

## *Geastrum minimum*, a new record of *Geastraceae* from Tunisia

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Received 21 January 2008 / Accepted 4 February 2008

**Abstract.** A gasteromycetous fungus, *Geastrum minimum* is newly recorded for the Tunisian mycobiota. It is described and illustrated based on its morphological characteristics.

**Key words:** fungal diversity, *Gasteromycetes*, *Geastrum*, taxonomy, Tunisia

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### Introduction

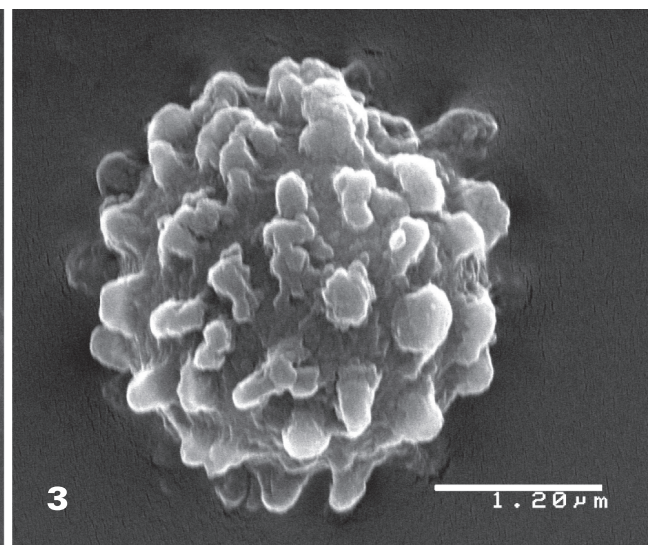
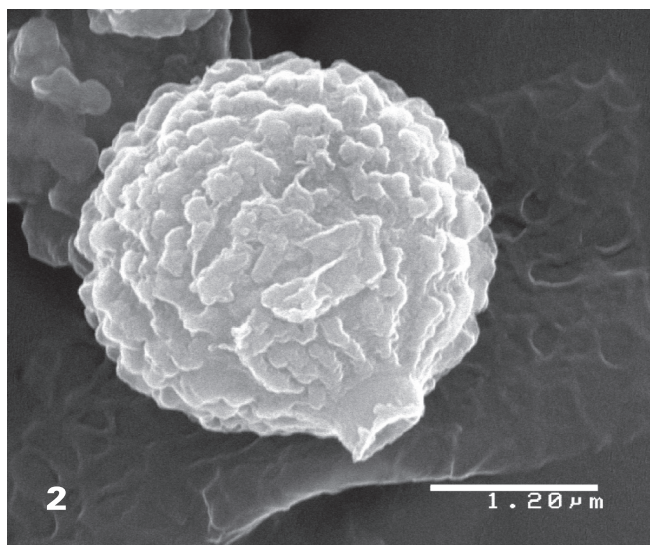
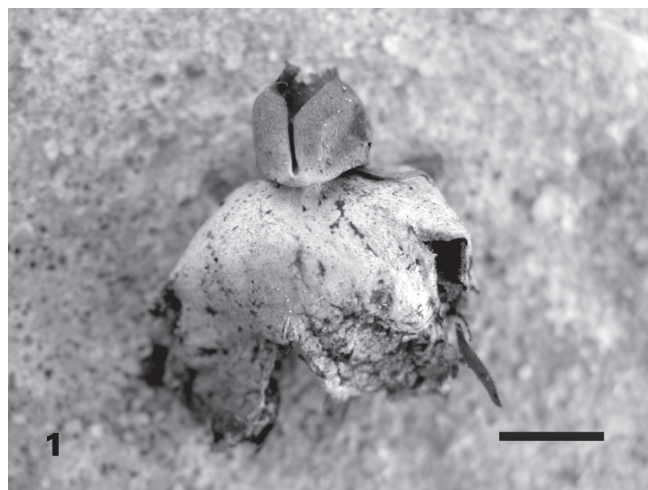
The genus *Geastrum* Pers. is a member of *Geastraceae*, *Geastrales*, which is characterized by exoperidium divided into 2-3 layers, endoperidium with peristome, gleba with distinct or indistinct columella, and with or without a stalk. Immature basidiomata are globose or subglobose to obovate or lageniform, hypogeous, subhypogeous or epigeous. Exoperidium splitting at maturity from the top in a stellate manner and exposing an endoperidial body attached at one point of the fibrous layer of the exoperidium (Sunhede 1989). Some species of this genus prefer xeric habitats with scarce rainfall and with nutritionally poor soils such as the Mediterranean (Calonge 1981; Moyersoen & Demoulin 1996), subarid to arid regions (Baseia *et al.* 2003; Esqueda *et al.* 2003), coastal sand dunes (Andersson 1950; Sunhede 1989). This genus has been systematically revised by several authors (Ponce de Leon 1968; Demoulin 1984; Dörfelt & Müller-Uri 1984; Dörfelt & Heklau 1987; Sunhede 1989) and currently, 50 species are considered in this group (Kirk *et al.* 2001).

