

## Two new hyphomycetes from submerged wood collected in China

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In the course of a study of freshwater fungi in Zhejiang Province, China we collected two new hyphomycete species from submerged woody materials. *Berkleasium zhejiangense* is distinct in the genus in having conidia with a pale brown to brown subtending cell. *Cacumisporium uniseptatum* differs from other species in the genus in having one-septate conidia. Each taxon is described, illustrated and compared with similar species.

Keywords: anamorphic fungi, freshwater fungi, taxonomy, *Berkleasium*, *Cacumisporium*.

Submerged wood from freshwater habitats supports a high level of fungal diversity, particularly ascomycetes and their anamorphs (Vijaykrishna *et al.* 2006, Raja *et al.* 2008, 2009). This ecological group are notable degraders and are important in recycling of carbon in freshwater ecosystems (Simonis *et al.* 2008). The freshwater fungi of mainland China have been rarely documented with the exception of Yunnan Province (eg. Cai *et al.* 2002, 2008, Luo *et al.* 2004, Cai & Hyde 2007a), and a recent collection from Zhejiang Province (Jiang *et al.* 2008, Wongsawas *et al.* 2008). We are documenting freshwater fungi on submerged wood in streams in Zhejiang Province and recently discovered two interesting hyphomycetes, belonging to the genera *Berkleasium* Zobel and *Cacumisporium* Preuss. Careful inspection showed that they are taxa new to science. These two species are described, illustrated and compared with similar taxa.

### Materials and Methods

Submerged wood samples were collected from a small stream at Baiyun Provincial Forest Park, Lishui City, Zhejiang Province, P.R.

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China. Samples were returned to the laboratory and processed following the methods outlined by Wongsawas *et al.* (2008). All observations and measurements were made with specimens mounted in water. Dried material was deposited in Herbarium of Mycology, Academia Sinica (HMAS).

### Taxonomy

***Berkleasium zhejiangense*** Wongsawas, H.K. Wang, K.D. Hyde & F. C. Lin **sp. nov.** – Figs. 1–4.  
MycoBank no.: MB 513561

Sporodochia punctiforma, pulvinata, atro-brunnea. Mycelium immersum, ex hyphis ramosis, septatis, pallide brunneis vel brunneis, 3–5  $\mu\text{m}$  crassis compositum. Conidiophora mononematosa, macronematosa, brevia, simplicia, non ramosa, aseptata, brunnea vel atro-brunnea. Cellulae conidiogenae terminalitor in conidiophoris, holoblasticae. Conidia solitaria, ovalia vel ellipsoidea, muriformia, laevia, septatis constrictus, 38–76  $\times$  19–33  $\mu\text{m}$ , brunnea vel atro-brunnea, cellulis basilaribus pallide brunneis vel brunneis, 1 cellulis pallide brunneis vel brunneis subtentis.

Holotypus. – P. R. China, Zhejiang Province, Lishui City, Baiyun Provincial Forest Park, on submerged wood in a small stream, Oct. 24, 2007, M. Wongsawas, HMAS 196813.

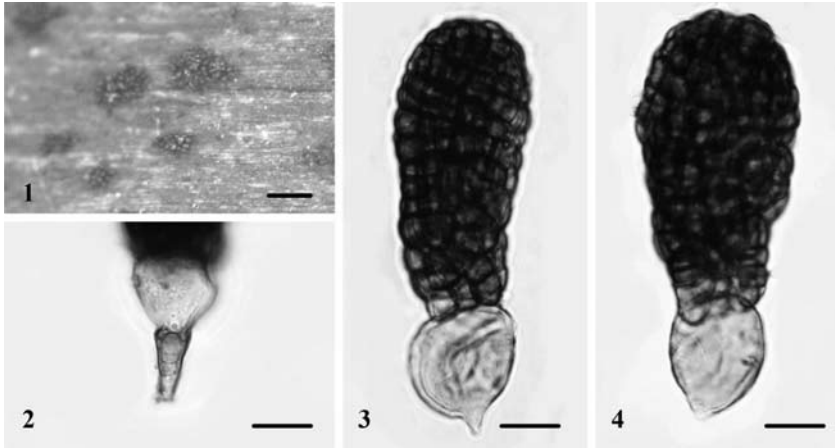
Sporodochia scattered and discrete, or confluent, pulvinate, dry, dark brown. – Mycelium mostly immersed in the substrate, comprising pale brown to brown, branched, 3–5  $\mu\text{m}$  wide, septate hyphae. – Conidiophores mononematous, macronematous, short, simple, aseptate, brown to dark brown. – Conidiogenous cells terminal on the conidiophores, holoblastic. – Conidia solitary, oval to ellipsoidal, muriform, smooth, constricted at the septa, 38–76  $\times$  19–33  $\mu\text{m}$  ( $\bar{x}$ ,  $\bar{y}$  = 55.7  $\times$  27  $\mu\text{m}$ ,  $n$  = 30), brown to dark brown, basal cells pale brown to brown, with a pale brown to brown, subtending cell at the base developing before release from conidiogenous cell.

