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Article

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Ascobolus gomayapriya: A new coprophilous fungus from Andaman Islands, India

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Abstract

Ascobolus is a very large genus among coprophilous fungi colonizing dung. There are very few workers who have explored dung fungi from India. During a recent trip to Andaman Islands, examination of cow dung samples revealed a new coprophilous fungus in the genus *Ascobolus* and the same has been reported in this paper. The present new species *A. gomayapriya* colonizes and grows on cow dung. *A. gomayapriya* is characterized by stalked, light-greenish-yellow apothecial ascomata, long cylindrical, short pedicellate asci with rounded apical caps, positive bluing reaction to Lougal's reagent, ascospores that are hyaline to pale yellow red, smooth, cylindrical, thick-walled with two layers, sparsely dotted verruculose surface, very thin crevices.

Key words – Ascomycetes – Dung fungi – Pezizomycetidae – Pezizales – Taxonomy

Introduction

Coprophilous fungi are an important part of the wildlife ecosystems as they help in recycling nutrients in animal dung in a saprophytic mode (Richardson 2001). Together with protozoa, myxomycetes, bacteria, nematodes and many insects, fungi are responsible for the breakdown of animal faeces, and for recycling the nutrients they contain. These are specialized fungi, able to withstand, and in many cases are dependent on, passage through an animal's gut before growing on the dung (Richardson 2003). Coprophily is a fairly common style of life in mycobiota, shared by most *Ascobolus* and *Saccobolus* species (Doveri 2014). The genus *Ascobolus* had been established by Persoon (1796) for *Ascobolus pezizoides*, a dung inhabiting cup-fungus, as it differed from species of *Peziza* in possessing clearly visible and far protruding coloured tips of ripe asci. After the establishment of *Ascobolus* in 1796 under Ascobolaceae, several species with coloured ascospores also were added to this genus (Van Brummelen 1967).

In a recent collection trip to Andaman Islands, cow dung sample having a cup fungus has been found near the NIOT (National Institute of Ocean Technology) regional campus, Port Blair, Andaman and Nicobar Islands, India. Upon microscopic examination of the sample it has been found to belong to *Ascobolus*. Since the taxon did not fit in any of the existing species it has been described as a new species in *Ascobolus* in this paper.

Material and methods

During the month of August, 2016 we collected cow dung sample near the National institute of oceanography (NIOT), Port Blair, South Andaman, Andaman & Nicobar Islands, India beneath a

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big plantation area with *Cocos nucifera* (cocos), *Areca catechu* (local name = supari) and many other plants. The fungus was collected and transferred into small zip lock plastic bag, air dried overnight, and packed into new plastic bags for shipment to the laboratory for further processing. Before undertaking the microscopic examination, the fruit bodies were separated from the dung samples. Then they were examined under a Stereo Zoom microscope (Optika SZM-LED, Italy). The fruit bodies were cut with a razor and the spore constituents were transferred to a microslide mounted with stains like Lactophenol, Lactophenol Cotton Blue and Lougal's reagent. These slides were then examined under the Nikon ECLIPSE TiU upright microscope with DIC objectives fitted with Nikon DS-Fi2 digital camera, Japan to take photomicrographs. Measurements were taken with Nikon NIS-Elements-Imaging Software version 4.4 program, photoplates were made with Microsoft power point, and Adobe Photoshop version 7.0. Morphological identification was carried out by referring to various monographs and individual publications including (Van Brummelen 1967, Kirk et al. 2008, Pandey 2008, Melo et al. 2014). The herbarium material of the holotype was deposited at Ajrekar Mycological Herbarium (AMH), Agharkar Research Institute (ARI), Pune, India.

Results

Taxonomy

Ascobolus gomayapriya M. Niranjan and V.V. Sarma, sp.nov. Fig. 1

Mycobank number: MB823982

Etymology – In Sanskrit gomaya means cow dung and priya means loving or fond of meaning a fungus loving to thrive on cow dung.

Holotype – AMH-9951

Saprobic on Cow dung. Sexual state: *Ascomata* 280–400 µm, apothecial, single to aggregated, fleshy, stalked, glabrous, funnel shaped, light greenish-yellow coloured. *Hymenium* flat, hyaline become blue in Lougal's reagent, long tubular aseptate paraphyses. Excipulum thin loosely connected hyaline tissue composed of *textura globulosa* cells, excipulum ectale hyaline and became brown when it dried with globulosa-angularis cells. *Paraphyses* hyaline, tubular, aseptate, unbranched. *Asci* 125–155 X 15–19.5 µm ($\bar{X}$=137.05 X 16.6) (n=20), 8-spored, unitunicate, long cylindrical, smooth-walled, rounded apical cap, short pedicel, deliquescent, immature asci become blue in Lougal's solution. *Ascospores* (24.9) 25.1–28.5× (11.7) 12.9– 15.7 (16.4) µm ($\bar{X}$ 26.6–15X 13.7) (n=25), overlapping uniseriate, rarely overlapping biseriate, hyaline when young, pale yellow to red at maturity, smooth, cylindrical, cemented in early stage and free when mature, thick-walled, with two layers, inner layer smooth, hyaline with circular depressions and the outer layer pale golden yellow with sparsely dotted verruculose on surface, with very thin crevices that turn into fissures and cease out from the ascospores. Asexual state: Not determined.

