
Two new species of *Dacampia* (Ascomycota, *Dacampiaceae*), with a key to and synopsis of the known species of the genus

Halıcı, M.G.¹ and Hawksworth, D.L.^{2*}

¹Erciyes Üniversitesi, Fen Edebiyat Fakültesi, Biyoloji Bölümü, 38039 Kayseri, Turkey

²Departamento de Biología Vegetal, Facultad de Farmacia, Universidad Complutense de Madrid, Plaza Ramón y Cajal, Ciudad Universitaria, ES-28040 Madrid, Spain; and Department of Botany, The Natural History Museum, Cromwell Road, London SW7 5BD, UK

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Two new lichenicolous fungi in the genus *Dacampia* are described: *D. muralicola* sp. nov. from the apothecia of *Protopermaliopsis muralis* (syn. *Lecanora muralis*) in Turkey, and *D. rhizocarpicola* sp. nov. from thalli of *Rhizocarpon obscuratum* in the UK. The new species differ from those previously recognized in the genus in the size and septation of the ascospores, as well as in occurring on unrelated hosts. A new combination *D. leptogiicola* comb. nov. (syn. *Pleospora leptogiicola*) is also made. A key to the seven accepted species of *Dacampia* is presented, along with line drawings of their ascospores.

Key words: *Lecanora*, lichenicolous fungi, lichens, *Pleospora*, *Protopermaliopsis*, *Rhizocarpon*, Turkey, UK.

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*Corresponding author: D.L. Hawksworth e-mail: d.hawksworth@nhm.ac.uk

Introduction

Lichenicolous fungi which grow obligately on lichens as commensals, parasites, or saprobes, continue to be a source of novel genera and species, with over 1500 species now known (Lawrey and Diederich, 2003), and 3-4000 species estimated worldwide (Hawksworth, 2001). Geographical regions and lichen hosts that have not previously been searched for these specialized fungi are most likely to yield some of the anticipated "missing" species, and this has proved to be true in the case of Turkey from which one new genus and five new species have recently been described (Halıcı *et al.*, 2005, 2007; Halıcı and Hawksworth, 2007; Hawksworth and Halıcı, 2007). Here we describe a further lichenicolous species new to science from Turkey, which belongs to the genus *Dacampia* (Ascomycota, *Dacampiaceae*). In addition we also provide a brief description of a further new species, that has the largest ascospores yet discovered in the

genus from the UK; this species has been known to D.L.H. for 16 years, but publication was delayed in the hope of finding more material. As this latter species has still not been refound, we also formerly name it here as it can be easily recognized from the data obtained. Further, since no key to all the known species of *Dacampia* has previously been published, we also present one here along with a synopsis of the species, and make some general remarks about the genus and its relationships. A new combination into the genus is also made.

Taxonomy

Dacampia muralicola Halıcı & D. Hawksw.,
sp. nov. (Figs 1, 2E)
 MycoBank: 511068.

Etymology: The specific epithet recalls the species epithet of the host lichen on which the new fungus grows.

A. dacampia engeliana similis, sed differt in *ascomata* solo 95–120 µm et *ascosporis* minoribus, 3-

5-7 transseptis et 1(-2) longiseptatis, 21-26(-31.5) × (7-) 9-12.5(-14.5) µm.

Typus: Turkey: Gaziantep: Kizilyazi, 37°09'N, 37°15'E, alt. 955 m, on apothecia of *Protoparmeliopsis muralis* on calcareous rocks, 7 June 2004, M .G. Halici MGH 0.2267 (Herb. Erciyes Universitesi, Kayseri – **holotypus**).

Ascomata perithecia, immersed with only the uppermost part visible, arising singly, scattered over areas of the host apothecia, the infections not in necrotic patches or otherwise delimited; *individual perithecia* subglobose, black, shiny, smooth, lacking setae, ostiolate, 95-120 µm diam; *ostiole* not papilliform, 30-38 µm wide; *exciple* composed of 5-8 layers of angular pseudoparenchymatous cells, textura angularis, 24-45 µm thick, the individual cells somewhat radially compressed, reddish brown to brown, individual cells 10-12.5 × (6-)7-9.5 µm in vertical section and 5-8 µm diam in surface view, smooth, walls ca 1 µm thick. *Mycelium* of sparse hyphae arising from the lower parts of the ascomata, ramifying into the host hymenium, septate, smooth, pale reddish brown, 4.5-5 µm thick. *Hamathecium* of cellular pseudoparaphyses, sparse, septate, branched and anastomosed, 1.5-2 µm thick; centrum Lugol's solution (after pre-treatment with 10% KOH) I –. *Asci* elongate-clavate, bitunicate, with a thick-walled apex and a small internal apical beak when young, but the apical wall about the same width as the sides at maturity, discharge not seen, 41-45 × 14-16.5 µm, 8-spored. *Ascospores* irregularly biserially arranged and overlapping in the ascus, broadly ellipsoid, rounded to somewhat broadly pointed at the apices, muriform, with 3-5(-7)-transsepta and 1(-2)-longisepta, the number of both kinds of septa increasing with age, often slightly constricted at the median septum, dark brown, cells similarly coloured, smooth, lacking a conspicuous gelatinous sheath, 21-26(-31.5) × (7-)9-12.5(-14.5) µm, length/breadth ratio 1.8-2.2.