Etymology. – *zhejiangense*, refers to the Province where the type originated.

Habitat. – On submerged wood.

Distribution. – P. R. China

*Berkleasium* is characterized by narrow, macronematous, rarely branched conidiophores that are closely packed in sporodochia (Bussaban *et al.* 2001). Conidiogenous cells are integrated, terminal, monoblastic, determinate and cylindrical. Conidia are solitary, acrogenous, brown, muriform, clavate, ellipsoidal or oblong and rounded or irregular at the apex, and often possessing a protruding hilum (Ellis 1971). Bussaban *et al.* (2001) reviewed *Berkleasium* and provided illustrations and a taxonomic key to 24 accepted species. Six species were later assigned to this genus: *B. sinense* Joanne E. Taylor, K.D. Hyde & E.B.G. Jones, *B. typhae* Somrith. & E.B.G. Jones, *B. atrovirens* G.Z. Zhao & T.Y. Zhang, *B. taishanense* G.Z. Zhao & T.Y. Zhang, *B. crunisia* Pinnoi and *B. pandani* McKenzie (Somrithipol & Jones 2003, Tay-



**Figs. 1-4.** *Berkleasmium zhejiangense* (holotype). **1.** Sporodochia on natural substrate (bar = 200  $\mu\text{m}$ ). **2.** Conidiophore, conidiogenous cell and immature subtending cell (bar = 10  $\mu\text{m}$ ). **3-4.** Conidia with a thin-walled, pale brown to brown subtending cell (bar = 10  $\mu\text{m}$ ).

lor & Hyde 2003, Zhao & Zhang 2004, Pinnoi *et al.* 2007, McKenzie 2008). Ribosomal DNA phylogenies reveal that *Berkleasmium* is not monophyletic and is closely related to the family *Sporormiaceae* Munk in order *Pleosporales* Luttr. ex M.E. Barr (Pinnoi *et al.* 2007).

Conidia of some species in the genus *Berkleasmium* are provided with a subtending cell(s) or part of the conidiogenous cell remains attached (McKenzie 2008). This occurs in *B. corticola* (P. Karst.) R.T. Moore, *B. crunisia*, *B. inflatum* Hol.-Jech., *B. moriforme* (Peck) R.T. Moore, *B. nigroapicale* Bussaban, Lumyong, P. Lumyong, McKenzie & K.D. Hyde, *B. pandani*, *B. sinense*, *B. taishanense* and *B. typhae* (Moore 1959, Holubová-Jechová 1987, Bussaban *et al.* 2001, Somrithipol & Jones 2003, Taylor & Hyde 2003, Zhao & Zhang 2004, Pinnoi *et al.* 2007, McKenzie 2008). *Berkleasmium zhejiangense* is comparable to *B. crunisia*, *B. inflatum* and *B. sinense* with respect to conidial size (38–76  $\times$  19–33  $\mu\text{m}$  in *B. zhejiangense*, 35–100  $\times$  17.5–30  $\mu\text{m}$  in *B. crunisia*, 40–48  $\times$  19.5–21  $\mu\text{m}$  in *B. inflatum* and 40–52  $\times$  20–32  $\mu\text{m}$  in *B. sinense*). However, the subtending cell(s) in *B. inflatum* and *B. sinense* are hyaline (Holubová-Jechová 1987, Taylor & Hyde 2003), *B. crunisia* has several subtending cells (Pinnoi *et al.* 2007), while those of *B. zhejiangense* are 1-celled and pale brown to brown.

***Cacumisporium uniseptatum*** Wongsawas, H.K. Wang, K.D. Hyde & F.C. Lin **sp. nov.** – Figs. 5–10.  
MycoBank no.: MB 513562

Coloniae effusae, atro-brunnea. Mycelium partim superficiale, partim in substrato immersum, ex hyphis ramosis, septatis, 4–5  $\mu\text{m}$  crassis, laevibus, brunneis vel

atro-brunneis compositum. Conidiophora macronematosae, mononematosae, brunnea, erecta, solitaria, 120–205 µm longa, 6–11-septata, non ramosa, percurrente proliferantia. Cellulae conidiogenae polyblasticae, in conidiophoris incorporatae, terminales, globosae, proliferationae sympodice. Conidia acrogena, holoblastica, 18–26 × 11–16 µm, ovoidea, 1-euseptata, laevia, crassitunicata; cellula basalis atro-brunnea, basi truncata; cellula apicalis pallide brunnea.

Holotypus. – P. R. China, Zhejiang Province, Lishui City, Baiyun Provincial Forest Park, on submerged wood in a small stream, Oct. 24, 2007, M. Wongsawas, HMAS 196815.

Colonies effuse, dark brown. – Mycelium partly immersed, partly superficial, consisting of branched, septate, smooth, 4–5 µm wide, brown to dark brown hyphae. – Conidiophores macronematous, mononematous, slightly tapering towards the apex, 120–205 µm long, 6–7 µm wide at base, 4–5 µm wide near apex, brown, paler towards the apex, smooth, thick-walled, 6–11-septate, unbranched, cylindrical, straight, erect, solitary, often with 1–2 percurrent proliferations. – Conidiogenous cells polyblastic, integrated, terminal, determinate, globose, producing conidia in sympodial succession and providing a cluster of conidia. – Conidia acrogenous, holoblastic, 18–26 × 11–16 µm ( $\bar{x}$ , = 23 × 15 µm, n = 30), ovoidal, 1-euseptate, smooth, thick-walled, not constricted at the septum; basal cell dark brown with truncate base; apical cell pale brown.

