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On *Cheimonophyllum candidissimum* from Greece with notes on its implied aphyllophoroid ancestry

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Abstract — *Cheimonophyllum candidissimum* is newly recorded from Greece and this is one of the very few records from the Mediterranean region. This is also the first report of the species on *Platanus orientalis.* Macroscopic and microscopic descriptions are given, as well as taxonomic and biogeographical comments, and a discussion on morphology with implications concerning the nature of the cystidioid elements and their possible ancestry.

Key words — lignicolous fungi, hyphidia, *Tricholomataceae, Gloeostereum*

Introduction

Cheimonophyllum Singer is a small genus in the family *Tricholomataceae,* comprising only three species to date. A recent molecular study (Moncalvo et al. 2002) places *Cheimonophyllum* in the same clade as *Gloeostereum,* with the nearest clade containing *Baeospora* and *Hydropus.*

The main distinctive characters of the genus are: basidiocarps lignicolous, pleurotoid, small, white; stipe absent or short, lateral; basidiospores hyaline, globose to subglobose, inamyloid; cheilocystidia filamentous (Singer 1986).

In the field, *Cheimonophyllum candidissimum* is a look-alike of *Panellus mitis*, *Clitopilus hobsonii* or various *Crepidotus* species, although the microscopical features of these species are strikingly different. Its distribution is wide, almost cosmopolitan, but, in most cases, its occurrence is uncommon if not rare.

Materials and methods

Microscopical observations were made in bright field and phase contrast using a standard light transmission microscope as well as a Differential Interference Contrast (DIC) microscope. Sections of dried material were mounted in 3% KOH and Melzer's reagent. All measurements were performed under 1000× magnification. At least 20 spores and 10 basidia and cheilocystidia were

measured per specimen. Spore sizes are given in approximation to 0.5 μm, with extreme values given in parentheses, followed by the length-width ratio of the spores (Q). The description and habitat reference given refer exclusively to the material collected from Greece. Specimens from other countries were also examined. Greek localities are transcribed into Latin according to ISO 843: 1997 (E). Authorities' abbreviations are in accordance to Authors of Fungal Names by Kirk & Ansell (1992). The collected specimen is deposited at the Mycological Herbarium of the University of Athens (ATHU–M). The loaned specimens are kept in Zürich (Z+ZT).

Taxonomic description

Cheimonophyllum candidissimum (Berk. & M.A. Curtis) Singer
Sydowia 9: 417 (1955)

Pileus 2–17 mm, convex to plano-convex, cyphelloid to flabelliform, laterally attached to the substrate, with straight or incurved margin, pure white; surface dry, smooth, minutely pubescent towards the point of attachment. Lamellae whitish to ivory in fresh specimens, cream colored when dried, moderately crowded to rather distant, radiating from the point of attachment. Stipe rudimentary or absent.

Basidiospores (5.0–)5.5–7.0 × (4.5–)5.0–6.5 μm, Q = 1.00–1.20 (–1.40), globose to subglobose, with a distinct apiculus, thin-walled, hyaline, smooth, inamyloid, with granular content or few oil droplets, occasionally fusing to one big oil droplet (Figs 1a; 3b). Basidia 20–31 × 7–9 μm, clavate, 4-spored, rarely 2-spored, with basal clamp; content granular or with numerous oil droplets (Figs 1b; 3c). Cheilocystidia 40–110 × 2–4 μm, filiform, some with a slightly swollen base, branched or not, often multiply so, some septate and clamped; apices acute, often markedly thin, less than 1 μm wide (Figs 1c; 3e–i). Pleurocystidia absent but rarely some clavate cystidioid bodies present with apical or apico-lateral outgrowths (Fig. 3d). Lamellar margin sterile or heterogeneous (Figs 2; 3j). Lamellar trama regular; hyphae 1.5–4 μm wide, more or less parallel, slightly thick-walled. Pileipellis an entangled trichodermium; hyphae 1.5–3 μm wide. Context of loosely interwoven hyphae 2–5 μm wide, hyaline, slightly thick-walled. Clamp connections present in all tissues, conspicuous, abundant.

Habitat: Gregarious on fallen branches of *Platanus orientalis*. November. In Greece known only from a single site.

