Conidial fungi from the semi-arid Caatinga biome of Brazil. Rare freshwater hyphomycetes and other new records

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Barbosa FR, Gusmão LFP. 2011 – Conidial fungi from semi-arid Caatinga Biome of Brazil. Rare freshwater hyphomycetes and other new records. Mycosphere 2(4), 475–485

During surveys for freshwater hyphomycetes on submerged plant debris in Brazil, six rare species were collected: Brachydesmiella anthostomelloidea, Camposporidium cristatum, Dactylaria hyalotunicata, Lauriomyces sakaeratensis, Pleurophragmium malaysianum and Pyricularia rabaulensis. Descriptions, illustrations and comments are given for these species. Additionally, 37 new records for Western hemisphere, Neotropics, South America, Brazil and Bahia State are listed. These results contribute to knowledge about the geographic distribution of freshwater hyphomycetes and reflect the lack of studies of these fungi in tropical regions.

Key words – aquatic fungi – mitosporic fungi – stream – taxonomy

Article Information
Received 4 July 2011
Accepted 15 Aug 2011
Published online 4 October 2011
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Introduction

Among the freshwater conidial fungi, the hyphomycetes have received most attention from taxonomists. Species in this group have been well investigated in temperate regions (Sivichai et al. 2002, Mavanová et al. 2003, Abdullah et al. 2005, Shearer et al. 2007). Study in tropical regions began about 20 years ago and about 280 species of freshwater hyphomycetes have been recorded in this region (Goh 1997). Knowledge of freshwater hyphomycetes is fragmented, but studies have been reported in countries including India (Sridhar & Kaveriappa 1989), Australia (Hyde & Goh 1998), Malaysia (Nawawi 1985, Kuthubutheen & Nawawi 1991), Cuba (Voglmayr & Delgado-Rodriguez 2001), Thailand (Sivichai & Hywel-Jones 1999, Sivichai et al. 2002), Schoenlein-Crusius & Grandi (2003) compiled data from the literature and registered 90 species of aquatic hyphomycetes for South America, including Argentina, Brazil, Chile, Ecuador, Peru and Venezuela.

During our continuing investigation of freshwater fungi collected on submerged substrate in the semi-arid region of Brazil, six rare hyphomycetes recorded previously only one or two times in the world, and 37 other new records, including for Western hemisphere, Neotropics, South America, Brazil and Bahia, were found.

The goal of this study was to describe and illustrate some rare species of freshwater hyphomycetes and to list new records to expand knowledge about the distribution of freshwater hyphomycetes in tropical regions.

Methods

Expeditions to “Serra da Jibóia”, Bahia, Brazil were made every 3 months, from July 2007 to July 2009. Samples of submerged plant debris (twig, bark, leaf and petiole) were collected in a small stream and placed in a plastic bag containing a wet paper towel. In the laboratory, the samples were placed in Petri dish moist chambers and stored in a 170 L
polyethylene box with 500 mL sterile water plus 2 mL glycerol. The material was scanned at regular intervals and reproductive structures of fungi were removed and mounted in PVL resin (polyvinyl alcohol, lactic acid and phenol). Species were also isolated in culture media. Slides and dry material were deposited in Herbarium HUEFS and cultures deposited in “Coleção de Cultura de Microrganismos da Bahia” CCMB.

Results and discussion

**Brachydesmiella anthostomelloidea** Goh & K.D. Hyde, Mycology Research 100: 1365, 1996 (Figs 1–2)

Conidiophores single, macronematous, solitary, unbranched, septate, erect, flexuous, geniculate, smooth-walled, pale brown, 25.5–37.5 × 4.5–6 μm. Conidiogenous cells polytretic, terminal, integrated, sympodial, cicatrized. Conidia solitary, dry, 1-septate, upper cell oval, sometimes slightly acuminate at apex, smooth, brown, 22.5–31.5 × 16.5–21 μm; lower cell cylindrical, smooth, truncate at base, light brown to subhyaline, 4.5–7.5 × 3–6 μm.


Known distribution – Australia (Goh & Hyde 1996).

Notes – Brachydesmiella G. Arnaud presently consists of eight accepted species (Castañeda-Ruiz et al. 2003) found both in freshwater (Goh & Hyde 1996, Sivichai et al. 1998, 2002) and in terrestrial habitats (Castañeda-Ruiz et al. 2003, 2006). The genus was established with the type species *B. bisep-tata* G. Arnaud and is characterized by the pyriform or limoniform, 2–3 celled, unequally coloured conidia, produced from simple conidiophores, with integrated, terminal, polytretic, sympodial, cicatrized conidiogenous cells (Ellis 1971). Brachydesmiella anthostomelloidea most closely resembles *B. orientalis* (V. Rao & de Hoog) Goh in having 2-celled, obpyriform conidia but differs in having longer, narrower conidia with a cylindrical basal cell (Goh & Hyde 1996). A key to all species was provided by Castañeda-Ruiz et al (2006).