Host: In the apothecia of *Protoparmeliopsis muralis* (syn. *Lecanora muralis*). The infected apothecia appear black due to the presence of the ascomata of the invading fungus, but otherwise unharmed so the species appears to be a biotrophic commensal. The type collection is also infected with an unidentified *Phoma* species that can occur in the same apothecium, and there is also

superficial torulose mycelium and developing dark brown (not reddish brown) ascomata suggestive of a species of *Lichenostigma* but in which we could find no ascospores; no *Lichenostigma* species is currently known from *Protoparmeliopsis*.

Distribution: Turkey (Gaziantep); only known from the holotype collection.

Notes: This new species is most similar to *Dacampia engeliana*, a fungus which appears to be largely restricted to thalli of *Solorina saccata*, though it has also been mentioned as occurring on *Peltigera rufescens* (Bricaud and Roux, 1990). However, that species differs from *D. muralicola* in having ascomata 250-450(-600) µm diam, elongated cylindrical 4-8-spored asci 140-200 × 10-13.5 µm, and ascospores which have 3(-5)-transsepta and 1(-2)-longisepta in most cells and are also (18-)19.5-25(-27) × (8-)8.5-10 µm (Crivelli, 1983; Hawksworth, 1986; Bricaud and Roux, 1990). Differences from other species of the genus so far described are indicated in the following key.

We speculated whether the associated *Phoma* might be an anamorph of *D. muralicola*, but we failed to find any physical connection between the conidiomata and the ascomata. Further, as no anamorph of any kind has yet been reported in *Dacampia*, despite detailed studies on some species (Wehmeyer, 1961; Crivelli, 1983; Henssen, 1995), we see no support for such an assumption at this time.

Key to and synopsis of the accepted species of *Dacampia*

As no key has been provided to the currently accepted species of *Dacampia*, we provide one here. Outlines of the ascospores of all seven species keyed out here are included in Fig 2.

1. Ascomata exceeding 150 µm diam..... 2
Ascomata 95-120 µm diam..... **muralicola**
- 2(1). Ascospores more than 30 µm in length..... 3
Ascospores less than 30 µm in length 4
- 3(2). Asci 8-spored; ascospores 30-36 × 11-16 µm;
lichenized..... **hookeri**
Asci 2-4-spored; ascospores (30-)34-37.5(-39) ×
(10-)14.5-16 µm; on *Rhizocarpon obscuratum*
..... **rhizocarpicola**

- 4(2) Ascospores with 3-5(-6)-transsepta and exceeding 8 μm in width.....5
Ascospores with 7-transsepta, 21-25 \times 5-6.5 μm ; on *Leptogium burgessii* and *Pannaria rubiginosa* **leptogiicola**
- 5(4) Ascospores mainly with 3-transsepta.....6
Ascospores 5(-6)-transsepta, (19-)21.5-26 \times 8-9 μm ; on *Peltigera rufescens* (not forming necrotic spots)..... **peltigericola**
- 6(5) Ascomata 150-250 μm wide; ascospores (23-)24.5-27 \times 11-13 μm ; on *Peltigera rufescens* (forming necrotic spots)..... **rufescentis**
Ascomata 250-450(-600) μm wide; ascospores 18-25 \times 8-10 μm ; on *Solorina saccata* **engeliana**

Dacampia engeliana (Saut.) A. Massal., Gen. Lich.: 22 (1854).

Basionym: *Sagedia engeliana* Saut., Bot. Centrabl. 1846: 406 (1846); as "*Engeliam*".

Descriptions: Crivelli (1983), Bricaud and Roux (1990).

Dacampia hookeri (Borr.) A. Massal., Sulla Lect. Hook. Schaer.: 7 (1853).

Basionym: *Verrucaria hookeri* Borr., in Smith and Sowerby, Engl. Bot. Suppl.: tab. 2622 (1831).