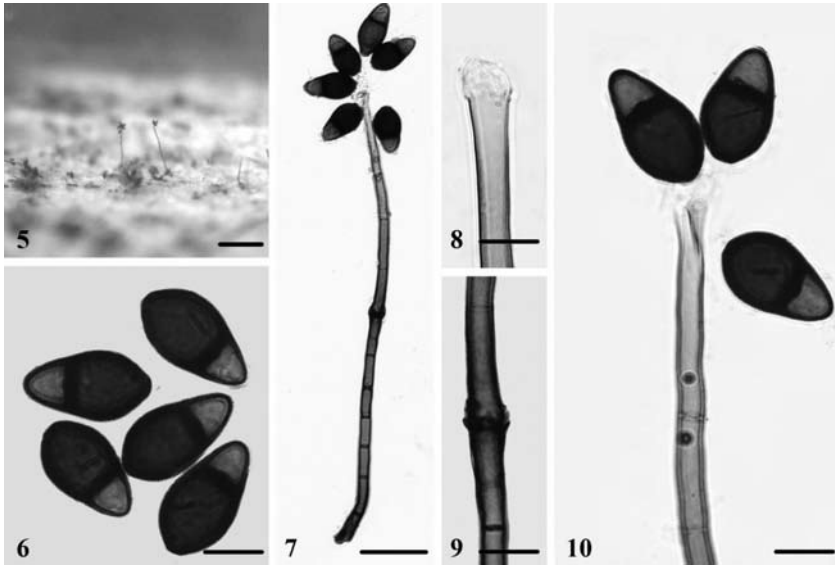
Etymology. – *uniseptatum*, refers to the one-septate conidia.

Habitat. – On submerged wood.

Distribution. – P. R. China

*Cacumisporium* is characterised by simple, septate conidiophores, which are dark and become paler towards the apex. Conidiogenous cells are terminally integrated on the conidiophores, polyblastic, and produce conidia in sympodial succession above cylindrical, phialidic collarettes. Conidial secession is schizolytic. Conidia are solitary, euseptate and pigmented (Goos 1969, Tsui *et al.* 2001). *Cacumisporium* currently comprises seven species: *C. capitulatum* (Corda) S. Hughes, *C. curvularioides* R.F. Castañeda & W.B. Kendr., *C. pleuroconidiophorum* (Davydkina & Melnik) R.F. Castañeda, Heredia & Iturr., *C. rugosum* K.M. Tsui, Goh, K.D. Hyde & Hodgkiss, *C. sigmoideum* Mercado & R.F. Castañeda, *C. spooneri* P.M. Kirk and *C. tropicale* R.F. Castañeda, Gusmão & Stchigel (Hughes 1958, Mercado Sierra & Castañeda Ruiz 1987, Castañeda & Kendrick 1992, Kirk 1992, Tsui *et al.* 2001, Castañeda Ruiz *et al.* 2007a, 2007b). The teleomorph of *Cacumisporium* is the ascomycete genus *Chaetosphaeria* Tul. & C. Tul. This connection has been established in culture and by molecular analysis (Réblová & Gams 1999, Fernández *et al.* 2006).

*Cacumisporium uniseptatum* is typical of *Cacumisporium* in having conidia forming on multiple conidiogenous loci within a collarette which is borne on the apex of brown, septate conidiophores (Goos 1969, Hammill 1972). However, *C. uniseptatum* is unique in that one-



**Figs. 5-10.** *Cacumisporium uniseptatum* (holotype) **5.** Colonies on natural substratum (bar = 200  $\mu\text{m}$ ). **6.** Conidia (bar = 10  $\mu\text{m}$ ). **7.** Production of conidia on conidiophore (bar = 30  $\mu\text{m}$ ). **8.** Apex of conidiophore showing conidiogenous cell (bar = 10  $\mu\text{m}$ ). **9.** A percurrent proliferation of conidiophore (bar = 10  $\mu\text{m}$ ). **10.** Upper portion of conidiophore, conidiogenous cell and conidia (bar = 10  $\mu\text{m}$ ).

septate conidia have not been observed in hitherto known species of *Cacumisporium*, which often produce 3 or 7-septate conidia. This species should be compared with *Exserticlava yunnanensis* L. Cai & K.D. Hyde, which is superficially similar in conidiophore characters, conidiogenesis, conidial shape and coloration (Cai & Hyde 2007b). Conidial dimension of *E. yunnanensis*, however, are smaller (16–22  $\times$  10–13  $\mu\text{m}$  ( $\bar{x}$ , = 18.5  $\times$  12  $\mu\text{m}$ , n = 30)), and the latter produces distoseptate conidia.

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