

A New Record of the Genus *Camarops* (Boliniaceae) in Korea

Changmu Kim^{1*}, Jin Sung Lee² and Young Woon Lim³

¹Microorganism Resources Division, National Institute of Biological Resources, Incheon 404-170, Korea

²Yurim Mushrooms, Gobul-ro 251, Babang-eup, Asan-si, Chungnam 336-856, Korea

³School of Biological Sciences, Seoul National University, Seoul 151-747, Korea

ABSTRACT : *Camarops ustulinoides* (Henn.) Nannf., belonging to the family Boliniaceae (Order Boliniales), is reported as new to Korea. The morphological characteristics and molecular phylogenetic analysis based on the nuLSU region sequence confirm the recognition of this taxon. Illustrated descriptions of *C. ustulinoides* are provided.

KEYWORDS : *Camarops ustulinoides*, *Boliniaceae*, New record, nuLSU

Camarops species encompass members of wood-inhabiting ascomycetous fungi and represent an ecologically important fungal group with many members commonly occurring throughout temperate and tropical regions [1, 2]. The genus *Camarops* P. Karst. is characterized by applanate or flat-pulvinate stromata, with separate ostioles at the surface and very long tubular perithecia composing a palisade layer of cream or brownish color [3]. *C. hypoxyloides* P. Karst was classified as the type species of the genus.

Since this genus was established in 1872, its classification has been changed. *Camarops* had been belonged to the Xylariaceae due to their stromatal affinities and brown ascospores as *Hypoxylon* and related genera [4, 5]. Although Doi [6] and Barr [7] have suggested it has affinities with the Sordariaceae, recent molecular data support that *Camarops* is placed in the Boliniaceae [8]. Currently, approximately 19 species have been reported worldwide

[9]. One species, *C. petersii* (Berk. & M.A. Curt.) Nannf., was reported in South Korea by Japanese researcher Iwade in 1894 [10].

The national biological inventory organized by the National Institute of Biological Resources (NIBR, www.nibr.go.kr) has yielded numerous collections of fungi within Korea. While investigating fungal specimens of wood-inhabiting ascomycetous fungi deposited at NIBR, we found an unreported *Camarops* species for Korea. To confirm its affinity with the genus *Camarops*, phylogenetic analysis was carried out based on the sequence data of nuclear large subunit ribosomal DNA (nuLSU rDNA) region. Here we present a detailed description of a new species for Korea.

Macroscopic and microscopic characteristics were based on the deposited *Camarops* specimen (NIBRFG0000106691) which was collected in 19 March, 2009 from Mt. Gaji in Ulsan-si, Korea. Measurements of micro-structures such as ascospores were made from slide preparations mounted in 3% KOH [11] using a NIKON 80i light microscope and the micro-structure of specimen was photographed using Digital Camera (Nikon D200).

The genomic DNA was extracted from the dry specimen using AccuPrep Genomic DNA extraction kit (Bio-neer, Korea). The nuLSU region was amplified using LR 0R and LR5 primers [12]. The PCR conditions used were 95°C for 5 min, followed by 30 cycles of 1 min at 94°C, 1 min at 51°C, and 1 min at 72°C, and a final extension step at 72°C for 10 min. The PCR product was confirmed using electrophoresis on 1.2% agarose gel and purified

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*Corresponding author
E-mail: snubull@korea.kr

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using an AccuPrep PCR purification kit (Bioneer, Korea). DNA sequencing was performed at the DNA Synthesis and Sequencing Facility, Macrogen (Seoul, Korea), by using an ABI3700 automated DNA sequencer. For molecular identification, *Camarops* sequence was compared with the reference sequences in GenBank by using BLAST [13]. Sequences were edited and aligned with reference sequences retrieved from GenBank database using MEGA4 [14]. The phylogenetic tree was constructed with 1,000 bootstrap replicates using Neighbor-Joining method. The partial nuLSU region sequence was deposited in the GenBank database (KM042417).

Phylogenetic analysis based on the nuLSU rDNA region sequences showed that *Camarops* did not form monophyletic group (Fig. 1). This result was in agreement with previous result in which three genera (*Camarops*, *Cornipulvina*, and *Camaropella*) belonged to the family Boliniaceae were intermingled in the nuLSU based phylogenetic tree [2]. Although *Camarops* did not form a monophyletic clade with the closely related genera, *Camarops* species are well separated. Also the phylogenetic tree showed that *C. ustulinoides* and *C. petersii* were clearly separated. Our specimen (NIBRFG0000106691) placed in a clade comprising reference the *C. ustulinoides* AFTOL-

ID 72 (DQ470941) with 95 % bootstrap values support and their sequences had 99 % similarity (842bp/845bp). The result indicated the specimen is *C. ustulinoides*.

Camarops ustulinoides (Henn.) Nannf., Svensk Bot. 66: 370, 1972.

Basionym: *Nummularia ustulinoides* Henn., Hedwigia. 36: 227, 1897.

Stromata: peltate, button-shaped, or loaf-shaped, 10-40 mm × 5-10 mm × 2-4 mm high, with abrupt angular to rounded margins, bark adhering, upper surface convex to nearly plane, with punctuate ostioles with raised circular rims, externally dull brown to blackish, internally tan to black, external stromatal layer 0.5-1 mm thick, very hard, completely encasing fragile perithecia and entostroma, entostroma cheesy to woody (Fig 2A and 2C).

Perithecia: 1-3 mm long × 0.3-0.5 mm diam, cylindrical to ellipsoidal, with periphysate neck, arranged in monostichous manner (Fig 2B and 2E).

Asci: 8-spored, cylindrical, the spores arranged in a partially biserial manner, short- or long-stipitate, 23-35 µm × 3-5 µm [15].

