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FIRST REPORT OF *Entocybe haastii* (ENTOLOMATACEAE, AGARICOMYCETES) FROM BRAZIL

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ABSTRACT

The genus *Entoloma* sensu lato (Entolomataceae) is one of the least studied amongst subtropical Agaricales, despite being very numerous in species. Although molecular analysis has allowed for the characterization of several genera there is little data on the distribution of the Entolomatoid taxa in Pampa, a biome restricted to southern Brazil, Uruguay and Argentina. With collections undertaken in this biome we identified a blue species whose occurrence in Brazil was unknown and which is described in this work: *Entocybe haastii* (G. Stev.) Largent. A key to all 16 blue *Entoloma* species reported from Brazil is proposed.

Keywords: entolomatoid group, mycogeography, fungal taxonomy, Pampa biome.

RESUMO

O gênero *Entoloma* sensu lato (Entolomataceae) é um dos menos estudados entre os Agaricales subtropicais, apesar de muito numeroso em espécies e tendo sido dividido já em vários outros gêneros, pelos trabalhos de biologia molecular. Há poucos dados sobre sua distribuição no Pampa, bioma que é restrito ao sul do Brasil, Uruguai e Argentina. Com coletas feitas neste bioma, encontrou-se uma espécie azul cuja ocorrência ainda não tinha sido registrada para o Brasil e que é aqui descrita: *Entocybe haastii* (G. Stev.) Largent. Uma chave para todas as dezesseis espécies azuis deste gênero encontradas no Brasil é apresentada.

Palavras-chave: fungos entolomatoides, micogeografia, taxonomia de fungos, Bioma Pampa.

INTRODUCTION

Brazil has one of the greatest levels of biodiversity in the world, representing about 20% of the total species on the planet (Calixto, 2003). However, many Brazilian agaricoid species have not yet been described, resulting in only 1,011 species of Agaricales registered in the country, which is much lower than expected (Putzke & Putzke, 2017). Amongst the genera of the order with the highest occurrence in Brazil is the genus

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Entoloma (Fr.) P. Kumm., first reported from Brazil by Johannes Rick in the early 20th century (Rick, 1919). Usually terrestrial, the members of the genus mainly develop in humus and other vegetal debris, and the occurrence of species with a lignicole habit is rare (Noordeloos, 1981).

The genus *Entoloma* (Entolomataceae, Agaricales, Basidiomycota) is represented by about 1,000 species worldwide (Kirk *et al.*, 2008) and is characterized by pink spore print and angular basidiospores. It is currently being divided into several other genera by molecular studies. In Brazil, about 100 species have already been cited (Putzke & Putzke, 2018); however, only a few studies exist on the ecology and distribution of the genus in Brazil, including the work of Putzke & Cavalcanti (1997), Coimbra *et al.* (2013), Karstedt & Capelari (2017), Wartchow & Braga-Neto (2019), and Karstedt *et al.* (2019), amongst others.

Thus, in view of the rich biodiversity in Brazil and the lack of extensive surveys in the Pampa biome, this paper aims to describe the first occurrence of *Entocybe haastii* (G. Stev.) Largent for the country.

METHODS

Basidiomata were collected in a forest remnant of the Pampa biome, located in the municipality of Pantano Grande (30°12'02.1"S and 52°26'43.0"W), a mid-eastern region of Rio Grande do Sul, southern Brazil.

A field expedition was undertaken in May 2019, following the usual methodology for the collection and identification of Agaricales (Singer, 1986; Putzke & Putzke, 2017). Photographic records of the habitat in which the taxon was found were made, as well as detailed notes on the macroscopic characteristics of the basidiomata. Subsequently, the organisms were collected and packed into sealed packages to avoid spore contamination between the samples. In the laboratory, slides were made in order to study the microscopic structures of the samples and for subsequent identification. Colors were identified according to the Online Auction Color Chart (2004). The novel occurrence of this strain was confirmed using the literature on the area (Putzke & Cavalcanti, 1997; Coimbra *et al.*, 2013; Karstedt & Capelari, 2017; Putzke & Putzke, 2017; Wartchow & Braga-Neto, 2019; Karstedt *et al.*, 2019).

