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SIGHTING OF *PULVEROBOLETUS FRIANS* (BASIDIOMYCETES: BOLETALES) AT BUKIT TIMAH NATURE RESERVE

F. Y. Tham[1] and **R. Watling**[2]
[1]*Natural Sciences and Science Education, National Institute of Education*
Nanyang Technological University, 1, Nanyang Walk, Singapore 637616, Republic of Singapore
[2]*Caledonian Mycological Enterprises, 26, Blinkbonny Avenue, Edinburgh EH4 3HI, UK*
(Email: foongyee.tham@nie.edu.sg; caledonianmyc@blueyonder.co.uk)

INTRODUCTION

Prolific fruiting of a basidiomycetous fungus, *Pulveroboletus frians* (Corner) Singer, at the Bukit Timah Nature Reserve in Singapore was observed towards the end of the Southeast monsoon season in Sep.2008. This fungus produces vivid yellow mushroom-shaped basidiocarps or fruit bodies. It belongs to the phylum Basidiomycota, the order Boletales, and the family Boletaceae. Members of the Boletales are often commonly referred to as boletes. Unlike many frequently encountered mushrooms that bear gills below their caps (often called agarics), boletes have vertically arranged tubes ending as pores below the cap surface instead of gills. A number of boletes are edible although a few have been found to be poisonous (Alexoupoulus et al., 1996).

The great majority of the members of the Boletaceae are however, partners in obligate symbiotic relationships with a wide range of plants (Halling et al., 2008). These include plants belonging to families with many representative tropical forest tree species such as the Dipterocarpaceae, Fabaceae (subfamilies Caesalpinioideae and Mimosoideae), Fagaceae, and Myrtaceae (Newman & Reddell, 1987; Lee et al., 1997; Lee et al., 2002). The boletes are thus integral parts of forest ecosystems and are involved in nutrient uptake as well as nutrient cycling and decomposition of organic matter.

The genus *Pulveroboletus* is characterized by basidiocarps (or fruit bodies) that are covered in a powdery, detersile (removable) veil (Watling, 2001). The type species of the genus *Pulveroboletus* is *Pulveroboletus ravenelii* and this genus has a wide distribution that ranges from North America, Africa, China, and Japan through the Peninsular Malaysia, and into Australia (Watling, 2008). *Pulveroboletus ravenelli* has a chrome-yellow cap, and long spores (8.0–11.5 × 4.0–5.5 µm)(Corner, 1972). It can be very common in some seasons in lowland dipterocarp forests such as that in Bukit Timah Nature Reserve. The species *Pulveroboletus frians*, first described as *Boletus frians* in subgenus *Pulveroboletus* by E. J. H. Corner, a well-known tropical mycologist and botanist, has been reported from Singapore and several localities in Malaysia. *Boletus frians* has since been transferred to the genus *Pulveroboletus* (Singer, 1986). It has a tawny-yellow cap with small spores (6.5–8.5 × 5.0–5.7 µm; Corner, 1972). Two other species of *Pulveroboletus* have been found in Malaysia: *Pulveroboletus icterinus* (Patouillard & C.F. Baker) Watling with lemon-yellow caps and *Pulveroboletus viridisquamosus* Watling, E. Turnbull & S.S. Lee with apple-green caps (Watling, 2001).

OBSERVATIONS

Troops of bright sulphur-yellow fruit bodies (basidiocarps) of the fungus were observed on the 8 Sep.2008 appearing on the forest floor along the Catchment Path of the Bukit Timah Nature Reserve (BTNR). As many as 50 basidiocarps were found under trees and saplings in the forest in one area alone. Elsewhere along the Catchment Path, prolific flushing of this fungus was observed as several other groups of about 10−20 basidiocarps were recorded in various parts within the forest (Fig. 1). Occasionally, solitary basidiocarps were observed on the sides of the forest path.

