Conidiobolus antarcticus, a new species from continental Antarctica

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Abstract—Conidiobolus antarcticus sp. nov. (Entomophthorales: Ancylistaceae), was isolated from the antarctic mosses Scistidium antarctici and Hennediella heimii. It is the first record of an Entomophthorales species in continental Antarctica. This new fungus is distinguished from other species of the same genus in the size and shape of the primary conidia and zygospores, and in the disjunctive mycelial hyphae.

Keywords—antarctic fungi, taxonomy

Introduction

An unusual zygomycete assigned to the genus Conidiobolus Bref. emend. Humber (1989) has been isolated from the mosses Scistidium antarctici and Hennediella heimii in Antarctica (Tosi et al., 2002). Although this fungus is represented by a single isolate, the new taxon is sufficiently distinctive to warrant a description of a new species of the genus Conidiobolus which is described in this paper.

Materials and Methods

A mixed sample of the mosses Scistidium antarctici and Hennediella heimii was collected aseptically by R. Bargagli at Kohler Head (75°48′S-162°51′E) in Victoria Land, on the west coast of the Ross Sea, during the austral summer, 2 February 1999.

The sample was placed in a sterile polythene bag, stored at -20°C and processed within two months in the Mycology Laboratory at the University of Pavia. The fungus was isolated by aliquots of 0.25 g of moss broken into small pieces and placed onto the surface of agar Petri dishes containing as cultural media potato dextrose agar (PDA; DIFCO, Detroit, Michigan) and malt extract agar (MEA; DIFCO) with streptomycin
concentrations of ethanol solutions and 24°C and examined daily for two weeks. Isolation and morphological studies of the fungus, modes of reproduction, assimilation of carbon and nitrogen compounds were carried out by means of techniques outlined by King (1976 a, b). Temperature-growth relationships were established at -1, 5, 10, 15, 20, 24, 30 and 45°C.

The diameter of primary conidia was measured on water agar. Strain cultures in 60-mm Petri-dish bottom containing PDA was placed in the top of inverted plates, each containing two slide mounts with a thin film of PDA on it in order to study development of the colony. Development of the colony from primary discharged conidia was controlled each hour for the first day and then each 24 hrs for 14 days. Specimens for scanning electron microscopy (SEM) were prepared as follows: the fungus growing on PDA was fixed for 4 h in 2.5% glutaraldehyde solution in 0.1 M cacodylate buffer (pH 7.2), post-fixed for 2 h with 1% OsO₄, in the same buffer, dehydrated in increasing concentrations of ethanol solutions. The material was processed by the critical point drying method in a Emitech K-850 apparatus. The dried specimens were placed on a mounting base, coated with gold, and examined with a Philips XL 20 scanning electron microscope.

**Taxonomic Description**

*Conidiobolus antarcticus* Tosi, Caretta & Humber, sp. nov. (Figs 1-3)

Coloniae in agarum cum saccharo et tubero solani levedinis ad temperatura 20°C crescunt post 5 dies ad 42 mm diam, planae, albae. Mycelium translucens, incospicuum; hyphae septatae, 8-(10)-12 μm latae, cellulis contiguis 3-4pl o ramulosis diverse, actinodendri vel columnae vertebralis similans. Conidiophora brevia, phototropica. Conidia primaria unitunicata, pyriformia globosa, 25-31(27.7±3)x20-25(22.8±2) μm longa, papilla prominent (5 μm), in cellulis conidiogenis apicale singulariter formantia et violenter absilientia. Conidia secondaria conidiorum primariorum conidis simulans sed parviora. Conidia primaria secondaria tubulos germinalia singulariter aliquotiesve formantia. Sporae perdurantes zygosporae vel acygosporae, globosae, 25-40 (30.2±4) μm diam, parietibus laeviscis bistatibus, 2.5-5 μm crassiss. Cystidia et rhizoida absentia.

Species ex muscusing Scistidium antarcticci et Hennediella heimii in Antarctica ad Kohler Head (Victoria Land) sepuncta.

*Etymology:* the specific epithet refers to the locality from which the specimen was collected.