Morphologically, collections from Brazil agree with the Australian collection (Goh & Hyde 1996). However, the Australian material has slightly larger conidia (29–38 × 14–18 μm; basal cell 6–9 × 3–5 μm) and larger conidiophores 40–90 × 5–7 μm.

Brachydesmiella anthostomelloidea was originally collected on submerged wood in a rain forest stream in Queensland (Goh & Hyde 1996). This is the second record of the species for the world and it is reported for the first time from the western hemisphere.

**Camposporidium cristatum** Nawawi & Kuthub., Mycotaxon 32: 161, 1988 (Figs 3–5)

Conidiophores single, macronematous, solitary, unbranched, septate, erect, straight or slightly flexuous, with percurrent proliferations, smooth-walled, brown to dark brown, 90–135 × 4.5–6 μm. Conidiogenous cells holo- blastic, terminal, integrated, proliferating percurrently, cylindrical. Conidia solitary, dry, 9–11-distoseptate, cylindrical, smooth-walled or rarely slight verruculose, subhyaline to light brown, 75–105 × 9–10 μm; basal cell truncate, darker and shorter than other cells, 3–4.5 × 6–7.5 μm; apical cell rounded and paler, 4.5–7.5 × 5–6 μm, with 4–5 aseptate, hyaline to subhyaline appendages, 37.5–82.5 μm. Two apical septa thicker.


Known distribution – Malaysia (Nawawi & Kuthubutheen 1988).

Notes – Three accepted species have been described in Camposporidium Nawawi & Kuthub.: *C. cristatum*, the type species of the genus, *C. ghindense* (Bhat) R.F. Castañeda, Guarro & Cano and *C. hughesii* R.F. Castañeda & Guarro (Kirk et al. 2008). Camposporidium is close to Camposporium Harkn. due to multisepate conidia with appendages (Peek & Solheim 1958). However, Camposporium has polyblastic, sympodial and denticulate conidio-
genous cells and conidia with a persistent portion of the denticle attached (Whitton et al. 2002). Following Nawawi & Kuthubutheen (1988), *C. cristatum* has characteristic conidia with a truncate, rectangular basal cell darker and shorter than the rest of the conidia cells, apical cell is rounded and paler in colour with the two apical septa thicker. *Camposporidium cristatum* clearly differ from *C. hughesii* R.F. Castañeda & Guarro, which has euseptate, verrucose, fusiform, cylindrical-fusiform, rarely navicular conidia (Castañeda-Ruiz & Guarro 1998) and *C. ghindense* (Bhat) R.F. Castañeda, Guarro & Cano, which has curved, broadly ellipsoidal conidia and branched appendages (Bhat 1983).

Our collection from Brazil agrees well with the original protologue of *C. cristatum* (Nawawi & Kuthubutheen 1988). However the appendages of our collection are longer (37.5–82.5 × 1.5 μm) compared to that of the type description (up to 60 × 1.5 μm).

*Camposporidium cristatum* was found on submerged leaves from Malaysia (Nawawi & Kuthubutheen 1988). The Brazil specimens are the second record of the species for the world and the first report from the western hemisphere.

**Dactylaria hyalotunicata** K.M. Tsui, Goh & K.D. Hyde, Sydowia 49: 182, 1997 (Figs 6–7)

Conidiophores single, macronematous, solitary, unbranched, septate, erect, straight, smooth-walled, hyaline, 33–53 × 3–4.5 μm. Conidiogenous cells polyblastic, terminal, integrated, denticulate, proliferating sympodially; denticles conspicuous, cylindrical, hyaline, 1.5 μm long. Conidia solitary, 1-septate, smooth, thin-walled, naviculate to fusiform, hyaline, 15–25 × 2.3–3 μm, with an hyaline gelatinous sheath.


Known distribution – China (Tsui et al 1997), United States (Raja et al 2009)

Notes – *Dactylaria* Sacc. is a worldwide, polyphyletic genus with about 109 species (Kirk et al. 2008). *Dactylaria tunicata* Goh & K.D. Hyde is the closest species to *D. hyalotunicata*. However, *D. tunicata* can be distinguished from *D. hyalotunicata* in having mid olivaceous brown and larger conidiophores (75–160 × 4–4.5 μm) and larger conidia (25–31 × 3–4.5) (Goh & Hyde 1997). *Dactylaria tunicata* has been also recorded from fresh water habitat and possesses a gelatinous sheath around the conidia (Tsui et al 1997).