The pileus (cap) of the fungus ranged from 20−50 mm across (Fig. 2). These appeared a bright opaque, sulphur-yellow in young specimens but weathered to a tawny-yellow with vinaceous (purplish) brown patches in more matured specimens. The pileus appeared convex when young but in expanded caps were flat, and in some specimens, slightly concave (Figs. 2, 3). The stipe (stem) ranged in length from 30−50 mm and in thickness from 4−5mm. A poorly-defined ring was observed about 5 mm from the stem apex (Fig. 3). Masses of pale-yellow mycelia were observed at the base of the stipes of basidiocarps that emerged in a cluster. Fine pale-yellow mycelial cords or rhizomorphs were also present. The tubes and pores on the lower surface of the pileus were concolorous and were a brownish-yellow initially, becoming a dingy olive-brown to light chocolate-brown as the basidiocarp matured (Fig. 3). Pores were 0.5−0.8 mm across. Both the pileus and stipe were covered with a dry, powdery, yellow, floccose tissue that rubbed off easily onto

Fig. 1. Basidiocarps of *Pulveroboletus frians* emerging from soil among the leaf litter along Catchment Path at the Bukit Timah Nature Reserve in Singapore between 8−10 Sep.2008. (Photograph by: Tham Foong Yee).

Fig. 2. The caps of fully mature basidiocarps appear a tawny-yellow with vinaceous-brown patches and are slightly concave. The cap diameters range from 20−50 mm. (Photograph by: Tham Foong Yee).

Fig. 3. Fruiting bodies are convex when young, expanding to become flat and slightly concave when mature. Dense mycelial masses and thick rhizomorphs (root-like structures) are at the base of the stipes. There are pores below the caps instead of gills. (Photograph by: Tham Foong Yee).

the fingers during collection of the specimen. This yellow "powder" is formed by the remnants of the detersile veil that surrounded the developing basidiocarp.

The spores en masse were olive-brown. Spores observed under the microscope in 10% ammonium hydroxide solution were small, pale-brown, ellipsoid, smooth-walled with 1−2 guttules (Fig. 4). The mean spore dimensions based on 50 basidiospores were 7.4 ± 0.8 µm × 3.5 ± 0.5 µm. Spore lengths ranged from 6.0−9.4 µm, and spore widths ranged from 2.5−4.6 µm. Spores were neither amyloid nor dextrinoid in Melzer's Reagent.

