

Two new species of *Chaetomidium* (Sordariales)

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Abstract: Two new species of *Chaetomidium*, *C. galaicum* isolated from a granite rock sample collected in Galicia (Spain), and *C. triangulare* isolated from a soil sample collected on Salta province (Argentina), are described and illustrated. The former species has a cephalothecoid ascomatal wall with flexuous hairs, subglobose to broadly fusiform asci, and large fusiform ascospores, with a terminal germ pore. *Chaetomidium triangulare* is characterised by non-cephalothecoid, glabrous ascomata, clavate asci and triangular ascospores in upper view, with a terminal germ pore surrounded by a dark area. A key for the accepted species of *Chaetomidium* is provided.

Taxonomic novelties: *Chaetomidium galaicum* Stchigel & Guarro sp. nov., *Chaetomidium triangulare* Stchigel & Guarro sp. nov.

Key words: Ascomycota, *Chaetomidium*, *Chaetomium*, rock, soil, Sordariales.

INTRODUCTION

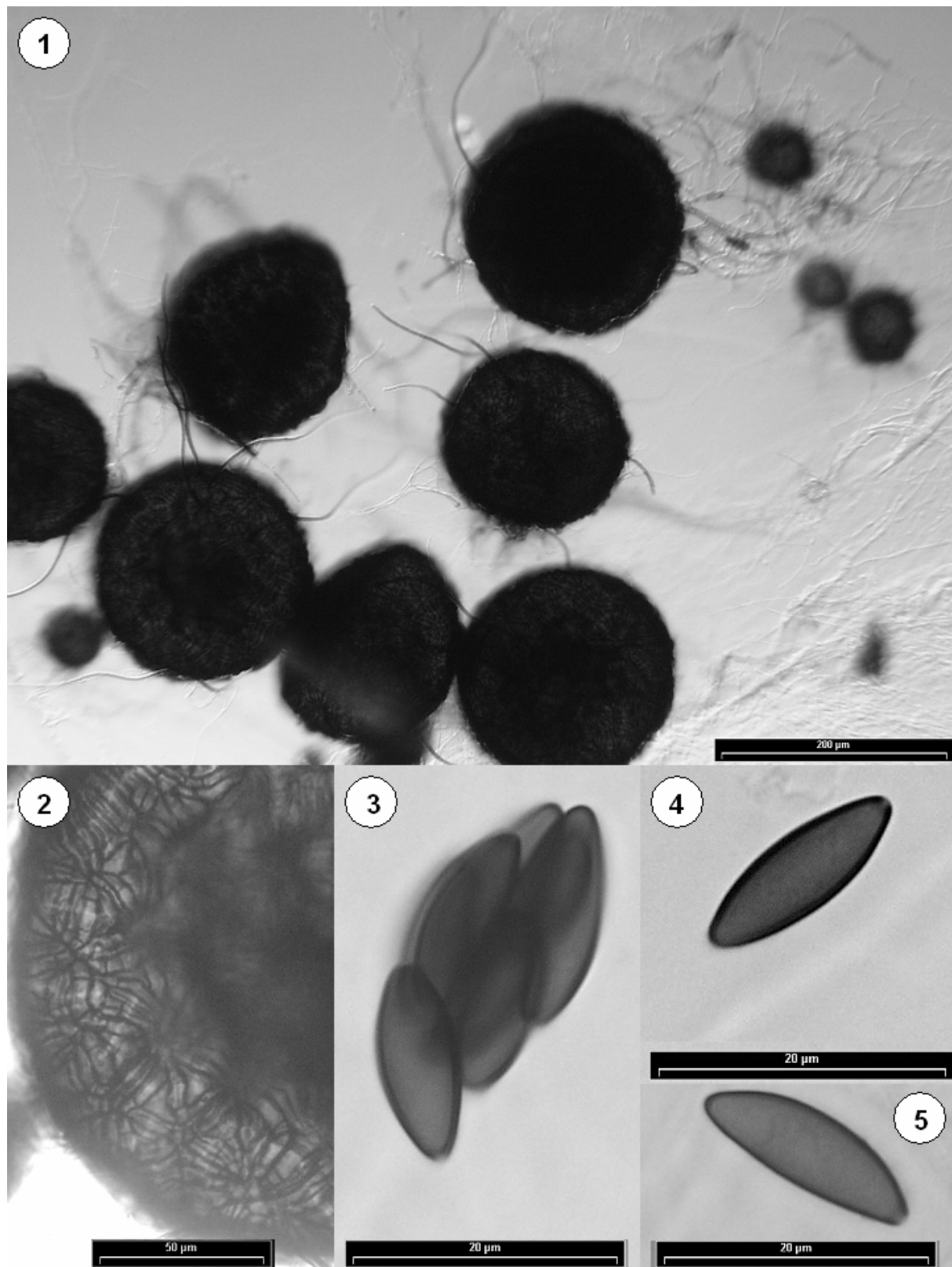
The genus *Chaetomidium* (Zopf) Sacc. (*Chaetomiaceae*, Sordariales) has been considered as the non-ostiolate counterpart of *Chaetomium* Kunze (von Arx *et al.* 1988). Currently, *Chaetomidium* comprises nine species, and it is characterised by non-ostiolate, globose ascomata, sometimes with a cephalothecoid peridium (four species), evenly hairy, 8-spored, clavate asci, and limoniform to broadly fusiform, often bilaterally flattened ascospores. Morphologically related genera, with also non-ostiolate ascomata, are *Boothiella* Lodhi & J.H. Mirza (characterised by 4-spored, cylindrical asci, and broadly obovate or nearly spherical ascospores) and *Thielavia* Zopf (with a peridium of *textura epidermoidea*, and fusiform, ellipsoidal, slightly clavate or ovoid, brown ascospores, with a terminal or lateral, distinctive germ pore) (von Arx *et al.* 1988, Stchigel *et al.* 2002). Other morphologically related genera are *Corynascella* Arx & Hodges, with obovate to broadly clavate asci, and ascospores with a thickened wall around the germ pores (one or two); *Corynascus* Arx, producing ascospores with two germ pores (one at each end) and a *Myceliophthora* Oorschot anamorph; and *Melanocarpus* Arx, with a pseudoparenchymatous peridium of several layers of angular or irregular cells, obovate or cylindrical-saccate asci, and opaque, ovate or broadly ellipsoidal and bilaterally flattened ascospores, with a distinct germ pore, and *Chrysonilia*-like anamorph (von Arx *et al.* 1988, Guarro *et al.* 1996, Stchigel *et al.* 2000).

