ferrari, Aptroot &
Cáceres 10607, CTES & ABL). **C. olivacea**
Thallus with psoromic acid; hypothallus and thallus not as above. 12
- 12(11) Ascospores 10–16 μm long, widest in the upper half; Australia. . **C. athertoniensis**
Ascospores 16–19 μm long, widest in the middle; Thailand. **C. biseptata**

Discussion

Most species of the recently described genus *Crypthonia* (Frisch & Thor 2010) are so far known only from their type. The remainder of the species are apparently rare; few collections were cited in the original paper and no new records or new species appear to have been subsequently reported. Here, we have added two new species from Brazil and report a collection of a known species from Argentina. The genus seems to be richest in species in Brazil. It is remarkable that nearly 20% of the species now recognized in this genus are known only from one mountain,

the Chapada do Araripe. The species newly described here share much of the thallus and ascoma organization with the other known species of the genus. Especially characteristic is the hydrophobic hymenium without gel, which is a shared character of only the genera *Crypthonia* and *Coniarthonia*. *Coniarthonia* differs from *Crypthonia* mainly by the crustose thallus and the always red-coloured apothecia. The new species markedly deviate by their ascospores, which have more septa, and they together share the lichexanthone chemistry which is not yet known from *Crypthonia*, but is rather frequent in tropical members of other genera in the *Arthoniaceae*.

The Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) is thanked for a research grant to MESC (Processo 501633/2009-0) and for financial support for the collecting trips (CNPq-PPBio/Semiárido Processo 558317/2009-0). The Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) is also thanked for a Master's scholarship to AAM and ABXL. The Hugo de Vries-fonds is thanked for travel support to AA. We are grateful to Leo Spier for performing thin-layer chromatography.

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