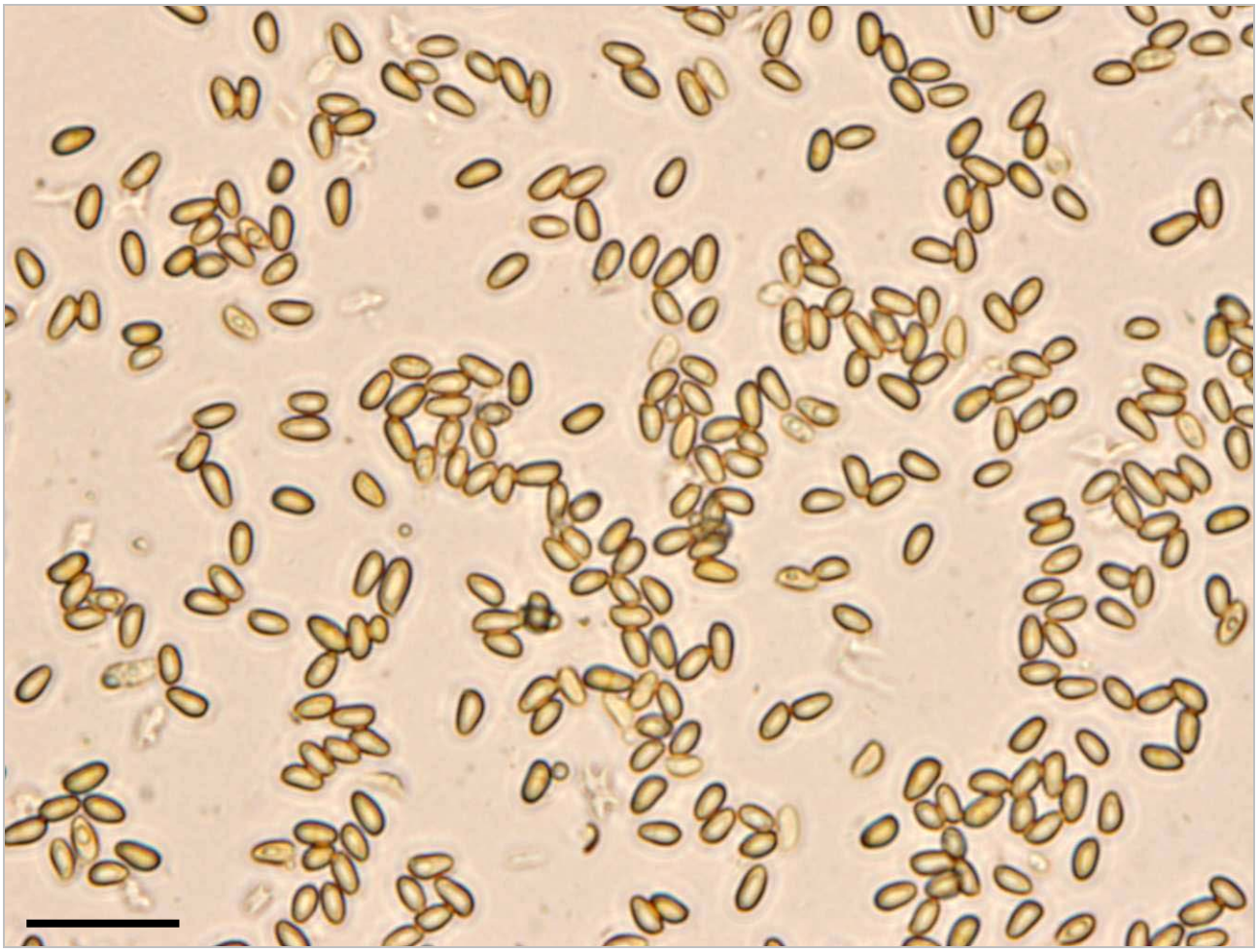

Fig. 4. Pale brown ellipsoid spores mounted in 10% ammonium hydroxide as seen under the microscope. Scale bar = 20 μm. (Photograph by: Tham Foong Yee).

Groups of young fruit bodies were seen emerging from the humus and as described so vividly by Corner (1972), the young basidiocarp primordia resembled small, brilliant sulphur-yellow cigars within the tip of which the cap formed. Fruit bodies with expanded caps which were plane or slightly concaved did not last for more than a day or two; a visit on the 10 Sep.2008 (two days after the flush of fruit bodies) to the same sites showed that the majority of the basidiocarps had decomposed. Larvae or grubs were found in several specimens of this fungus, indicating that it is edible to other animals and may be an important food source.

From the above observations of the various basidiocarps and spores, the fungus was identified as *Pulveroboletus frians* (Corner) Singer. This species was first described by Corner (1972) and indeed the type specimen of the species was collected from the BTNR in Singapore on 19 Aug.1939. Corner subsequently collected this fungus again in the BTNR on 27 Aug.1940, and also from several different parts of Malaysia and Brunei. Corner noted that the Singapore collections had more slender stipes of 3−6 mm thickness when compared to fruit bodies collected from Brunei. The fruit bodies examined in the present study were also observed to agree partially with descriptions of *Pulveroboletus ravenelii* although the spore size was smaller and were similar to those of *Pulveroboletus frians*. Corner (1972) also indicated that he had collected specimens in Johore that agreed macroscopically with *Pulveroboletus ravenelii* but microscopically with *Pulveroboletus frians*. More new data are probably needed to better circumscribe these two species.

Several interesting compounds have been isolated from *Pulveroboletus* including variegatic acid, variegatorubin, and xercomic acid from *Pulveroboletus lignicola*; and vulpinic acid, isoravenelone, ravenelone, pulveravens A and B from *Pulveroboletus ravenelii* (Quang et al., 2003; Duncan et al., 2003). Compounds such as vulpinic acid have been shown to have diverse biological activities, and lichens containing vulpinic acid have a strong history of medicinal use. *Pulveroboletus ravenelii* is reported to be edible with a mild taste and odour and is used in traditional Chinese medicine to cure lumbago, painful legs, numbed limbs, tetanus, and also to stop bleeding (Duncan et al., 2003). Crude extracts of the fungus have also demonstrated antibacterial activity against *Bacillus subtilis*, *Micrococcus luteus*, and both methicillin-resistant and -susceptible *Staphylococcus aureus*. It may be worthwhile to further examine if *Pulveroboletus*

frians, which fruits readily in our Nature Reserve, can be established in culture, and if biologically active and useful compounds may be derived from this fungal species.

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