

## First Report of *Ceriporiopsis resinascens* (Phanerochaetaceae, Basidiomycota) in Korea

Jin Sung Lee, Eun Ju Woo and Young Woon Lim\*

Division of Non-Vascular Plants, National Institute of Biological Resources, Incheon 404-170, Korea

(Received October 28, 2009. Accepted November 30, 2009)

An unrecorded *Ceriporiopsis* species was collected at Mt. Gariwang, Gangwon Province, in 2008. Based on morphological characteristics, such as a fully resupinate basidiocarp, a reddish white to pinkish poroid hymenophore and a monomitic hyphal system with clamp connections, the species was identified as *Ceriporiopsis resinascens*. This is the first report of *Ceriporiopsis resinascens* in Korea. We confirmed the identity of the species as *Ceriporiopsis resinascens* based on ITS sequence analysis.

**KEYWORDS :** *Ceriporiopsis resinascens*, ITS, Wood-rotting fungi

The genus *Ceriporiopsis* Domański was classified in the family Polyporaceae Fr. ex Corda along with other genera that possess poroid hymenophores (Ryvarden, 1991). This genus is characterized by resupinated basidiocarps, monomitic hyphal systems, non-amylloid hyaline basidiospores and white rot physiology. Most characteristics of *Ceriporiopsis* are similar to those of *Oligoporus* Bref. and *Tyromyces* P. Karst. (Gilbertson and Ryvarden, 1986). However, *Ceriporiopsis* differs from *Oligoporus* in its rotting type. Specifically, the latter causes brown rot in attacked wood. *Tyromyces* is distinguished by the presence of mostly pileate basidiocarps and scattered skeletal hyphae (Gilbertson and Ryvarden, 1986). Previous studies have suggested that *Ceriporiopsis* exhibits a stronger relationship with members of Corticiaceae Herter, such as *Phlebia* Fr. and *Phanerochaete* P. Karst., than with other polypores (Nakasone and Burdsall, 1984; Burdsall, 1998). Recent phylogenetic studies support the classification of the genus *Ceriporiopsis* in the modern family Phanerochaetaceae Jülich and its close relationship with the genera *Irpex* Fr. and *Phlebia* (Greslebin *et al.*, 2004; Lee, 2006).

In Korea, three species of *Ceriporiopsis* have been reported: *C. gilvescens* (Bres.) Domański (the type species of the genus), *C. mucida* (Pers.) Gilb. & Ryvarden and *C. subvermispora* (Pilát) Gilb. & Ryvarden (Jung, 1992, 1994, 1996; Lee and Jung, 2005). During an assessment of the national biological inventory in Korea, which was organized by the National Institute of Biological Resources (NIBR; www.nibr.go.kr), we encountered an unreported *Ceriporiopsis* species from Gangwon Province. Based on its morphological characteristics, we identified the species as *Ceriporiopsis resinascens* (Romell) Domański (Breitenbach and Kränzlin, 1986; Burdsall,

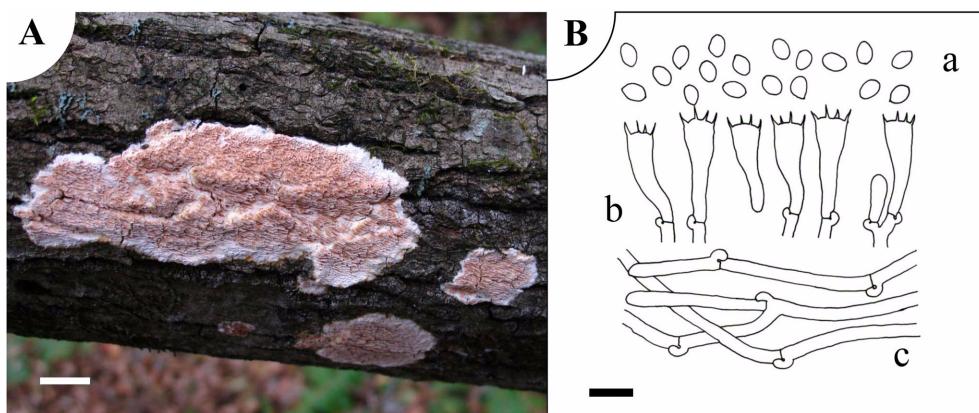
1998). To confirm its affinity to *Ceriporiopsis resinascens*, we sequenced the internal transcribed spacer (ITS) region and conducted a phylogenetic analysis of the organism.