After identification, the samples were deposited in the Bruno Edgar Irgang Herbarium of the Federal University of Pampa (HBEI).

RESULTS AND DISCUSSION

Taxonomy

Entocybe haastii (G. Stev.) Largent, Mycotaxon 126: 64. 2014. (Figure 1)

Syn.: *Entoloma haastii* G. Stev.

Pileus 10-27 mm diam., umbonate to applanate, pruinose to slightly furfuraceous, dull blue (AOC366 to AOC386), with an involute margin in the primordial and latter plane. Lamellae emarginated, orange grey to pinkish-orange (AOC675), distant. Stipe 21-45 × 6-2 mm, central, somewhat fusoid to cylindrical, bulbous to subradicant at base, striate to slightly scabrose, slightly lilaceous blue (AOC909 to AOC340). Context white, not changing when bruised. Basidiospores 6.7–9.3 × 6.2–9.1 μm, angulose, slightly melleous, isodiametric and inamyloid. Cystidia of all kinds absent. Hymenophore trama regular. Cortical layer of pileus with a palisade layer.

Species found growing solitary in forest soil, with several specimens distributed throughout an area of 10 m².

Material examined: Rio Grande do Sul: Pantano Grande. Remanescente de floresta do Bioma Pampa, F. Bertazzo & J. Putzke, 20/05/2019, 30°12'02.1"S 52°26'43.0"W, (HBEI 0043).