Known distribution – India

Material examined – INDIA, Andaman and Nicobar Islands, South Andaman, Port Blair, near NIOT campus, beneath *Cocos nucifera* plantation, on wet cow dung (11˚38'34.6"N 92˚42'17.7"E), 9 August 2016, M. Niranjan, Holotype AMH-9951, ARI, Pune, India.

Notes – The family Ascobolaceae comprises 129 species grouped in 6 genera (Kirk et al. 2008). The first world monograph on the genera *Ascobolus* and *Saccobolus* (Ascomycetes, Pezizales) was published by Van Brummelen (1967) who also reported 7 species from India. *A. gomayapriya* is characterized by stalked, light-greenish-yellow apothecial ascomata, long cylindrical, short pedicellate asci with rounded apical cap, ascospores that are hyaline when young, pale yellow to red at maturity, smooth, cylindrical, thick-walled with two layers, sparsely dotted verruculose surface, with very thin crevices. The species reported under the genus *Ascobolus* from India were: *A. immersus* from Patna, *A. furfuraceus* unknown place in India, *A. denudalus* from Uttarakhand, *A. geophilus* from Mussoorie Hills Uttarakhand, *A. gollanii* from Saharanpur-Garden manured soil, Uttar Pradesh, *A. scatigenus* Hyderabad, Punjab and Uttar Pradesh, *A. indicus* from

Delhi (Sanwal 1953). Later, Pandey (2008) listed *A. behniziensis* from Kolhapur, Maharashtra on dung of Ox, *A. crenulatus* from Satara Maharashtra, on bird droppings, *A. foliicola* from Radhanagari, Maharashtra on dung, *A. hawaiiensis* in Kolhapur, Maharashtra, on dung, *A. minutus* in Karad, Maharashtra, *A. sacchariferus*, Kolhapur, Maharashtra, on buffalo dung. Altogether 13 species belonging to *Ascobolus* have been reported from India (Van Brummelen 1967, Kar & Pal 1968, Khare 1976, Ghandge & Patil 1988, Pandey 2008) (Table 1). So far no species of *Ascobolus* have been reported from Andaman Islands, India. This is the first report of a fungus belonging to *Ascobolus* from Andaman Islands and it has been found to be a new one. A dichotomous key is provided that delineates the new species from other closely related species of *Ascobolus.*

Table 1 A synopsis of dimensions of ascomata, asci and ascospores of different species of *Ascobolus* species reported from India.

S.no	Species name	Ascomata	Asci	Ascospore	Reference
1.	*Ascobolus behnitziensis* Kirschst.	0.2-0.6 × 10 mm	160-200 × 17-23 µm	20.5-25.5×11.5-14 µm	(Ghandge & Patil 1988)
2.	*Ascobolus crenulatus* P. Karst.	1-2 mm	132×11.5-13 µm	11.5-13×7-8.5 µm	(Ghandge & Patil 1988)
3.	*Ascobolus denudatus* Fr.	1-2 × 10 mm	170-230×16-23 µm	(16-) 18-22 (-23) × (8.5-) 9.5-11.5 µm	(Thind & Waraitch 1974)
4.	*Ascobolus foliicola* Berk. & Broome.	1-2 × 4-5 mm	165-172×18-22 µm	20×10 µm	(Ghandge & Patil 1988)
5.	*Ascobolus furfuraceus* Pers.	0.4-0.8 × 0.5-5 mm	(120) 180-250 × (20-) 24-30(-32) µm	(16-) 19-28 (-32) × (9-) 10-14 (-16) µm	(Van Brummelen 1967)
6.	*Ascobolus geophilus* Seaver.	5-7×0.5-1.0 mm	132-150×21-23 µm	18-22×10-13 µm	(Ghandge & Patil 1988)
7.	*Ascobolus gollanii* P. Hennings	_____	_____	_____	(Hennings 1901)
8.	*Ascobolus hawaiiensis* Brumm.	0.2-0.25 mm	100-115×25-32 µm	13-8.5 µm	(Ghandge & Patil 1988)
9.	*Ascobolus immersus* Pers.	0.5-1 mm	350-600(700)×50-85(100) µm	30-50(60)×16-33 µm	(Ghandge & Patil 1988)
10.	*Ascobolus indicus* Sanwal.	_____	_____	_____	(Sanwal 1953)
11.	*Ascobolus minutus* Boud.	0.2-0.4 × 0.3-1.2 mm	140-170 × 13-14 µm	12.5-15×7-8 µm	(Ghandge & Patil 1988)
12.	*Ascobolus sacchariferus* Brumm.	1-3×1 mm	149-165×18-20 µm	16-20× 6.5-8 µm	(Ghandge & Patil 1988)
13.	*Ascobolus scatigenus* (Berk. & M.A. Curtis) Brumm.	1.2 cm	150-180×18-24 µm	27-33×6.5-8 µm	(Leelavathy & Flower 1981)