Recently, during a survey of soil fungi and fungus-altered stones in different regions of Spain and South America, respectively, two interesting and undescribed fungi belonging to *Chaetomidium* were found, which are described in the present study.

MATERIALS AND METHODS

Granitic samples were collected near As Maus de Salas, in the Baixa Limia-Serra do Xurés natural park, Ourense province, Galicia, Spain. This area is very rich in megalithic monuments of 4000–6000 years old (Neolithic period). The altitude is around 900 m, and the weather is wet and cold, with an annual precipitation to 1500 mm and an average annual temperature of 11 °C. The vegetation contains species of both Eurosi-berian and Mediterranean origin.

In Argentina soil samples were collected near Taffi del Valle, Tucumán province. The terrain is sandy, and the vegetation is mainly composed of xerophilic plants (*Aphylloclados spartioides* Wedd., *Baccharis boliviensis* (Wedd.) Cabrera, *Bougainvillea spinosa* (Cav.) Heimerl, *Bulnesia schickendantzii* Hieron. ex Griseb., *Caesalpinia trichocarpa* Griseb., *Cassia crassiramea* Benth., *Cercidium andicola* Griseb., *Chuquiraga erinacea* D. Don, *Gochnatia glutinosa* D. Don, *Lycium* spp., *Proustia cuneifolia* D. Don, etc.), including a large diversity of cacti (*Trichocereus pasacanus* (F.A.C. Weber) Britton & Rose, *Opuntia* spp., *Parodia* spp.) (Cabrera 1994).



Figs 1–5. *Chaetomidium galaicum* (CBS 113678). 1. Ascomata. 2. Peridial wall. 3. Ascus with mature ascospores. 4–5. Ascospores. Scale bars: 1 = 200 µm, 2 = 50 µm, 3–5 = 20 µm.

The altitude is 1976 m, and the weather is dry and hot, with an annual precipitation below to 200 mm and an average annual temperature of 22 °C.