The distribution of *Geastrum* has been intensively studied for Central and South Africa (Bottomley 1948; Dissing & Lange 1962a), Europe (Dissing & Lange 1961, 1962b; Calonge 1981; Sunhede 1989), North America (Long & Stouffer 1948), Latin America (Baseia *et al.* 2003; Esqueda *et al.* 2003) and Oceania (Cunningham 1944). However, its family is poorly documented in North Africa. Tunisia is located in the subarid to arid parts of central North Africa, and is ecologically diverse and consequently supports a unique fungal diversity (Kasuya *et al.* 2007). Although Tunisian mycobiota are considered to be diverse (Alsheikh & Trappe 1983; Pacioni 1984; Kasuya *et al.* 2007), *Geastrum* has not yet been comprehensively studied in this country. Hitherto, only one species, *Geastrum asper* Lloyd has been recorded from Tunisia (Patouillard 1909). During our investigations of macromycetes of Tunisia undertaken during March to April of 2007 (Kasuya *et al.* 2007), one species of *Geastrum* has been collected, and identified as *G. minimum* Schwein. It is a new record for the Tunisian mycobiota. In this article, we describe this fungus based on results of morphological observations.

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**Fig. 1.** *Geastrum minimum* – a mature basidioma (TNS-F-17650). Bar = 7 mm. **Figs 2-3.** Basidiospores in SEM (TNS-F-17650): 2 – a basidiospore with a prominent basal apiculus; 3 – a basidiospore with dense verrucae. Bars = 1.2  $\mu$ m



## Material and Methods

The material examined in this study is deposited in the Mycological Herbarium of the National Museum of Nature and Science, Tsukuba, Japan (TNS). Macroscopic characters were described by observations on fresh and dried material. For light microscopic (LM) observations, free-hand sections of gleba and peridium were mounted in water, 3 % (w/v) KOH and 1 % cotton-blue lactophenol on glass slides. Forty randomly selected basidiospores were measured under a light microscope at 1000 $\times$  magnification. The surface features of basidiospores were also observed by scanning electron microscopy (SEM). For SEM, gleba were dusted onto specimen holders attached with double-sided adhesive tape and then coated with platinum-palladium with a Hitachi E-1030 ion sputter coater. They were examined with a Hitachi S-4200 SEM operating at 20 kV.

## Description

*Geastrum minimum* Schwein., Schriften Nat. Ges. Leipzig 1: 58, 1822. — *G. marginatum* Vittad., Monogr. Lycoperd.: 19, 1842 (as *Geaster*). — *G. cesatii* Rabenh., Bot. Zeitung 9: 628, 1851 (as *Geaster*). **Figs 1-3**

Basidiomata hypogeous to subhypogeous, globose to subglobose when young, ca 10-15 mm in diameter, surface encrusted with debris, whitish to pale brown. Expanded basidiomata 20-35 mm across, exoperidium splitting into 4-9 rays which sometimes become arched or curved downwards, non-hygroscopic although sometimes partly curled back when dry. Mycelial layer well-developed, whitish, persistent, with plant debris and soil particles, attached to the fibrous layer for a long time, without forming mycelial cup. Fibrous layer papery, white, cream to pale brown, outer side covered by the mycelial layer. Pseudoparenchymatous layer whitish at first, later becoming brown to dark brown, sometimes forming a collar-like patch around the stalk. Endoperidial body stipitate, depressed globose to subglobose, 5-10 mm in diameter, often with an indistinct apophysis. Stalk short, 1-2 mm long, pale

brown to greyish brown. Endoperidium pale brown to greyish brown, almost smooth when old, but usually pruinose with whitish crystalline material in fresh basidiomata except for a smooth, circular area surrounding the peristome. Peristome fibrillose, distinct, 1-1.5 mm long. Columella cylindrical to clavate, sometimes indistinct. Mature gleba olivaceous brown to brown.