The macroscopic and microscopic characteristics were evaluated based on a voucher specimen (F20081106KCM38) deposited at the NIBR. Measurements and drawings were made from slide preparations mounted in 3% KOH (Largent *et al.*, 1977) using an Olympus BX51 light microscope. Size measurements were made using 20 randomly selected mature basidiospores and basidia from the voucher specimen. A key to the *Ceriporiopsis* species that have been found in Korea was constructed according to the description by Jung (1992, 1994, 1996).

For molecular identification, the total DNA was extracted from a dried specimen using an AccuPrep genomic DNA extraction kit (Bioneer, Korea). The ITS region was amplified using the primer sets ITS5 and ITS4 (White *et al.*, 1990). PCR amplification was performed as described by Lee and Jung (2008). Amplified products were purified using a PCR purification kit (Bioneer). Sequencing was performed using the aforementioned primers on an ABI 3730XL automated sequencer (Applied Biosystems, USA). The ITS sequence was proofread and edited using the jPHYDIT program (Jeon *et al.*, 2005) and then deposited in GenBank (accession number GU080235). Phylogenetic trees were inferred from sequence alignment using the neighbor-joining (NJ), maximum parsimony (MP) and maximum likelihood (ML) methods implemented using PAUP 4.0b10 (Swofford, 2002). The tree was rooted with the sequences of *Ceriporia lacerata* (FJ462746) and *Irpex lacteus* (AF163046), which showed the highest similarity with *Ceriporiopsis* species among the ITS region sequences in the GenBank database.

An unrecorded *Ceriporiopsis* species was identified to

\*Corresponding author <E-mail : youngwlim@korea.kr>



**Fig. 1.** Basidiocarp (A) and microscopic features (B) of *Ceriporiopsis resinascens* (F20081106KCM38). a, basidiospores; b, basidia; c, generative hyphae. Scale bars, 1 cm for A; 10  $\mu\text{m}$  for B.

the genus level by its fully resupinate basidiocarp and reddish white to pinkish poroid hymenophore and to the species level based on microscopic features such as the size of the basidiospores and basidia. Unfortunately, we could not examine specimens of the previously reported Korean *Ceriporiopsis* species, *C. gilvescens*, *C. mucida* and *C. subvermispora*. According to Jung (1992, 1996) and Gilbertson and Ryvarden (1986), the microscopic features of the four *Ceriporiopsis* species found in Korea vary somewhat. The allantoid basidiospores of *C. subvermispora* are clearly distinguished from those of *C. resinascens*. Additionally, the large basidiospores (5.1~6.6  $\times$  3.4~4.3  $\mu\text{m}$ ) of *C. resinascens* are evidently distinguished from those of *C. gilvescens* (4~5  $\times$  2  $\mu\text{m}$ ; Jung 1992) and *C. mucida* (2.5~3.5(4)  $\times$  2~2.5  $\mu\text{m}$ ; Gilbertson and Ryvarden, 1986).

A BLAST search of the GenBank database revealed that the ITS sequences of the unknown specimen (F20081106KCM38) were 99.0% homologous (5 of 622 positions showed nucleotide differences) with European *Ceriporiopsis resinascens* (EU340896). The aligned sequences of 14 *Ceriporiopsis* species and two outgroup species (*Ceriporia lacerata* and *Irpex lacteus*) formed a matrix of 440 nucleotide positions in length. Among these, 275 sites were constant, 36 sites were variable but parsimony-uninformative and 129 sites were parsimony-informative. NJ, MP and ML analyses yielded similar phylogenetic trees. The NJ tree is presented in Fig. 2. Branches supported by the three different analyses are represented as bold lines in the tree. The phylogenetic trees included Korean *Ceriporiopsis resinascens* in a monophyletic clade with the other eight *Ceriporiopsis* species.