Dark-coloured spots on the surface of granitic stones, that suggested biodeterioration, were removed using a disposable sterile scalpel, placed in sterilised polyethylene bags, closed by rubber band, and stored

at room temperature. Soil material was collected mainly from the A horizon, placed into sterilised plastic bags, closed and stored in a refrigerator at 4–7 °C.

Approximately 1 g of rock spot or soil was suspended in 5 mL of 5 % v/v acetic acid, shaken vigorously for 5 min and left for further 5 min. The layer of

acetic acid was decanted, the residual solid was resuspended in 9 mL of sterilised water, and the suspensions were plated in a Petri dish. Potato-carrot agar with 30 mg/L chloramphenicol (PCA; 20 g potatoes, 20 g carrots, 20 g agar, 1 L tap water) was poured over the suspension and mixed with it. Cultures were incubated at 15 and 25 °C under 12 h of darkness, alternating with 12 h of cool white fluorescent light (Stchigel *et al.* 2001). The fungi growing on this medium were transferred to oatmeal agar (OA; 30 g oatmeal, 15 g agar, 1 L water), PCA and potato-dextrose agar (PDA; Difco) at 5, 15, 25 and at 35 °C under 12 h of darkness, alternating with 12 h of cool white fluorescent light. Colour notations in parentheses are from Kornerup & Wanscher (1984) (M. = Methuen). Fungal structures were mounted and measured in lactophenol and lactic acid.

RESULTS AND DISCUSSION

Chaetomidium galaicum Stchigel & Guarro, **sp. nov.** MycoBank MB500061. Figs 1–10.

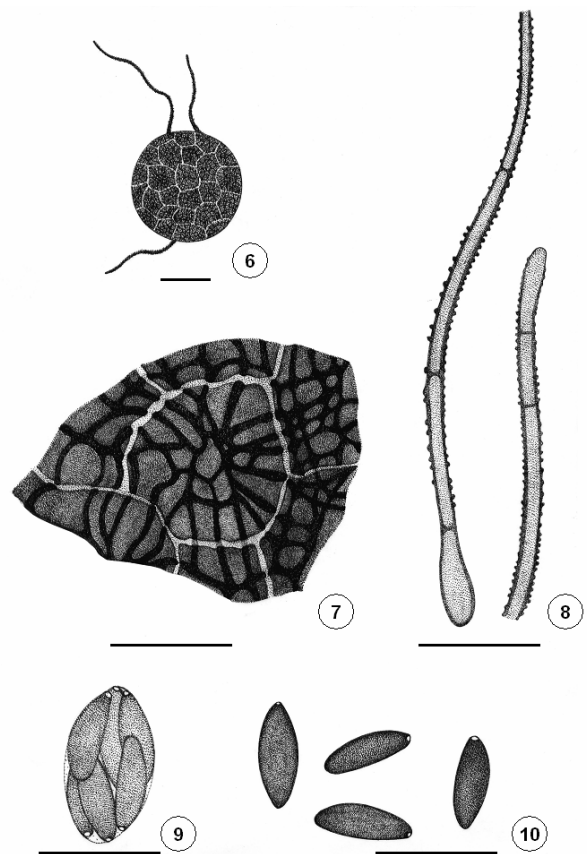
Etymology: The epithet *galaicum* refers to the geographic province from where the samples were collected (Galicia).

Mycelium ex hyphis hyalinis vel subhyalinis, septatis, ramosis, levibus, 1–5 µm latis compositum. Coloniae in "PCA" expansae, planae, hyalinae; reversum album-flavescens. Ascomata superficialia, non-ostiolata, pilosa, atrobrunnea, globosa, 100–300 µm diam. Pili 1–5 per ascoma, flexuosi, septati, verrucosi et crassi-tunicati, brunnei, ad 250 µm longi, 6–10 µm lati ad basim. Peridium cephalothecoideum ex 1–2 stratis, textura angulari compositum, atrobrunneum. Asci 8-spori, subglobosi vel late fusiformes, 25–35 × 12–19 µm. Paraphyses nullae. Ascosporae unicellulares, fusiformes, 14–19 × 5–7 µm, laeves, foramine germinali singulari apicali praeditae. Anamorphosis absens.