Specimens examined — **Greece:** Granitsa, Evrytania, 39°06'N, 21°31'E, alt. *ca* 700 m, stands of *Platanus orientalis,* on fallen branches of *P. orientalis,* 11 Nov. 2004, Delivorias, ATHU–M 5467; **Estonia:** Valga, Mehiksoo, on *Populus tremula,* 22 Nov. 1982, Veldre, TAA 114978; **Canary Islands:** Tenerife, Altos de la Matanza, 11 Jan. 1984, Beltran, TFC Mic 2211; **Switzerland:** Ormont-Dessus, Les Diablerets, alt. 1260 m, mixed hardwood

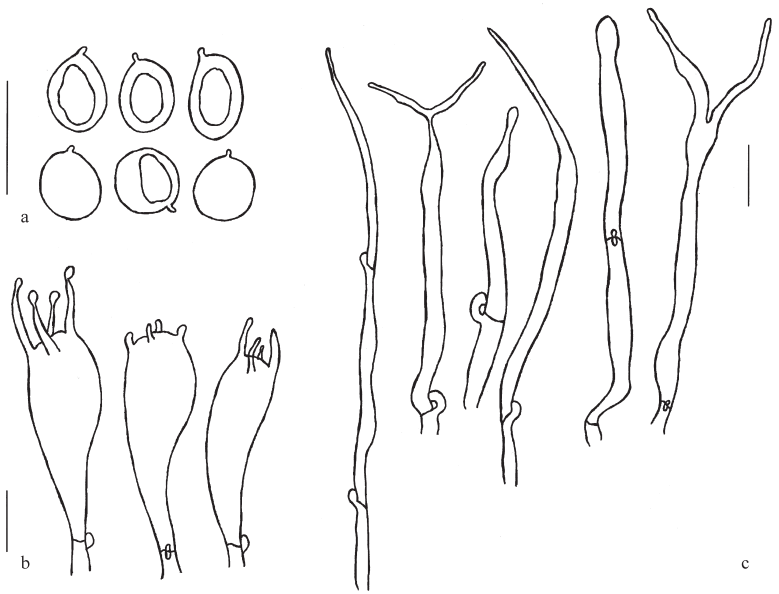

Fig. 1. *Cheimonophyllum candidissimum:* **a.** Basidiospores, **b.** Basidia, **c.** Cheilocystidia. Bars = 10 µm.

forest, 17 Sep. 1992, Senn-Irlet, Herb. Helv. 92/222; Gurnigel-Berghaus, subalpine spruce forest, on dead *Sorbus aucuparia,* 27 Sep. 1995, Senn-Irlet, Herb. Helv. 95/115; **France:** Dpt. Ardennes, Rocroi – Bois des Hingues, 15 Sep. 1993, mixed hardwood forest, on moss-covered branch, Senn-Irlet, Herb. Helv. 93/56.

Remarks: *C. candidissimum* is recognized by the minute, laterally attached to the substrate, pure white basidiocarps with somewhat distant lamellae (Fig. 3a), and the white, globose to subglobose, inamyloid basidiospores. It is macroscopically similar to young specimens of *Panellus mitis, Clitopilus hobsonii* or several species of *Crepidotus*.

Segedin (1994) reports 1-, 2- and 4-spored basidia, and Senn-Irlet (1990) reports mostly 4-spored basidia or (for one collection) with 2- and 4-spored basidia intermixed. The great majority of basidia in our specimen were 4-spored; a few 2-spored basidia were also encountered but seemed very rare. The same applies to the specimens we examined from other countries, kindly provided to us by Senn-Irlet, with one notable exception: in specimen TAA 114978 from Estonia, 2-spored basidia were quite common, if not dominant (Fig. 3c). Some 1-spored basidia were also observed in this specimen.

Senn-Irlet (1990) provides an interesting discussion on the characterization of the elements at the lamellar margin, questioning their origin, and retaining

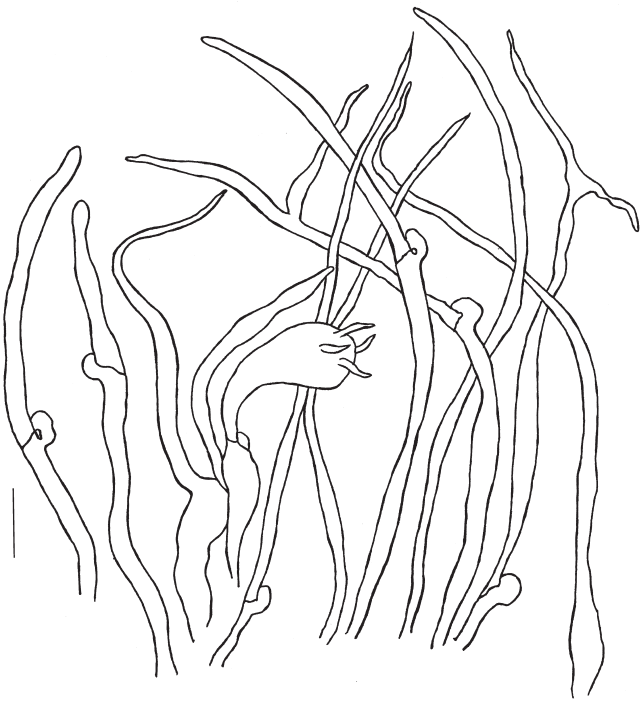

Fig. 2. Lamellar margin of *C. candidissimum.* Bar = 10 μm.