Based on the results of these morphological and phylogenetic analyses, we confirmed the identity of *Ceriporiopsis resinascens* within the genus *Ceriporiopsis*. Due to the ecological importance of *Ceriporiopsis* species, such as their ability to degrade nonphenolic lignin structures (Sre-

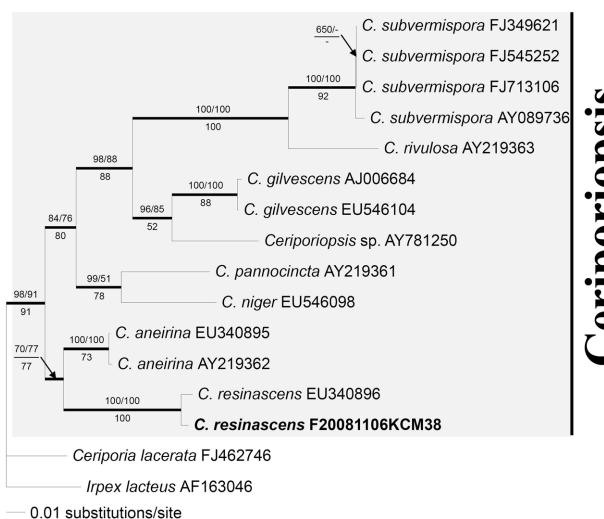
botnik et al., 1997), further studies exploring the ecological role of Korean *C. resinascens* are necessary.

## Taxonomy

*Ceriporiopsis resinascens* (Romell) Domáñski, Acta Soc. Bot. Pol. 32: 732 (1963)

**Korean name.** Su-Ji-Mil-Gu-Meong-Beo-Seot, nom. nov.

Fig. 1



**Fig. 2.** The neighbor-joining (NJ) tree of *Ceriporiopsis* based on the sequence of the ITS. Branches maintained in three different analyses (maximum parsimony [MP], maximum likelihood [ML] and NJ analyses) are represented by bold lines. Numbers above the branches before the slash are MP bootstrap proportions, while those after the slash are NJ bootstrap proportions. Values below the branches are ML bootstrap proportions. *Ceriporia lacerata* (FJ462746) and *Irpex lacteus* (AF163046) were used as outgroups.

**Ceriporiopsis**

**Synonymy.** *Polyporus resinascens* Romell, Ark. Bot. 11(3): 20 (1911), *Poria resinascens* (Romell) S. Lundell & Namnf., Fungi Exsiccati Suecici: 201 (1937), *Tyromyces resinascens* (Romell) Bondartsev & Singer, Ann. Mycol. 39(1): 52 (1941).

Basidiocarp annual, resupinate, about 5 cm wide along the bark of deciduous trees, soft when young; pores angular, variable, 2~3(~4) per mm, pore surface reddish white to pinkish; margin cream to pale yellowish white, 1~3 mm wide. Hyphal system monomitic; generative hyphae with clamp connections. Basidia clavate, 21.7~24.6 × 6.3~10.3  $\mu\text{m}$ . Basidiospores ellipsoid, 5.1~6.6 × 3.4~4.3  $\mu\text{m}$ .

**Specimens examined.** KOREA: Gangwon Province, Mt. Gariwang, collected from the branch of a dead deciduous tree, 6 November 2008, Jin Sung Lee and Changmu Kim (F20081106KCM38).

**Notes.** This species is easy to recognize, in part because of its white to pinkish pore surface when fresh. The basidiocarp frequently becomes hard and brittle. Larger basidiospores distinguish *Ceriporiopsis resinascens* from *C. gilvescens* and *C. mucida*.

#### Key to Korean *Ceriporiopsis* species

1. Basidiospores cylindrical to alantoid ..... *C. subvermispora* (Pilát) Gilb. & Ryvarden
1. Basidiospores subglobose to ellipsoid ..... 2
2. Basidiospores longer than 5  $\mu\text{m}$  ..... *C. resinascens* (Romell) Domański
2. Basidiospores shorter than 5  $\mu\text{m}$  ..... 3
3. Basidiocarp firm and pore surface white to pale pinkish ..... *C. gilvescens* (Bres.) Domański
3. Basidiocarp soft and pore surface cream-yellow ..... *C. mucida* (Pers.) Gilb. & Ryvarden

#### Acknowledgements

The authors thank Dr. C. Kim (NIBR, Korea) for providing a photograph of *Ceriporiopsis resinascens*. This work was supported by the Korean indigenous species research project from the National Institute of Biological Resources (NIBR), Ministry of the Environment, Republic of Korea.

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