Colonies grown on PDA for 5 days at 20°C have a diameter of ca 42 mm. Mycelium colourless, inconspicuous. Hyphae septate, 8-(10)-12 μm wide. The mycelium constituted by short segments (hyphal bodies) that develops from a single conidium. The hyphal segments contiguous, but disjoined putting forth (3-4) short diverticulate branches with an appearance like Actinodendron or a vertebrate skeleton’s spinal column. Conidiophores short, mostly simply, positively phototropic. Conidiogenous cells undifferentiated in diameter and appearance from vegetative hyphae, with a basal septum, producing a single conidium. Primary conidia unitunicata, pyriform to globose, 25-31(27.7±3)x20-25(22.8±2) μm, with broadly rounded apex and prominent papilla (5 μm), containing numerous globules. Primary conidia forcibly discharged toward light source, germinating on PDA. Secondary conidia formed from primary conidia,
slightly smaller (20%). Primary and secondary conidia producing multiple germ tubes and containing large globules. Resting spores present and numerous. Resting spores sensu Benny, Humber and Morton (2001) represented by zygospores and azygospores. Zygospores smooth, globose 25-40 (30.2 ±4) μm, thick-double walled (2.5-5 μm), containing one or more globules, formed between conjugating cells (gametangia) of different or the same hyphae or hyphal bodies. Azygospores, zygospore-like of the same size, with two thick wall layers (2.5-5 μm), formed without prior gametangial conjugations of the hyphae or hyphal bodies. Cystidia and rhizoids absent. Utilizes (NH₄)₂SO₄, glucose and trehalose. Cardinal temperatures for growth: minimum –1°C, optimum 20°C, maximum 26°C.

Holotype: CMM 1018S, slide ex CMM 1018, isolated from mosses Scistidium antarctici and Hennediella heimii, collected in Antarctica at Kohler Head (Victoria Land), deposited in the Collection of Medical Mycology of the University of Pavia. A living ex-type culture ARSEF 6913 (ex CMM 1018) is deposited in the USDA-ARS Collection of Entomopathogenic Fungal Cultures (Ithaca, NY).

Figure 1 (top). a) Primary conidia, 1000x; b) Production of secondary conidium, 1000x; c) mycelium, 200x; d) production of conidium, the arrow indicates the basal septum, 1000x.

Figure 2 (bottom). a) conidium producing multipolar germ tubes, 1000x; b and c) azygospores, 1000x; d) zygospore formed between the two conjugating gametangia, 1000x.
Figure 3. SEM micrographs of: a) primary conidium, 2400x; b) secondary conidia production, 800x; c) conidia and mycelial fragments, 800x; d) mycelium and conidia of the fungus growing on the moss, 540x.

To some extent, the morphological features of \textit{Conidiobolus antarcticus} resemble those of \textit{C. megalotocus} Drechsler, \textit{C. thromboides} Drechsler, \textit{C. bangalorensis} Sriniv. & Thirum., and \textit{C. lamprauges} Drechsler. \textit{C. antarcticus} differs from \textit{C. megalotocus} mainly in the size and shape of the primary conidia but also in the disjunctive branching pattern of the mycelial hyphae, conidiophores \textit{Actinodendron}-like and microconidia lacking in \textit{C. antarcticus}. The vegetative appearance of the fungus is different from \textit{C. thromboides}. The branching pattern is different, and the shape of the conidia is not like that in \textit{C. thromboides}, in which the papilla is prominent and the overall shape of the conidium pyriform; the papilla of our fungus is smaller and emerges more abruptly from the overall outline of the conidium. The papilla of \textit{C. antarcticus} also shows some greater tendency to be apiculate whereas the conidial papilla in \textit{C. thromboides} is not apiculate. Some similarities with \textit{C. antarcticus} are shown by \textit{C. lamprauges} and \textit{C. bangalorensis}. These two entomophthoraceous fungi have been listed by Srinivasan and Thirumalachar (1967) in the zygosporic species of \textit{Conidiobolus}. The size and shape of the zygospores were the important characters for the differentiation of these species. In \textit{C. antarcticus} the zygospores are formed through union of gametangia and the resting spores (variously called chlamydospores or azygospores) are globose measuring 25 to 30 \(\mu m\). The zygospores of \textit{C. bangalorensis} are globose and 12-18 \(\mu m\) diam, and those of \textit{C. lamprauges} are also usually 12 to 18 \(\mu m\) in diam.

\textit{Conidiobolus antarcticus} is the first species of \textit{Entomophthorales} recorded from continental Antarctica. Bridge and Worland (2004) recently collected an unidentified species of \textit{Neozygites} from mites, \textit{Alaskozetes antarcticus} (Acarina: Oribatidae), on Nelson Island off the northwestern tip of the Antarctic Peninsula. The particular climate and the geographically isolated habitat in which the Antarctic strain of \textit{Conidiobolus} lives make this fungus different from all known similar species. This is supported by the fact that there is a high degree of endemism among \textit{Conidiobolus} in the few parts of...
the world that have been studied at all intensely for the flora of this entomophthoralean genus, particularly by Drechsler (1953) in U.S.A. and Srinivasan & Thirumalachar in India (1961, 1962a, 1962b, 1965, 1968).

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Literature cited


