



Taxonomy and phylogeny of *Postia*. Multi-gene phylogeny and taxonomy of the brown-rot fungi: *Postia* (Polyporales, Basidiomycota) and related genera

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Key words

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Abstract Phylogenetic and taxonomic studies on the brown-rot fungi *Postia* and related genera, are carried out. Phylogenies of these fungi are reconstructed with multiple loci DNA sequences including the internal transcribed spacer regions (ITS), the large subunit (nLSU) and the small subunit (nSSU) of nuclear ribosomal RNA gene, the small subunit of mitochondrial rRNA gene (mtSSU), the translation elongation factor 1- α gene (TEF1), the largest subunit of RNA polymerase II (RPB1) and the second subunit of RNA polymerase II (RPB2). Ten distinct clades of *Postia* s.lat. are recognized. Four new genera, *Amaropostia*, *Calcipostia*, *Cystidiopostia* and *Fuscopostia*, are established, and nine new species, *Amaropostia hainanensis*, *Cyanosporus fusiformis*, *C. microporus*, *C. mongolicus*, *C. piceicola*, *C. subhirsutus*, *C. tricolor*, *C. ungulatus* and *Postia subloui*, are identified. Illustrated descriptions of the new genera and species are presented. Identification keys to *Postia* and related genera, as well as keys to the species of each genus, are provided.

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INTRODUCTION

Postia was established by Fries (1874). *Postia* species are characterized by annual growth habit, mostly soft to corky fruiting bodies when fresh, a monomitic hyphal system with clamped generative hyphae, allantoid to cylindrical basidiospores which are usually thin-walled, negative in Melzer's reagent and acyanophilous in Cotton Blue, and producing a brown rot (Hattori et al. 2011, Cui & Li 2012). More than 60 species have been accepted in the genus worldwide so far (Jülich 1982, Larsen & Lombard 1986, Renvall 1992, Buchanan & Ryvarden 2000, Wei & Dai 2006, Hattori et al. 2011, Dai 2012, Shen et al. 2015), of which 34 species were recorded from China (Wei & Qin 2010, Dai 2012, Shen et al. 2014, 2015).

Postia is closely related to *Oligoporus* and *Spongiporus*. Historically, most taxa in the three genera were placed in *Tyromyces* (Murrill 1907, 1912, Bondartsev & Singer 1941, Lowe 1975, Ryvarden 1981). However, it became clear that the species in *Tyromyces* cause a white rot, while species in the other three genera cause a brown rot (Gilbertson & Ryvarden 1987, Ryvarden 1991, Ryvarden & Gilbertson 1994). Because no species was listed when *Postia* was first proposed in Fries (1874), some mycologists did not accept *Postia*, but supported *Spongiporus* or *Oligoporus* instead. *Oligoporus* was established in 1888 by Brefeld and included three species initially, with the characteristics of fleshy fruitbody when fresh, turning to fragile when dry and allantoid to cylindrical basidiospores. Later, Gilbertson & Ryvarden (1985) placed 22 taxa into *Oligoporus* containing two previous species in *Tyromyces* and gradually *Oligoporus* was widely used (Gilbertson & Ryvarden 1987,

Ryvarden & Gilbertson 1994, Núñez & Ryvarden 2001, Bernicchia 2005, Ryvarden & Melo 2014). Murrill erected 29 genera, including *Spongiporus* for North American polypores in early 20th century, and he defined *Spongiporus* species as brown rot fungi with whitish and spongy basidiocarps that bear cylindrical basidiospores. David (1980) transferred 13 *Tyromyces* species into *Spongiporus*, adopted by many other studies (Bondartsev & Singer 1941, Lowe 1975, Ryvarden 1981). In fact, *Postia* is the oldest name among the competing genera. Some mycologists combined the brown rot taxa of *Tyromyces* into *Postia* (Renvall 1992, Niemelä et al. 2005, Wei & Dai 2006, Hattori et al. 2011, Cui & Li 2012, Pildain & Rajchenberg 2013). With more species recognized in *Postia*, the definitions of the genus and related genera remain murky, and so are the genetic relationships among these fungi.

Pildain & Rajchenberg (2013) sequenced the ITS and nLSU regions from eleven species of *Postia* and related species; their phylogenetic analysis indicated that most species in *Postia* and *Oligoporus* were monophyletic, but supported the transfer of *P. placenta* into its own genus as *Rhodonia placenta*, in agreement with previous studies (Boidin et al. 1998, Kim et al. 2001, Binder et al. 2005, Niemelä et al. 2005). Ortiz-Santana et al. (2013) investigated the phylogenetic relationships among members of the antrodia clade with molecular data from ITS and nLSU regions; in their study, species of *Postia* s.lat. were divided into four clades: the *Spongiporus* clade, the *Oligoporus* clade, the *Postia* s.str. clade and the *Spongiporus undosus* clade. Cui et al. (2014) discussed the phylogenetic position of the monotypic genus *Osteina* in the Fomitopsidaceae of Polyporales, and accepted *Osteina obducta* rather than *Oligoporus obductus*.

Up to now, no comprehensive investigation has been carried out on *Postia* s.lat. with sufficient sampling, and taxonomic delimitation of *Postia* s.lat. has been controversial and remained insufficiently resolved (Donk 1960, Larsen & Lombard 1986, Ryvarden 1991, Walker 1996, Pildain & Rajchenberg 2013).

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