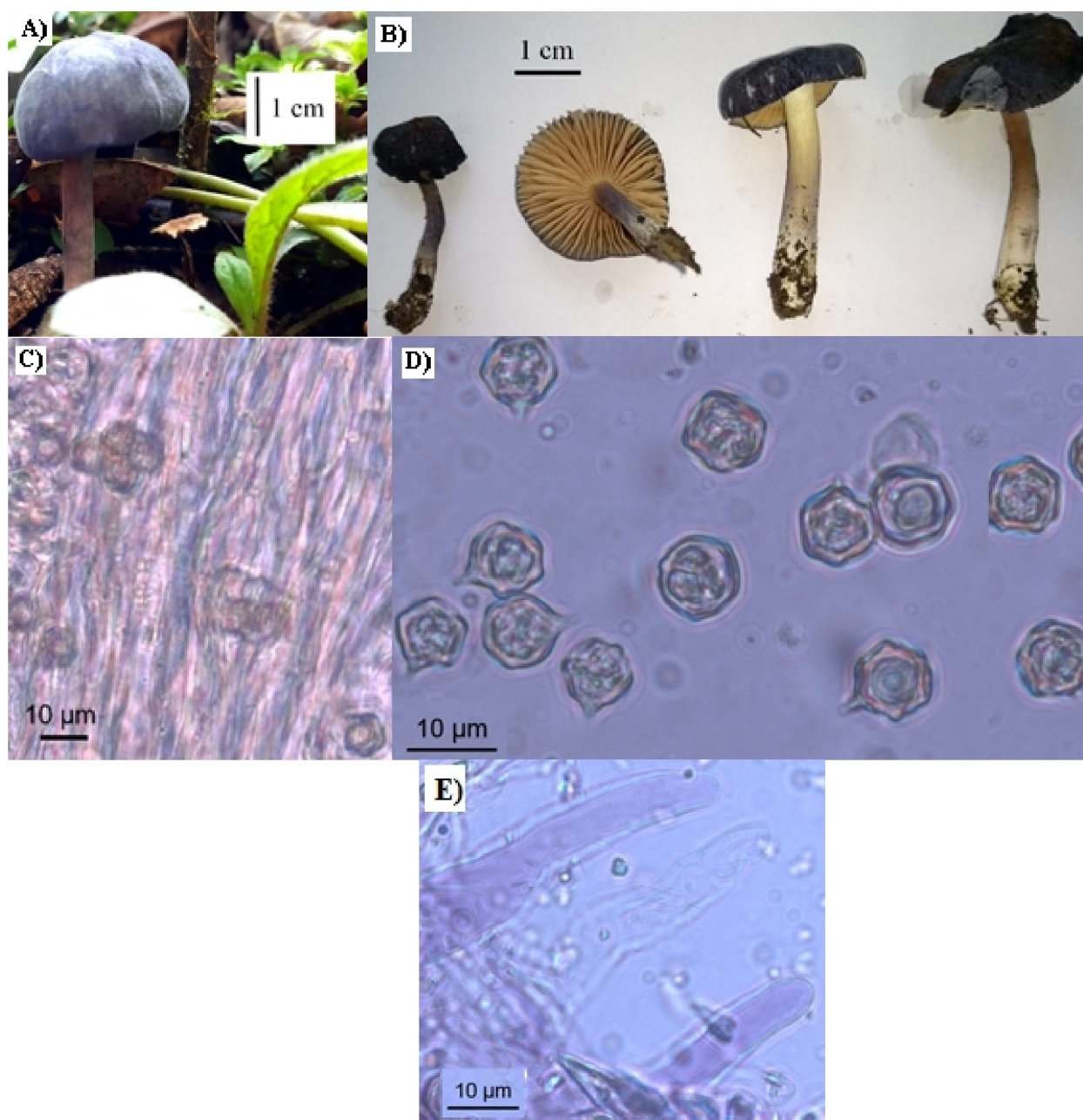


Figure 1: (A) Basidiome in the field; (B) basidiomata *ex situ*; (C) hymenophoral trama; (D) basidiospores; (E) cortical layer of pileus terminal elements.

Entocybe haastii was first described in New Zealand (Stevenson, 1962). Following this description, the species was reported in Chile (Horak, 1978) and in Tierra del Fuego, Argentina (Horak, 1980, as *Rhodophyllus haastii*). With the addition of molecular techniques, Bergemann *et al.* (2014) proposed its insertion into a new genus, reporting the occurrence of *Entocybe haastii* in Australia. The absence of cheilocystidia is a striking characteristic of this blue mushroom species.

When comparing the studied material of the present work with the material described by Stevenson (1962), macroscopic differences were found regarding the shape of the

pileus and the insertion of the lamellae. In the original sample (holotype), the specimen presents a conical-shaped pileus and adnate lamellae, unlike the umbonate to flattened and emarginated lamellae described for the Brazilian specimens (present study).

Among the blue entolomatoid fungi found in Brazil *Entoloma gainsville* is the only pleurotoid species. The other colybioid or tricholomoid mushrooms are differentiated from *E. haastii* by the pileus diameter (*Entoloma bloxamii* (Berk. & Broome) Sacc. reaches 80 mm in diam.) or heterodiametric basidiospores (*Calliderma fibulatum* Karstedt & Capelari, *Entoloma argyropelle* (Pegler) Coutec. & Fiard, *E. sodale* Kuhn. & Romagn. ex Noordel., *E. infirmum* E. Horak, *E. underwoodii* Dennis, *E. vallicutis* (Pegler) J. Putzke & M.T.L. Putzke, *E. serrulatum* (Fr.) Hesler, *Leptonia acystidiata* Karstedt & Capelari, *Leptonia atrocyanea* Karstedt & Capelari and *Trichopilus fasciculatus* Largent & Aime). Among the blue species that have isodiametric basidiospores, *Entoloma callidermus* (Romagn.) Noordeloos & Co-David has a pileus tending to brown with age (unchanging in *E. haastii*) and *Entoloma (=Inocephalus) azureoviride* E. Horak & Singer and *Inocephalus virescens* (Berk. & M.A. Curtis) Karstedt & Capelari have cheilocystidia (completely absent in *E. haastii*) (Putzke & Putzke, 2017).