–rather reluctantly– the term **cheilocystidia.** Reijnders & Stalpers (1992) deduce that these 'cheilocystidia' are in fact sterile hyphae of the trama, piercing through the hymenial palisade. They also report that the lamellar margin is sterile, covered by a tuft of tramal hyphae. On the other hand, Senn-Irlet (1990) reports that the margin is never totally sterile and that basidia are always present. In our specimens, we observed that basidia are usually interspersed amongst the 'cheilocystidia', especially in mature specimens, but are significantly shorter. Hence, at a low magnification, the lamellar margin may appear to be sterile if the cheilocystidia are abundant. Some parts of the lamellar edge, particularly those adjacent to the pileal margin, seem indeed to be sterile. This may also be the case in young specimens, in which the lamellar margin seems to be sterile throughout. On the other hand, at the medial parts of the lamellar margin, the cheilocystidia may be less frequent and the basidia may prevail. Reijnders & Stalpers (1992) suppose a tramal origin for the cheilocystidia and provide a convincing photo. According to our observations, the cheilocystidia seem indeed to be tramal projections (Fig. 3e,h) and in some cases basidioles seem to originate from the same tramal hyphae as adjacent cystidia (Fig. 3f-g: arrows).

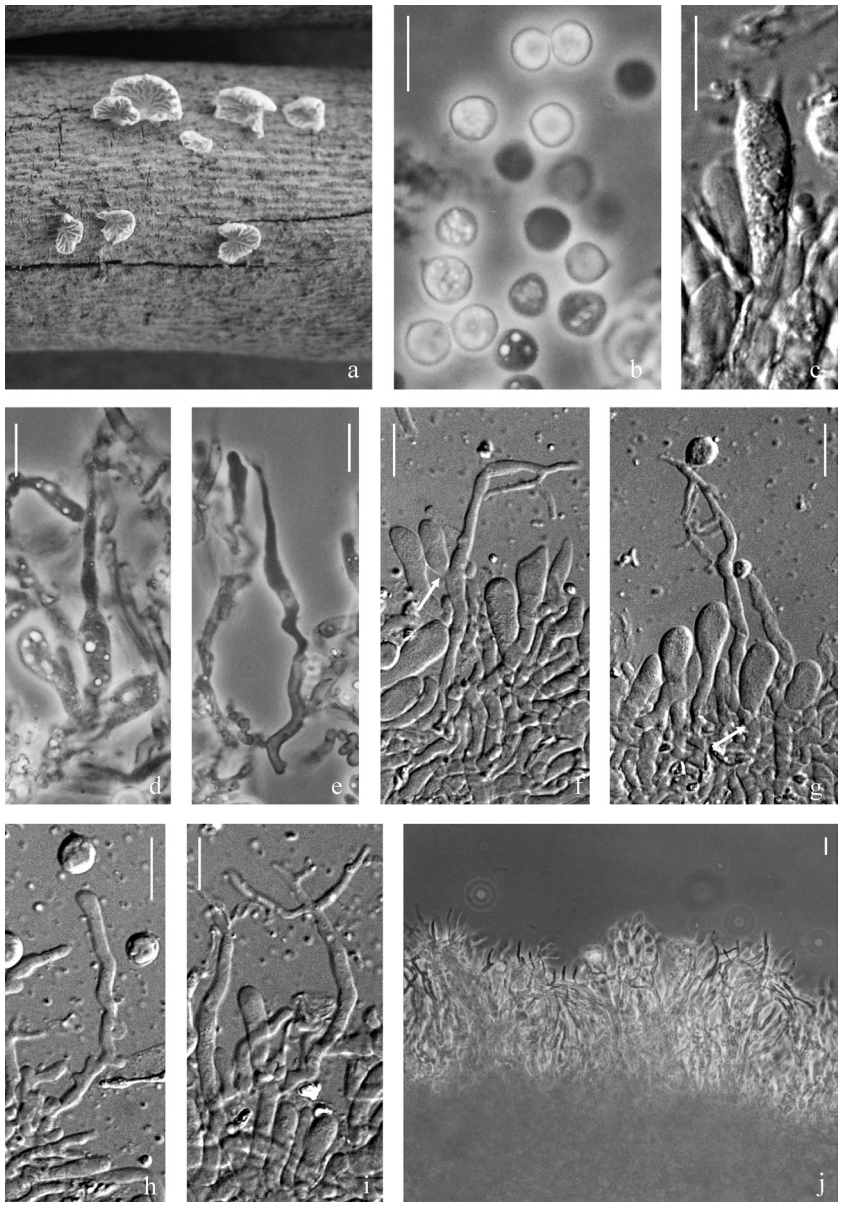

Fig. 3. *Cheimonophyllum candidissimum:* **a.** Dried basidiocarps (ATHU–M 5467). **b.** Basidiospores (ATHU–M 5467). **c.** Basidium with 2 sterigmata (TAA 114978). **d.** Basidiole with secondary growth (ATHU–M 5467). **e-i.** Cheilocystidia (e: ATHU–M 5467; f-i: TAA 114978). **j.** Lamellar margin covered by cheilocystidia (ATHU–M 5467). Bars = 10 μm.