The collections from Brazil agree in all aspects with the original description of *D. hyalotunicata* from China (Tsui et al. 1997).

*Dactylaria hyalotunicata* was recorded on submerged wood in China (Tsui et al. 1997) and on herbaceous and woody debris in United States (Raja et al. 2009). The present collections represent a new record for the Neotropics.

**Lauriomyces sakaeratensis** Somrith., Kosol & E.B.G. Jones, Nova Hedwigia 82: 210 (Figs 8–9)

Setae unbranched, flexuous, smooth, thick-walled, up to 1230 μm long, 5.5–6.0 μm wide at the base, brown to dark brown, paler toward the apex. Conidiophores single, macronematous, solitary or in small groups, septate, erect, straight or flexuous, smooth-walled, brown to dark brown, paler towards the rounded apex, 75–105 × 5–6 μm; primary branches in group of 3–4, 6–7.5 × 2.3–3 μm; subsequent branches in group of 3–6, 4–4.3 × 1.5 μm. Ramoconidia 0-septate, smooth, cylindrical to obclavate, hyaline, 4–5 × 1.5 μm. Conidia cateenate, dry, 0-septate, smooth, thin-walled, obclavate, hyaline, 3–4.2 μm long, up to 1 μm wide at base.


Known distribution – Thailand (Somrithipol et al. 2006)
**Figs 1–9** — *Brachydesmiella anthostomelloidea*. 1 Conidiophore, 2 conidia. 3–5 *Camposporidium cristatum*. 3 Conidia and conidiophores, 4 Conidiophore, 5 Conidium. 6–7 *Dactylaria hyalotunicata*. 6 Conidiophore, 7 Conidia, Arrow shows gelatinous sheath. 8–9 *Lauriomyces sakaeratensis*. 8 Setae, conidiophores and conidia, 9 Conidia. Scale Bars = 1, 3, 8 = 50 µm; 2, 4, 6, 7 = 10 µm; 5 = 30 µm; 9 = 2.5 µm.

Notes — Castañeda-Ruíz & Kendrick (1990) established the genus *Lauriomyces* RF Castañeda typified by *L. pulcher* R.F. Castañeda & W.B. Kendr. Currently, there are eight accepted species in the genus distinguished by conidial shape and size (Somrithipol & Gareth-Jones 2007). The shapes can be clavate, obclavate, fusiform, cylindrical or ellipsoidal.*Lauriomyces pulcher* has clavate conidia and can be distinguished from the obclavate conidia of *L. sakaeratensis* (Castañeda-Ruíz & Kendrick 1990, Somrithipol et al. 2006). A diagrammatic comparison of conidial shape was provided by Somrithipol & Gareth-Jones (2007).
The Brazilian material fits well into the concept of *L. sakaeratensis*, but it has smaller conidiophores than reported in the original description (100–160 × 5.0–5.5 μm) (Somrithipol et al. 2006).

*Lauriomyces sakaeratensis* was originally found on decaying *Dipterocarpus costatus* C.F. Gaertn. fruits from Thailand. The Brazil specimens represent the second record of the species for the world and the first report from the western hemisphere.

**Pleurophragmium malaysianum** Matsush., Matsush. Mycologia Memoir 9: 20, 1996

(Figs 10–12)

Conidiophores single, macronematous, solitary, unbranched, septate, erect, flexuous, smooth-walled, hyaline; denticles conspicuous, cylindrical. Conidia solitary, dry, 10–12-distoseptate, smooth, thin-walled, ellipsoidal, subhyaline 15–18 × 6–7.5 μm; rostrum conical truncate, hyaline, 7.5–15 × 1.5–2.3 μm.


Known distribution – Papua New Guinea (Matsushima 1971).

Notes – *Pyricularia* Sacc. was erected with *P. grisea* Sacc. as the type species of the genus. The present specimen fits well in all aspects with the original description of *P. rabaulensis* (Matsushima 1971).

*Pyricularia rabaulensis* was originally collected on decaying leaves of *Musa* sp. from Papua New Guinea (Matsushima 1971). The Brazil specimen constitutes the second record of the species for the world and the first report from the western hemisphere.