Descriptions: Wehmeyer (1961), Riedl (1969), Hawksworth (1975), and Henssen (1995).

Dacampia leptogiicola (D. Hawksw.) D. Hawksw., **comb. nov.**
MycoBank: 511070.

Basionym: *Pleospora leptogiicola* D. Hawksw., Kew Bull. 30: 196 (1975).

Descriptions: Hawksworth (1975) and Etayo (1994).

Notes: This species was compared to *D. hookeri* in the original account, and while it has narrower ascospores than the other species of the genus, we see not obstacle to a placement in *Dacampia*. The species is clearly no member of *Pleospora* as now interpreted which is even placed in a different family, *Pleosporaceae* (Eriksson, 1981). *Pleospora s. str.* species grow as saprobes on dead herbaceous stems and have a *Stemphylium* anamorph. Further, the ascospores of *Pleospora s. str.* are different, with at least three and often many more transsepta with numerous longisepta and thick gelatinous sheaths (Eriksson 1981; Simmons 1986).

Dacampia peltigericola D. Hawksw. & Hitch, in Earland-Bennett *et al.*, Boln Soc. Micol. Madrid 30: 244 (2006).

Description: Earland-Bennett *et al.* (2006).

Dacampia muralicola Halici & D. Hawksw., Fungal Diversity 28: 49 (2008).

Description: See above.

Dacampia rhizocarpicola D. Hawksw., **sp. nov.**

MycoBank: 511069

Diagnosis: Similis *Dacampiis hookeris* sed differ in ascis 2-4-spori et ascosporiis (30-)34-39 \times (10-)14.5 \times 16 μm .

Typus: UK: Angushire: Glen Esk, on *Rhizocarpon obscuratum*, 1989, R. Munro (IMI 332935 – **holotypus**).

Description: *Ascomata* perithecia, carbonaceous, in groups, breaking up. *Hamathecium* of cellular pseudoparaphyses, abundant, (1.5-)2-3 μm wide. *Asci* 2-4-spored. *Ascospores* deep golden brown, surface generally appearing smooth, but verruculose at high magnifications, rounded to somewhat broadly pointed at the apices, muriform, with 4-5-transsepta and 3-4-longisepta, often slightly constricted at the median septum, (30-)34-39 \times (10-)14.5 \times 16 μm .

Notes: D.L.H. first studied this material back in 1991, but as it was scant he delayed publication in the hope more would be discovered to facilitate a fuller description. As no more specimens have been found, and the fungus is so characteristic in the genus because of its 2-4-spored asci and massive ascospores, it is formally named here. It is hoped this will encourage the search for more material which will enable a more detailed description to be prepared at a later date.

The ascospore sizes are most similar to those of *D. hookeri*, but that species is lichenized (Henssen, 1995) and has constantly 8-spored asci and uniseriately arranged ascospores. Furthermore, this new species is the only known *Dacampia* species on *Rhizocarpon*.

Dacampia rufescentis (Vouaux) D. Hawksw., Notes R. bot. Gdn Edinb. 43: 497 (1986).