The morphology of the cheilocystidia and their abundance on most lamellae, where they seem to form a protective structure covering the basidia, has led us to speculate that these elements might in fact correspond to **hyphidia,** cells of a supposedly protective nature in aphyllophoroid fungi. The hyphidia may form catahymenia, with buried, scattered basidioles extending though the hyphidial layer only at maturity (Clémençon 1997, 2004). Eriksson & Ryvarden (1973) provide a line drawing of the hymenium of *Aleurodiscus cerussatus,* which shows basidia and **acanthophyses** (termed **acanthohyphidia** by Donk 1964) originating from the same tramal hyphae. This seems to fit well with our observations, as well as with Senn Irlet's report of basidia always being present at the lamellar margin. Petersen & Parmasto (1993) report the presence of hyphidia in *Gloeostereum incarnatum,* a species which, according to molecular data, is closely related to *C. candidissimum* (Moncalvo et al. 2002). Their reference "Hyphidia numerous, undulate, sometimes sparsely branched, 1–2 μm diam." corresponds rather well to the 'cheilocystidia' of *C. candidissimum.* If these species are indeed related, it is quite possible that these cells have a common ancestry and a similar function. To add to the point, Reijnders & Stalpers (1992) note that the hymenophoral trama in *Cheimonophyllum* has a trametoid-type structure, which "is considered a sign of aphyllophoroid relationship".

In some cases, we observed basidioles with secondary growth, giving rise to elements that markedly resemble cystidia (Fig 3d). Such secondary growth of basidia has been noted by Aime (2001) in *Crepidotus,* and considered by her to be induced by humidity.

The distribution of *C. candidissimum* is worldwide, including Europe, North Africa, North and South America, and New Zealand. It seems to be rather common in the Americas. It is listed as common in a Checklist of Columbia Basin Fungi (Miller & Miller 1994). Putzke (2002) reports it from various locations in Brazil. Twelve reports exist from various islands of the Caribbean (Minter et al. 2002) and numerous reports of the species from various locations in U.S.A. and Canada can be found in the Internet. Five collections are reported from New Zealand, where it is rather widely distributed (http://nzfungi.landcareresearch.co.nz/html/mycology.asp). In Europe, Senn-Irlet (1990) noted six examined specimens from Germany, eight from the former USSR (Estonia and Russia), one from Slovakia and one from the Canary Islands (Tenerife). She kindly lent us for examination two of these specimens, as well as three more collected at later dates (two from Switzerland and one from France). She deduced (1990) that the species is rare in Central and Western Europe, and more frequent in East and Northern Europe (noting the presence of exsiccata in herbaria from Norway and Estonia). It is reported as widespread but rare in the UK (Watling & Gregory 1989). It has been listed as Rare in a 1997 red list of Denmark

(Stoltze & Pihl 1998). Four specimens collected from Belgium are kept in the Herbarium of the National Botanic Garden of Belgium (http://www.br.fgov.be). Two cultures isolated from France are available in CBS. Various websites report *C. candidissimum* from several countries of Central and Northern Europe, such as Switzerland, the Netherlands, Norway, Sweden, Finland, Estonia, Latvia and Lithuania. However, the picture is quite different in the countries surrounding the Mediterranean. It is not included in recent checklists from Croatia (Tkalčec & Mešić 2002) and Turkey (Sesli & Denchev 2005). It has not been found in Bulgaria (Gyosheva, pers. com.). We have been unable to find any reports of *C. candidissimum* from other Balkan countries, although we cannot rule out their existence. We have also not found any reports from mainland Spain (the only existing report is from Tenerife), Portugal or Italy. It is not included in a checklist from Sicily (Venturella 1991). It is also not included in recent web-based fungal databases from Ukraine (Minter et al. 2004) and Georgia (Gvritishvili et al. 2007). One sole report exists from Morocco, on *Ilex aquifolium* (Malençon & Bertault 1975, as *Pleurotellus candidissimus*). It has not as yet been recorded from Greece.

C. candidissimum is reported in the literature to grow always on dead branches of deciduous trees, such as *Populus, Alnus, Fraxinus, Corylus, Fagus, Sorbus, Tilia, Salix, Ilex* and *Quercus*. After an extensive search of both printed and web-based literature, we have not encountered any reports of the species on *Platanus.* To our knowledge, this is the first report of *C. candidissimum* on *Platanus orientalis* in Europe, if not worldwide.

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