Pseudoparenchymatous layer consisting of 10-40 µm in diameter, thin-walled, hyaline to pale brown, bladder-like hyphae. Columella hyphae 1.5-10 µm in diameter, thick-walled, hyaline to pale yellowish brown. Capillitium yellowish brown, thick-walled, 2-8 µm in diameter, tapered gradually to subacute tips, rarely dichotomously branched, surface smooth or encrusted. Basidia not observed. Basidiospores globose, densely verrucose, thick-walled, olivaceous brown to dark brown, 4.5-5.5 µm in diameter (5 µm in mean diameter) excluding ornaments, 5-6 µm in diameter (5.5 µm in mean diameter) including ornaments, verrucae up to 0.5 µm high, basal apiculus prominently present.

Habitat: solitary or scattered on sandy soil.

Distribution: Africa (Tunisia), Europe (Calonge 1981, 1998; Sunhede 1989; Pegler *et al.* 1995), Asia (Zhou *et al.* 2007), North America (Lloyd 1902; Long & Stouffer 1948) and Latin America (Esqueda *et al.* 2003).

*Specimen examined*: TUNISIA: Gouvernorat de Jendouba: Near Ain Draham, 36°07'03" N, 08°67'58" E, alt. ca 476 m, 27 Mar 2007, coll. T. Kasuya (TNS-F-17650).

## Discussion

The Tunisian specimen of *G. minimum* is well characterized by non-fornicate, non-hygroscopic, white to pale brown fibrous layer of exoperidial rays, whitish mycelial layer persistently attached to the fibrous layer, and delimited, fibrillose peristomes. Morphological characteristics of the specimens examined are in good agreement with the previous descriptions of *G. minimum* (Long & Stouffer 1948; Calonge 1981, 1998; Sunhede 1989; Pegler *et al.* 1995). Therefore, we have identified the Tunisian material as *G. minimum*. This species is newly recorded from Tunisia.

*Gastrum quadrifidum* DC. ex Pers. is morphologically very similar to *G. minimum* in having the same characteristics of basidiomata, especially of endoperidial bodies, peristomes and basidiospores. However, *G. minimum* is clearly distinguished from *G. quadrifidum* by non-fornicate, 4-9 exoperidial rays, and mycelial layer attached to fibrous layer for a long time, without forming mycelial cup. Morphological and ecological characteristics of *G. arenarius* Lloyd are very close to *G. minimum* in their non-fornicate exoperidial rays, whitish mycelial layer persistently attached to the fibrous layer, and well-delimited, fibrillose peristomes (Long & Stouffer 1948; Oteino 1966). Moreover, those two species usually grow on sandy soil. Nevertheless, *G. arenarius* has hygroscopic rays of exoperidium and non-stalked endoperidial body while *G. minimum* has non-hygroscopic rays and distinct stalk.

Basidiospores of *G. arenarius* are smaller (3.8-4.7 µm in diameter; Oteino 1966) than those of *G. minimum*.

*Gastrum leptospermum* Atk. & Coker and *G. welwitschii* Mont. also have similar morphological characters to *G. minimum* in having small basidiomata, whitish fibrous layer of exoperidia and fibrillose peristomes. However, *G. leptospermum* and *G. welwitschii* are well separated from *G. minimum* by their fornicate, mostly 3-6 rays of exoperidia and mycelial layer easily loosening from fibrous layer and forming mycelial cup (Coker & Couch 1928; Sunhede 1989). Further, *G. leptospermum* has more smaller basidiospores (2-3 µm in diameter; Coker & Couch 1928) than those of *G. minimum*.

**Acknowledgements.** We gratefully acknowledge Prof. Toru Nakamura, Prof. Tatsuhiro Fujimura and Prof. Hiroko Isoda (University of Tsukuba, Japan) for their valuable suggestions and supports for this study. We also express our thanks to Mr. Kazuo Obata (Ibaraki Nature Museum, Japan) for his valuable helps for this study. For collecting specimens, we are grateful to Mr. Souichiro Fujii, Ms. Mayu Kurosu and Mr. Kouhei Suzuki (University of Tsukuba, Japan). This study was supported in part by Grant-in-Aid for Scientific Research of Ministry of Education, Culture, Sports, Science and Technology of Japan.

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