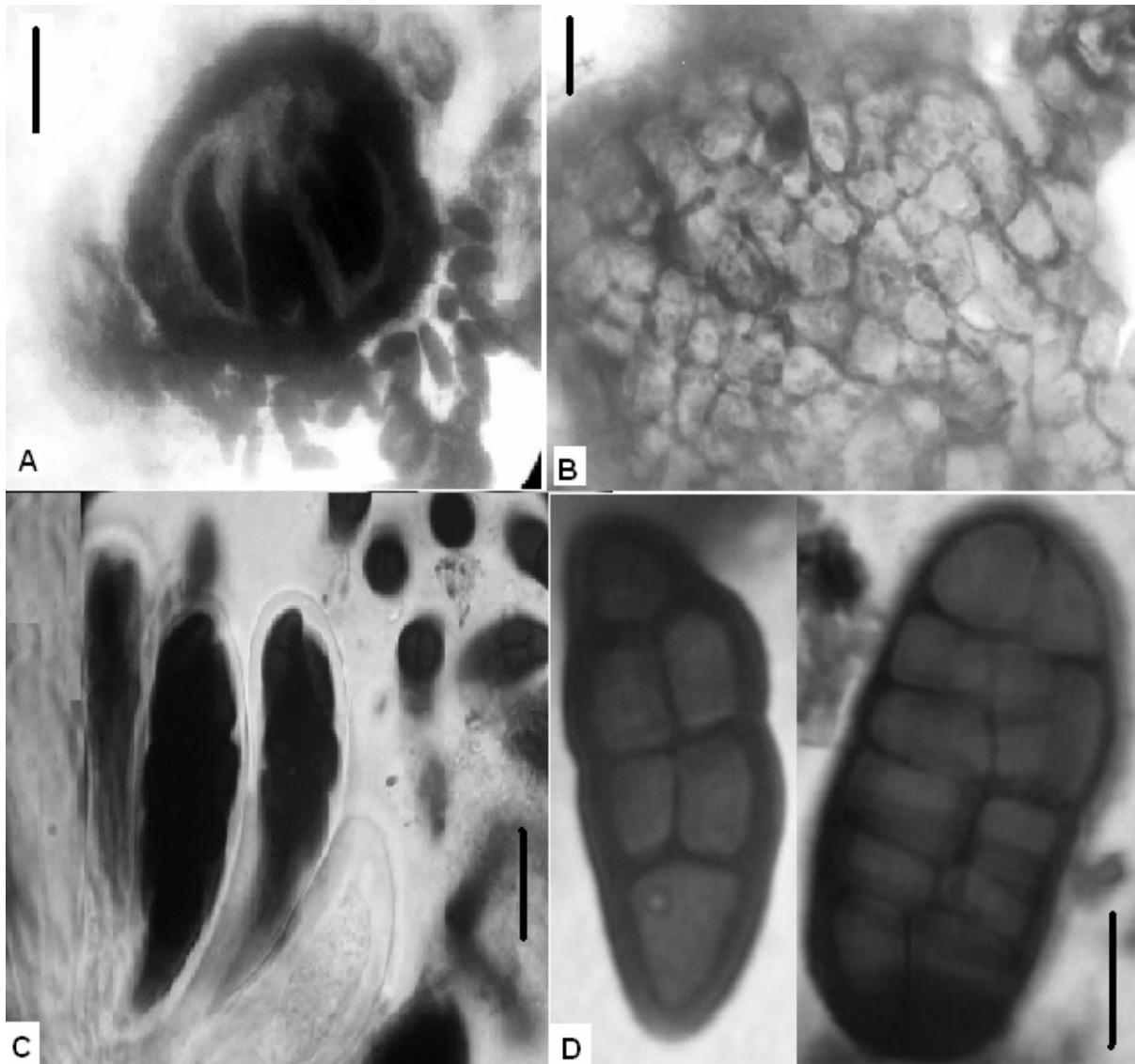


Fig.1. *Dacampia muralicola* (from holotype). **A.** Perithecia, showing the basal mycelial hyphae. **B.** Surface view of ascomatal wall showing the angular pseudoparenchymatous cells. **C.** Ascii in a vertical section of an ascoma. **D.** Ascospores. Bars: (A) = 30 μm , (B) = 20 μm , (C-D) = 10 μm .

Basionym: *Pleospora rufescentis* Vouaux, Bull. Soc. mycol. Fr. 29: 124 (1913).

Descriptions: Vouaux (1913) and Hawksworth (1986).

Discussion

The genus *Dacampia* is very similar to several other lichenicolous genera placed in the same family, *Dacampiaceae* (syn. *Pyrenidiaceae*), notably *Clypeococcum*, *Polycoccum*, *Pyrenidium*, and *Weddellomyces*. *Polycoccum* and *Pyrenidium* have a similar ascomatal structure and wall tissues to *Dacampia*, but have 1-transseptate, and more than 1-trans-

septate ascospores, respectively. In *Clypeococcum*, which has 1-transseptate ascospores, the ascomatal wall tissue is hyphal and not angular-pseudoparenchymatous, while in *Weddellomyces* the ascospores may be transseptate or muriform, but the upper parts of the ascomatal walls are made up of cephalothecoid plates and break up irregularly to release the ascospores. The current ascospore and ascomatal structure generic concepts in the family need to be tested by molecular phylogenetic methods. However, at the moment there is only one lichenicolous sequence of the family in GenBank, an unpublished LSU rRNA sequence