Key for blue species of *Entoloma s.l.* reported in Brazil:

- 1.1 Pileus with up to 10 mm diam.; stipe excentric to lateral; spores heterodiametric
.....*Entoloma gainsvillae* (= *E. cyaneum*)
- 1.2 Pileus with up to 10 mm diam. or larger; stipe central; spores iso- or heterodiametric..2
 - 2.1 Pileus very large, up to 80 mm diam., large-convex and sometimes with a small umbo; lamellae adnate to emarginated, white to pink; basidiospores 7.5-9 × 6.5-8 µm, isodiametric.*Entoloma bloxamii*
 - 2.2 Pileus smaller than 40 mm diam., versiform; lamellae free to adnate or decurrent; basidiospores as above or larger, hetero- to isodiametric3
- 3.1 Basidiospores heterodiametric4
- 3.2 Basidiospores isodiametric13
 - 4.1 Pileus plane-convex to conic with revolute margin; cheilocystidia pyriform to clavate-cylindrical 5
 - 4.2 Pileus irregularly campanulate to convex, with depressed to umbilicate or slightly umbonate center; cheilocystidia absent or, if present, then cylindrical to clavate, if pileus, plane-convex, then cheilocystidia absent6
- 5.1 Pileus up to 20 mm diam., gray to blue-gray, plane-convex*E. argyropelle*
- 5.2 Pileus up to 35 mm diam., dark blue, conic with revolute margin ...*E. sodale*
- 6.1 Cheilocystidia absent7
- 6.2 Cheilocystidia present9
 - 7.1 Pileus blue-grey, fibrillose-pubescent when young, especially in the center, glabrescent in age, translucent-striate.....*Entoloma infirmum*
 - 7.2 Pileus dark blue and in some stages, at least squamulose.....8
 - 8.1 Pileus squamulose, the scales more evident in the striations; basidiospores 10-13.7 × 6.2-8.7 µm *Leptonia acystidiata*
 - 8.2 Pileus with entire to squamulose-pruinose surface when young and later scamosse and cracked at the center; basidiospores 8.7-10 × 7.5-8.7 µm*Leptonia atrocyanea*

- 9.1 Cortical layers of pileus hymeniform with terminal fusoid, cylindrical to obclavate elements in chains of 2–3 cells; basidiospores 7.5–10 × 6.2–8.7 µm (if larger, then cheilocystidia sinuose-cylindrical and septate); clamp connections present10
- 9.2 Cortical layers of pileus with prostrate elements interspersed with dematocystidia in groups that form a somewhat trichodermial or hymeniform covering; basidiospores 10-12.5 × 7.5-8.7(-10) µm; cheilocystidia not septate; clamp connections present or absent11
- 10.1 Basidiospores 7.5 – 10 × 6.2 – 8.7 µm. *Calliderma fibulatum*
- 10.2 Basidiospores 10-12 × 8-9 µm..... *E. underwoodii*
- 11.1 Pileus up to 7 mm diam.; pileus cortical layers formed by a trichodermial palisade; clamp connections absent
.....*E. valllicutis*
- 11.2 Pileus larger than 20 mm diam.; cortical layers of pileus formed by a trichodermial or an hymenioderm12
- 12.1 Pileus up to 24 mm diam.; clamp connections absent ...
.....*E. serrulatum*
- 12.2 Pileus up to 32 mm diam.; clamp connections present
.....*Trichopilus fasciculatus*
- 13.1 Pileus tends to brown with age; cortical layers of pileus with clavate to lageniform elements, with violaceous-blue vacuolar pigments; basidiospores 6.5–8.5 × 5.7–8.0 µm..... *Entoloma callidermus*
- 13.2 Pileus tends to turn green with age or when bruised or not changing the colors to brown, remaining blue with age; basidiospores 6.7-10 µm in diam.....14
- 14.1 Cheilocystidia absent*E. haastii*
- 14.2 Cheilocystidia present15
- 15.1 Pileus surface tending to green with age; basidiospores 4-angled, 6.2-10 µm diam.; pileitrama pseudoparenchymatous.....
.....*I. azureoviridis*
- 15.2 Pileus surface turns green when bruised; basidiospores 3 – 4 angled, 8.7-12.5 µm diam.; pileitrama not pseudoparenchymatous.....
.....*I. virescens*

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