Mycelium composed of hyaline to sub-hyaline, septate, branched, anastomosing, smooth-walled 1–5 µm wide hyphae. *Colonies* on PCA growing quickly, attaining more than 80 mm diam in 14 d at 25 °C, flat, white, sulcate, with hyaline exudate; reverse yellowish white (M. 4A2). *Ascomata* formed abundantly after 14 days, superficial, scattered, non-ostiolate, hairy, dark brown, globose, 100–300 µm diam. *Hairs* 1–5 per ascoma, flexuose, septate, verrucose- and thick-walled, brown, up to 250 µm long, 6–10 µm wide at the base. *Peridium* cephalothecoid, 1–2-layered, 5–10 µm thick, of *textura angularis*, dark brown, composed of polygonal plates up to 50 µm diam; external cells prismatic, measuring 5–25 µm diam. *Asci* 8-spored, subglobose to broadly fusiform, 25–35 × 12–19 µm, without differentiated apical structures, evanescent.

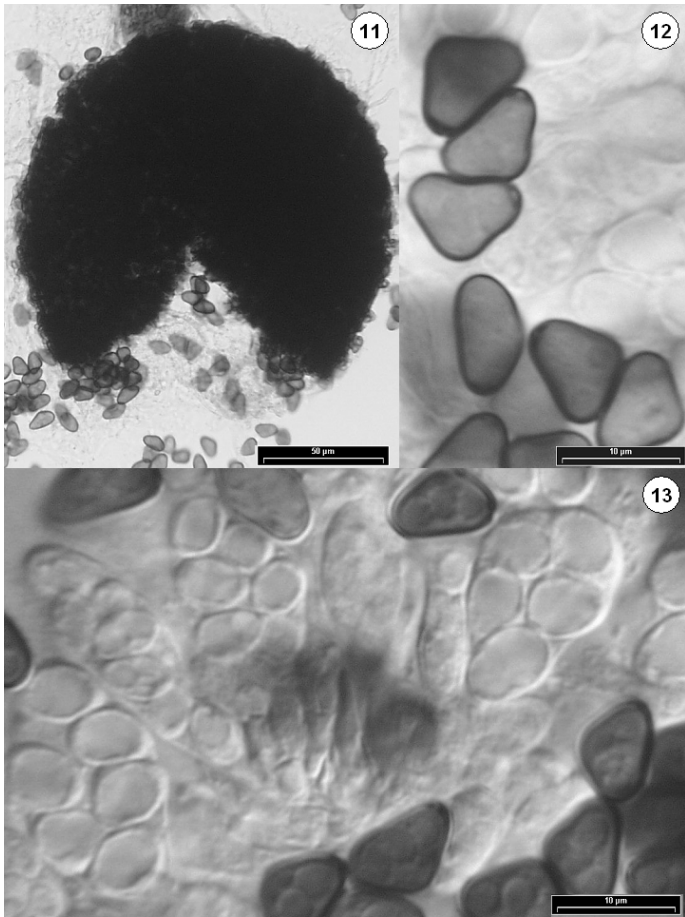
Paraphyses absent. *Ascospores* 1-celled, brown, fusiform, 14–19 × 5–7 µm, smooth-walled, with a terminal germ pore, up to 1 µm diam. *Anamorph* unknown. *Colonies* on PDA at 25 °C attaining more than 80 mm diam in 14 d, velvety to cottony, white, sulcate, without production of ascomata; reverse pale yellow (M. 4A2). *Colonies* on OA at 25 °C attaining 58–63 mm diam in 14 d, flat, white; reverse white. *Colonies* growing on OA, PCA and PDA at 15 °C, similar to those growing at 25 °C, but with a diam of 50–53 mm on OA, 30–32 mm on PCA, and 63–67 mm on PDA. No growth at 5 °C and 35 °C.

Typus: **Spain**, Galicia, Ourense province, Serra do Xurés natural park, from a black spot on granite rock sample, 10 Nov. 2001, coll. by V. Jato and A.M. Stchigel, isol. A.M. Stchigel, IMI 392312 **holotypus**; cultures ex-type CBS 113678 = FMR 8192.



Figs 6–10. *Chaetomidium galaicum* (CBS 113678). 6. Ascoma. 7. Detail of peridial wall. 8. Hair. 9. Ascus with mature ascospores. 10. Ascospores. Scale bars: 6 = 100 µm, 7–10 = 20 µm.

Notes: The morphologically closest species to *C. galaicum* are *C. khodense* Cano, Guarro & El Shafie (1993) and *C. megasporum* Doveri, Guarro, Cacialli & Caroti (1998). All have a cephalothecoid peridium and ellipsoidal to fusiform ascospores.