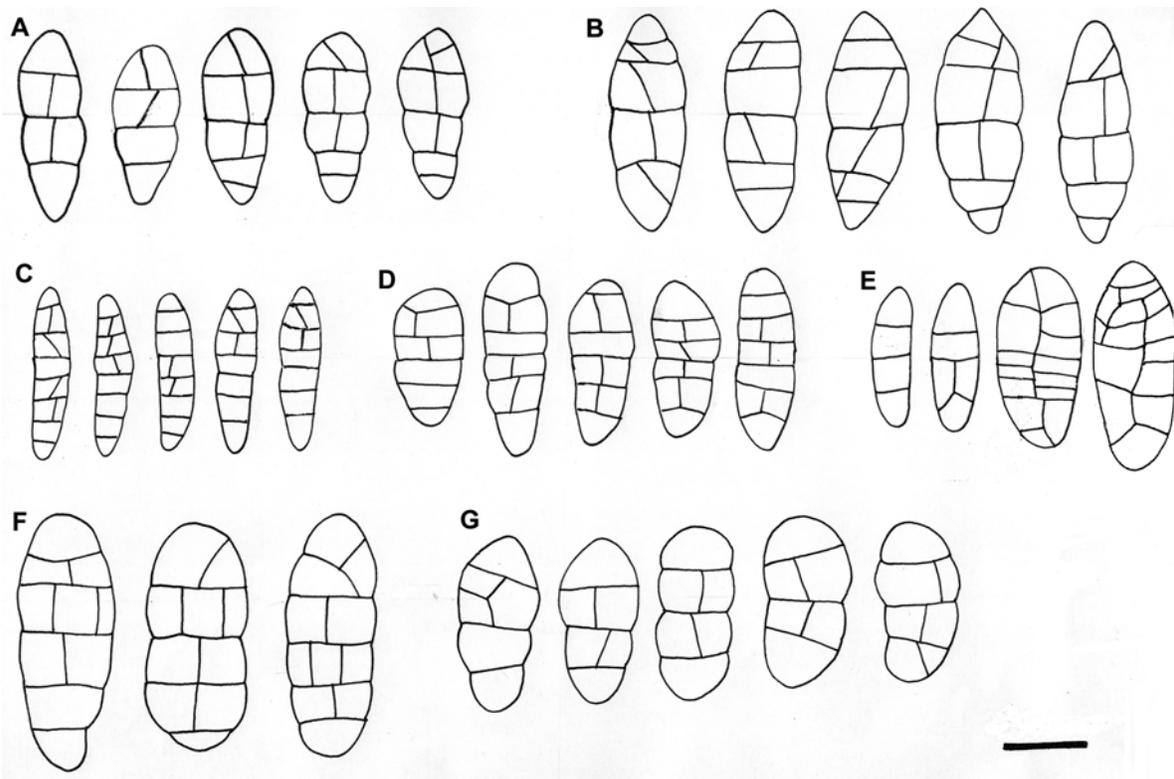


Fig. 2. Ascospore outlines of *Dacampia* species. **A.** *D. engeliana* (Magnno, Rehm, Ascomyceten no. 1516, K). **B.** *D. hookeri* (J. D. Hooker, K – **holotype**, three left ascospores; D. A. Walkinshaw, BM, two right-hand ascospores). **C.** *D. leptogiicola* (F. Rose, IMI 185080 –**holotype**). **D.** *D. peltigericola* (C. J. B. Hitch, MAF Lich 14110 – **holotype**). **E.** *D. muralicola* (Halici, Herb. Erciyes Universitesi, Kayseri – **holotype**). **F.** *D. rhizocarpicola* (R. Munro, IMI 332935 – **holotype**), **G.** *D. rufescentis* (M. C. Clark, IMI 277765). Bar = 10 µm.

from material named as *Polycoccum vermicularium* (AY961601). In the absence of such data on representatives of the other genera, including their type species, we consider it premature to make any changes. We are especially cautious as there are also biological differences: for example, *Polycoccum* species almost always form galls on the host lichens (Hawksworth and Diederich, 1988), while no known *Dacampia* stimulates the production of such structures, and some *Weddellomyces* species can be destructive pathogens killing their hosts.

With the interesting exception of *Pyrenidium actinellum*, the lichenicolous species in the *Dacampiaceae* are almost always host specific. This may be partly due to them selectively attacking the fungal partner of the lichen host and penetrating their hyphae, although invasive haustoria are also reported in *Pyrenidium* (de los Ríos and Grube, 2000).

However, we wonder if *D. leptogiicola* might be an exception and be attacking the photosynthetic partner as this is a *Nostoc* cyanobacterium in both its lichen hosts.

Dacampia is biologically interesting as a genus as the type species, *D. hookeri*, is now demonstrated to be an independent lichen (Henssen, 1995). In *D. engeliana*, however, the fungus modifies the host lichen to form a structure not unlike that of *D. hookeri* (de los Ríos and Grube, 2000). The other lichenicolous species in the genus tend to cause limited damage or be commensalistic. In the case of the two species occurring on *Peltigera rufescens*, it is interesting that one forms necrotic patches (*D. rufescentis*) and the other has scattered ascomata (*D. peltigericola*). The genus would therefore appear to be an excellent one in which to further explore the different biologies both functionally and ultrastructurally.

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