**New records of hyphomycetes for western hemisphere**

*Brachydesmiella caudata* V. Rao & de Hoog, Studied in Mycology 28: 5, 1986


**Canalisporium exiguum** Goh & K.D. Hyde, Canadian Journal Botany 76: 145, 1998


**Cancellidium applanatum** Tubaki, Transaction Mycological Society Japan 16: 358, 1975


**Pithomyces elaeidicola** M.B. Ellis, Mycological Paper 76: 10, 1960

Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged bark,
Figs 10–15 – *Pleurophragmium malaysianum*, 10 Conidiophore and conidium, 11 Conidiophore with denticles, 12 Conidia. 13–15 *Pyricularia rabaulensis*, 13 Conidiophore and conidia, 14 Detail of conidia attached to the conidiophores, 15 Conidia. Scale Bars: 10, 11, 13 = 25 µm; 12, 14, 15 = 10 µm.


Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged bark, 8 August 2007, F.R. Barbosa and L.F.P. Gusmão (HUEFS 165787).


Material examined – Brazil, Bahía, Santa Terezinha, Serra da Jibóia, on submerged bark.


**New records of hyphomycetes for Neotropics**

**Sporoschisma juvenile** Boud., Icones Mycologica 1: 12, 1904


**New records of hyphomycetes for South America**

**Bactrodesmium longisporum** M.B. Ellis, More Dematiaceous Hyphomycetes: 68, 1976


**Cryptophialoidea secunda** (Kuthub. & B. Sutton) Kuthub. & Nawawi, Transaction of the British mycological Society 89: 583, 1987


Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged twig, 29 August 2007, F.R. Barbosa and L.F.P. Gusmão (HUEFS 169114).

**Hermatomyces sphaericus** (Sacc.) S. Hughes, Mycological Paper 50: 100, 1953


**Junewangia martinii** (J.L. Crane & Dumont) W.A. Baker & Morgan-Jones, Mycotaxon 81: 310, 2002


**Linkosia ponapensis** (Matsush.) R.F. Castañeda, Saikawa & Gené, Cryptogamie Mycologie 21: 219, 2000

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Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged leaf, 16 August 2007, F.R. Barbosa and L.F.P. Gusmão (HUEFS 169117).


**New records of hyphomycetes for Brazil**

*Berkleasmium corticola* (P. Karst.) R.T. Moore, Mycologia 51: 735, 1961


*Brachysporiella pulchra* (Subram.) S. Hughes, N.Z. Journal Botany 17: 184, 1979


*Brachyzelum capillare* (Sacc. & Sacc.) K. Ando & Tubaki, Transactions Mycological Society Japan 26: 153, 1985

Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged twig, 13 June 2009, F.R. Barbosa and L.F.P. Gusmão (HUEFS 169091).

*Ityorhoptrum verruculosum* (M.B. Ellis) P.M. Kirk, Transaction of the British mycological Society 86: 419, 1986


*Mirandina corticola* G. Arnaud ex Matsush., Icones microfungorum a Matsushima lectorum (Kobe): 96, 1975

Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged twig, 13 June 2009, F.R. Barbosa and L.F.P. Gusmão (HUEFS 169091).

*Scutisporus brunneus* K. Ando & Tubaki, Transactions Mycological Society Japan 26: 153, 1985


*Xylomyces clamidosporus* Goos, R.D. Brooks & Lamore, Mycologia 69: 282, 1977

**Zygosporium minus** S. Hughes, Mycological Paper 44: 6, 1951


**New records of hyphomycetes for Bahia**

**Chaetopsina splendida** B. Sutton & Hodges, Nova Hedwigia 27: 346, 1976


**Dictyochaetopsis gonytrichoides** (Shearer & J.L. Crane) Whitting, McKenzie & K.D. Hyde, Fungal Diversity 4: 156, 2000


**Dictyochaetopsis polysetosa** R.F. Castañeda, Gusmão, Guarro & Saikawa, Mycotaxon 103: 2, 2008


**Idriella cagnizarii** R.F. Castañeda & W.B. Kendr., The University Waterloo Biological Series 35: 63, 1991

Material examined – Brazil, Bahia, Santa Terezinha, Serra da Jibóia, on submerged leaf, 3 June 2009, F.R. Barbosa and L.F.P. Gusmão (HUEFS 169115).

**Ingoldiella hamata** D.E. Shaw, Transaction of the British mycological Society 59: 258, 1972


**Monodictys putredinis** (Wallr.) S. Hughes, Canadian Journal Botany 36: 785, 1958


**Periconia minutissima** Corda, Icones Fungorum 1: 19, 1837


**Pseudotracylla dentata** B. Sutton & Hodges, Nova Hedwigia 27: 699, 1976


**Rhexoacrodictys erecta** (Ellis & Everh.) W.A. Baker & Morgan-Jones, Mycotaxon 82: 99, 2002


**Acknowledgements**

The authors express deep thanks to CNPq for financial support and to the “Programa de Pós-graduação em Botânica – PPGBot/UEFS”.

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