Figs 11–13. *Chaetomidium triangulare* (CBS 113677). 11. Ascoma. 12. Ascospores. 13. Young asci. Scale bars: 11 = 50 µm, 12, 13 = 10 µm.

However, *C. galaicum* differs from *C. khodense* in number (1–5 per ascoma vs. more than 5) and in the length (up to 250 µm vs. up to 1000 µm) of the ascomatal hairs, in the size of the ascospores (14–19 × 5–7 µm vs. 11–13 × 6.5–7 µm), and the position of the germ pore (terminal vs. subapical); from *C. megasporum*, it differs in the ornamentation (smooth in *C. galaicum* and coarsely warty in *C. megasporum*) and the branching pattern (unbranched in *C. galaicum* and dichotomously branched *C. megasporum*) of the ascomatal hairs, and in the smaller size of the ascospores (19–21.5 × 11–13 µm in *C. megasporum*).

***Chaetomidium triangulare* Stchigel & Guarro, sp. nov.** MycoBank MB500062. Figs 11–16.

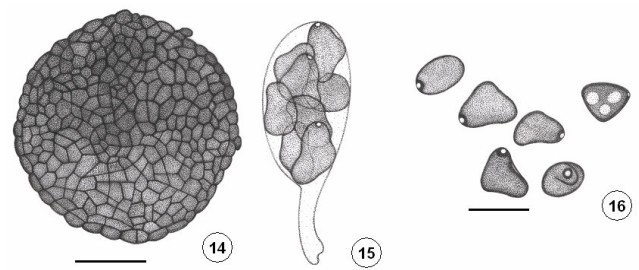
Etymology: The epithet *triangulare* refers to the triangular form of the ascospores.

Mycelium ex hyphis hyalinis vel dilute brunneis, septatis, ramosis, laevibus, 1–5 µm latis compositum. Coloniae in “PCA” restrictae, pallidae vel atro-brunneae; reversum pallidum vel atro-brunneum. Ascomata superficialia, non-ostiolata, glabra, atrobrunnea, globosa, 100–200 µm diam. Peridium ex 2–3 stratis, textura angulari compositum. Asci 8-sporei, clavati, 35–40 × 12–15 µm. Paraphyses nullae. Ascosporeae unicellulares, brunneae pallidae vel brunneae,

triangulares e latere visae ellipsoideae, 9–11 × 7–8 × 5–6 µm, laeves, foramine germinali singulari apicali praeditae. Anamorphosis absens.

Mycelium composed of hyaline to pale brown, septate, branched, anastomosing, smooth-walled 1–5 µm wide hyphae. *Colonies* on PCA growing slowly, attaining 14–19 mm diam in 14 d at 25 °C, flat, pale to dark brown (M. 6D5 to 6F5), slightly granulose due to the production of ascomata, exudate hyaline, soluble pigment pale orange; reverse pale to dark brown (M. 6D5 to 6F5). *Ascomata* appearing after 14 days, superficial (rarely immersed), scattered, non-ostiolate, glabrous, dark brown, globose, 100–200 µm diam. *Peridium* 2–3 layered, 3–5 µm thick, of *textura angularis*, brown; external cells polygonal, 7–15 µm diam. *Asci* 8-spored, fasciculate, clavate, 35–40 × 12–15 µm, stipitate (stipe approximately 10 µm long), without differentiated apical structures, evanescent. *Paraphyses* absent. *Ascospores* 1-celled, pale brown to brown, triangular in upper view and ellipsoidal in lateral view, 9–11 × 7–8 × 5–6 µm, smooth-walled, with a terminal germ pore surrounded by a dark area, up to 1 µm diam. *Anamorph* unknown. *Colonies* on PDA at 25 °C attaining 20–23 mm diam in 14 d, velvety to fasciculate, yellowish white (M. 4A2), without production of ascomata, soluble pigment light orange; reverse pale yellow (M. 4A3). *Colonies* on OA at 25 °C attaining 15–18 mm diam in 14 d, flat, pale yellow to greyish yellow (M. 4A3 to 4B3), without production of ascomata, soluble pigment pale orange; reverse pale yellow to greyish yellow (M. 4A3 to 4B3). *Colonies* growing on PDA and OA at 15 °C, similar to those growing at 25 °C, but with a diameter of 8 mm. No growth at 5 °C and 35 °C.