Ascospores: grayish to brown to dark brown, ellipsoidal with one end somewhat acute, laterally compressed, smooth, 4-5 µm × 2.5-3 µm × 2-2.2 µm, with a germ pore at the more pointed end (Fig 2D).

Habitat: on trunk of dead oak tree.

Specimen examined: KOREA, Ulsan, Mt. Gaji, on trunk of dead oak tree, 19 March 2009, Changmu Kim (NIBR FG0000106691; GenBank KM042417).

Geographical distribution: Costa Rica, French Guiana, Puerto Rico [2,3].

Camarops ustulinoides specimens represent brown to blackish stromata with bark adhering (Fig. 2A), elongated perithecia in section of stromata (Fig. 2B) and generally raised circular rims (Fig. 2C). This species is distinguished by elongated perithecia and raised circular rims from *C. petersii*. *C. petersii* has white outer layer and brown liquid exhibited at early stage. *C. ustulinoides* has not been commonly reported from Asia and Europe [16].

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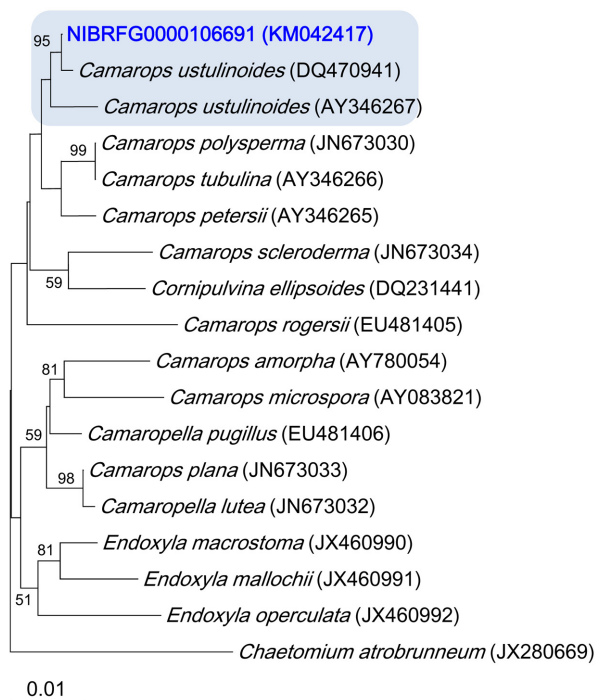


Fig. 1. A phylogenetic tree of *Camarops* species inferred from Neighbor-Joining method based on nuclear large subunit (nuLSU) sequences. Bootstrap values more than 50% from a sample of 1,000 replicates are shown on each branch.

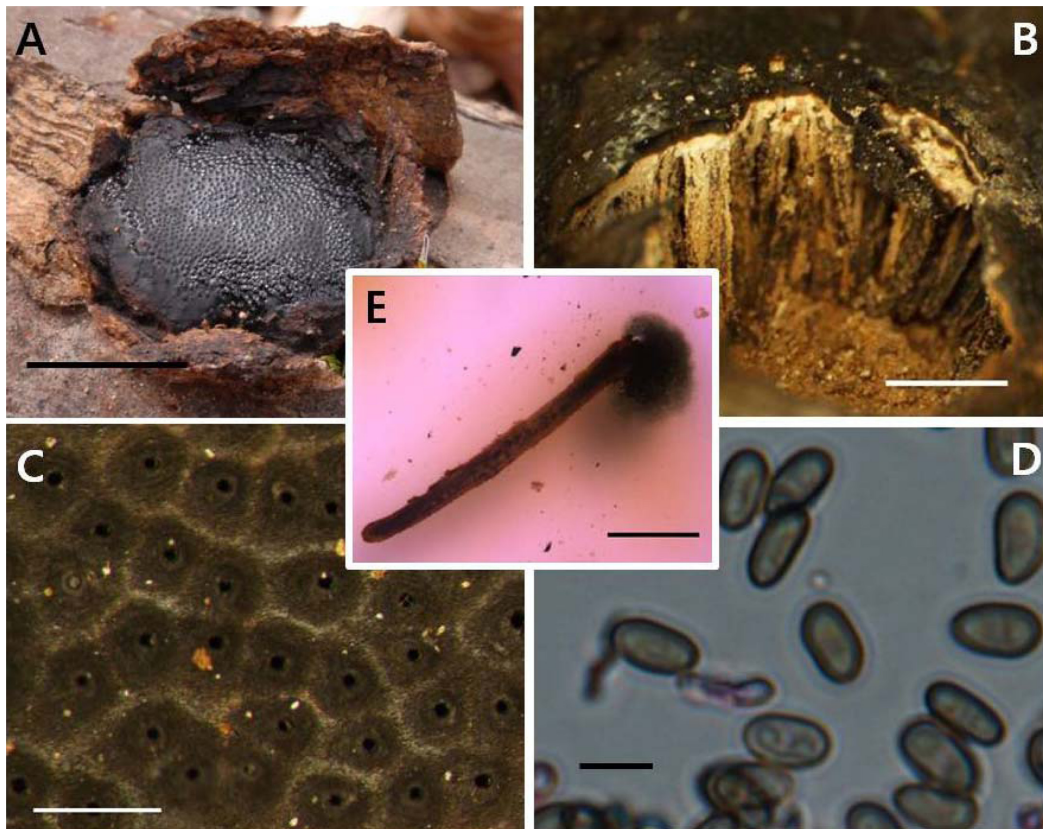


Fig. 2. A, Stromata with adhering bark. B, Section of stromata with elongated perithecia. C, Ostioles with doughnut shaped rims. D, Ascospores. E, Elongated perithecium in 3 % KOH solution. Scale bar; 1 cm for A; 2.5 mm for B; 0.5 mm for C; 5 μ m for D; 1 mm for E.

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