Discussion

Species belonging to *Ascobolus* are mostly recorded on various animal dungs but rare on cow dung (Van Brummelen 1967). In the present study a taxon that has characters of the genus *Ascobolus* has been recorded on cow dung and upon comparing with other species has been found to be new and is named as *Ascobolus gomayapriya.* Ascomata of *A. gomayapriya* are greenish-yellow in appearance which is similar to ascomata of *A. lineolatus, A. immersus, A. mancus, A. elegans, A. furfuraceus, A. michaudii,* and *A. crenulatus.* While *A. furfuraceus* is different from *A. gomayapriya* in having larger ascomata, *A. crenulatus* is different in having sessile ascomata when

compared to *A. gomayapriya*, Ascospores of *A. mancus* have similar dimensions as that of *A. gomayapriya*, while the ascospores of *A. michaudii* were found to be smaller. However, asci with an apical cap is present in *A. mancus* which is lacking in *A. gomayapriya*. Other similar species such as *A. roseopurpurascens, A. furfuraceus A. lineolatus* vary by having striated ascospores and lack dotted verruculose surface. Ascospores of *A. immersus* have striated and dotted verruculose surface but are smaller in size when compared to *A. gomayapriya*. *A. elegans* has similar but larger ascospores when compared to *A. gomyapriya.* While *A. immersus* has been reported on dung from various animals excepting cow, *A. elegans* has been reported only from horse dung. Based on the above morphological differences a new species *A. gomayapriya* has been proposed to be accommodated in the genus *Ascobolus*.

Key to the different species of *Ascobolus* that are closely related to *A. gomayapriya* reported from India

1. Ascomata more than 1.2 mm high ……..…...2
1.′Ascomata less than 1.2 mm high ……..……...……3
2. Ascomata up to 3 mm high ……..……...*A. sacchariferus*
2.′ Ascomata 5-7 mm high ……...….*A. geophilus*
3. Ascomata 1.2 mm high and asci more than 200 µm ……...4
3.′Ascomata less than 1.2mm high and asci less than 200 …….....5
4. Asci 170-230×16-23 µm ……..……..…….…….....*A. denudatus*
4.′ Asci (120) 180-250 × (20-) 24-30(-32) µm ……..…….....…...*A. furfuraceus*
5. Ascomata 1.2 mm high and asci up to 200 µm high ……...*A. behnitziensis*
5.′ Ascomata 1.2 mm high and asci less than 200 µm high ……...……6
6. Ascospores more than 50 µm high ……..…….....*A. immersus*
6.′ Ascospores less than 50 µm high ……...…...7
7. Ascospores 27-33×6.5-8 µm episoprium with one or two warts.……*A. scatigenus*
7.′Ascospore episporium without warts ……...……...8
8. Ascospores more than 30 µm high ….…….....9
8. Ascospores less than 30 µm high ……...…...10
8.′ Ascospores episoprium smooth or granular ……...…….....*A. elegans*
9. Ascospores episoprium granular surface …….....*A. hawaiiensis*
9.′ Ascospores episoprium with striae ……...……..……11
10. Ascospores episoprium with striae and granular surface …….……...12
11. Ascospores episoprium longitudinal anastomosing striae …….……...*A. foliicola*
11.′ Ascospores episoprium with longitudinal and rarely anastomosing striae ……..….*A. minutus*
12. Ascospores with a sheath …….……...13
12.′Ascospores without a sheath ……...……...14
13. Ascospores episoprium with longitudinal, rarely anastomosing striae and unilateral sheath ……..…….....A. *crenulatus*
13.′Ascospores episoprium with longitudinal, anastomosing striae and unilateral sheath ……*A. sacchariferus*
14. Ascospores episoprium with multiple short striae and granular ……*A. geophilus*
14.′ Ascospores episoprium with one or two long striae and granular ……*A. gomayapriya*

Fig. 1 – *Ascobolus gomayapriya* (AMH-9951, holotype). a Ascomata on cow dung. b Asci bluing in Lougal's reagent. c Excipulum. d Paraphyses. e–h Asci. i–p Ascospores. Scale bars – b=50 µm, d, e, h = 20 µm, c, f–g, i–p =10 µm.

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