Typus: **Argentina**, Salta province, Tafi del Valle, from a soil sample, 22 May 2000, coll. and isol. A.M. Stchigel, IMI 392313 **holotypus**; cultures ex-type CBS 113677 = FMR 7545.



Figs 14–16. *Chaetomidium triangulare* (CBS 113677). 14. Ascoma. 15. Ascus with mature ascospores. 16. Ascospores. Scale bars: 14 = 50 µm, 15, 16 = 10 µm.

Notes: *Chaetomidium triangulare* differs from the other species of the genus by the absence of ascomatal hairs and by its triangular ascospores. Similar ascospores are present in other members of *Chae-*

tomiaceae such as *Chaetomium microascoides* Guarro and *Chaetomium trigonosporum* (Marchal) Chivers (von Arx *et al.* 1986). The former has ascospores of similar size as those of *Chaetomidium triangulare*, but it has ostiolate and beaked ascomata, with sparse, short, straight or reflexed, smooth-walled or punctulate hairs. *Chaetomium trigonosporum* differs in having narrower ascospores ($9\text{--}12 \times 5\text{--}7 \times 4\text{--}5 \mu\text{m}$), an ascomatal wall composed of cells arranged in a petaloid pattern (cephalothecoid) with seta-like hairs, and a *Scopulariopsis*-like anamorph. As well as *Chaetomidium triangulare*, *Pidoplitchkoviella terricola* Kirilenko has non-ostiolate, glabrous ascomata,

clavate asci, and triangular ascospores, but the latter differs in having a peridium of *textura epidermoidea* (*textura angularis* in *C. triangulare*) and smaller ascospores ($7\text{--}9 \times 4\text{--}5 \times 2.8\text{--}3.5 \mu\text{m}$) without germ pores. *Microascus* Zukal (*Microascaceae*) also has similar ascospores (i.e. *M. inopitatus* Udagawa & Furuya, *M. trigonosporus* var. *macrosporus* G.F. Orr, and *M. trigonosporus* C.W. Emmons & B.O. Dodge var. *trigonosporus*), but differs by obovate to spherical asci, straw-coloured to reddish brown ascospores, and by the presence of *Scopulariopsis* Bainier or *Wardomyopsis* Udagawa & Furuya anamorphs.

Key to the species of *Chaetomidium*

1. Asci 4-spored *C. heterotrichum* R.J. Mey. (1983)
1. Asci 8-spored 2
2. Ascomatal wall cephalothecoid 3
2. Ascomatal wall not cephalothecoid 7
3. Ascomatal hairs circinate at the apex *C. cephalothecoides* (Malloch & Benny) Arx (1975)
3. Ascomatal hairs not circinate 4
4. Ascomatal hairs straight; ascospores obovate *C. arxii* Benny (1980)
4. Ascomatal hairs flexuous; ascospores ellipsoidal to fusiform 5
5. Ascomatal hairs coarsely warty, and dichotomously branched
..... *C. megasporum* Doveri, Guarro, Cacialli & Caroti (1998)
5. Ascomatal hairs smooth-walled and not branched 6
6. Ascospores measuring $11\text{--}13 \times 6.5\text{--}7 \mu\text{m}$ *C. khodense* Cano, Guarro & El Shafie (1993)
6. Ascospores measuring $14\text{--}19 \times 5\text{--}7 \mu\text{m}$ *C. galaicum*
7. Ascomata glabrous; ascospores triangular in upper view *C. trigonosporum*
7. Ascomata hairy; ascospores ellipsoidal 8
8. Ascomatal hairs circinate at the tips, $> 9 \mu\text{m}$ wide at the base *C. trichorobustum* Seth (1968)
8. Ascomatal hairs not circinate, $< 9 \mu\text{m}$ wide at the base 9
9. Ascomatal hairs stiff, verruculose and pale colored *C. pilosum* (C. Booth & Shipton) Arx (1975)
9. Ascomatal hairs of two types: long and smooth, and short and verruculose 10
10. Ascospores $8\text{--}11 \times 7\text{--}8 \times 6\text{--}7 \mu\text{m}$ *C. subfimetii* Seth (1967)
10. Ascospores $11\text{--}16 \times 10\text{--}12 \times 8\text{--}10 \mu\text{m}$ *C. fimeti* (Fuckel) Zopf (1882)

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