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RESEARCH ARTICLE

New Record of *Mutinus caninus* (Huds.) Fr. (Phallaceae) in Southern India, Tamil Nadu

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Abstract

The dog stinkhorn mushroom *Mutinus caninus* (Huds.) Fr., belongs to Phallaceae family. It was recorded from Loyola College Campus, Chennai and also from some other places of Chennai city. *Mutinus caninus* was collected during southwest and northeast monsoon seasons from 2013-2015. This is a new record for Southern India. The morphological and microscopic characteristics of *M. caninus* were studied in detail for the confirmation of the species.

Keywords: Dog stinkhorn, *Mutinus caninus*, microscopic characteristics, monsoon, southern India.

Introduction

The family Phallaceae in fungi kingdom is commonly called dog stinkhorns. It consists of 77 species described under 21 genera (Kirk *et al*., 2008). The genus *Phallus* is cosmopolitan in distribution, mostly saprophytes; nearly 76% of fruiting bodies grow in soil and 29% grow in leaf litters. Ten percent of the species are documented as ectomycorrhizal (Grgurinovic and Simpson, 2001). It is wide spread in distribution and commonly found in North America, Europe and Asia. The different kinds of stinkhorn fungi, various puffballs, earthballs, earthstars, stiltballs and some other related species have long been grouped together in an entirely artificial taxonomic class, the Gasteromycetes. Stinkhorns confuse the people often by projecting out from lawns and thrusting their slime covered tips in their environment. Stinkhorns were considered harmful over the years, probably because of their unpleasant smell and their appearance like phalli (human, canine or alien). Unlike other mushrooms, the stinkhorn spreads its spores by applying a fragrant and slimy juice on the tip of spores. This fragrance and slimy juice attracts flies and other insects. Flies are important carriers of the spores of this mushroom (Kuo, 2006). The genus *Mutinus* belongs to the family Phallaceae of the order Phallales and the Subclass Phallomycetidae (Hosaka *et al*., 2006). It is characterized by presenting a globose to ovoid, white to yellowish immature basidiome basally attached by white rhizomorphs; with a mucilaginous layer inside, splitting at the apex into two or three lobes and finally collapsing against the base of the spongy pseudostipe, cylindrical to fusiform, hollow, perforated or not at the tip; gleba mucilaginous, covering the apical portion of the pseudostipe and elliptical and smooth basidiospores (Bottomley, 1948; Dring, 1964; Liu, 1984; Pegler *et al.*, 1995; Calonge 1998). Cunningham (1944) separated the species of the genus into three sections: Glabrosi, characterized by the fertile portion smooth or rugulose; Granulosi, with fertile portion with irregular pseudoparenchymatous processes, appearing pseudo-reticulate and Tuberculosi, with fertile portion covered with digitate processes. *Mutinus* is close to *Phallus*, differing by the presence of gleba on the receptacle on the apical part of the pseudostipe in *Phallus* (Calonge, 1998). According to Index Fungorum and MycoBank, there are 36 species of *Mutinus* described to date. *Mutinus caninus* is the type species of the genus and six synonyms have been considered: *Aedycia*, *Caromyxa*, *Corynites*, *Cynophallus*, *Floccomutinus* and *Jansia* (Kirk *et al*., 2008). In 1778, the British Botanist William Hudson described *Mutinus caninus* scientifically as *Phallus caninus*. Later the genus, *Phallus* was renovated to transfer the dog stinkhorn to the new genus as *Mutinus* by the great Swedish Mycologist Elias Magnus Fries in 1849. At the moment the accepted name of this species is *Mutinus caninus.* The genus name *Mutinus* was a phallic deity, *Mutinus mutunus*, one of the Roman *di indigetes* placated by Roman brides (Arora, 1986) and *caninu*s in Latin means "dog-like" (Simpson, 1979). In India, *Phallus* spp. have been reported from various places of Eastern Himalayas, West Bengal, Odisha, Western Ghats of Maharashtra, Karnataka and Kerala (Bhagwat *et al*., 2005; Bakshi and Mandal, 2006; Abrar *et al*., 2007; Swapna *et al*., 2008; Dash *et al*., 2010; Mohanan, 2011). Synonyms of *Mutinus caninus* include *Phallus caninus* Huds., *Phallus inodorus* Sowerby, *Ithyphallus inodorus* Gray and *Cynophallus caninus* (Huds.) Berk.

Materials and methods

Collection and examination of specimens: The samples were collected during the southwest and northeast monsoon seasons from 2013-2015 from Loyola college campus and from nearby places in Chennai city. The fresh specimens were thoroughly described for their macroscopical and ecological characters. They were photographed in natural habitat.

Fig. 1. Habitat of *Mutinus caninus* in saprobic soil in Mahalingapuram, Chennai (Collection site – I).

Fig. 2. Developmental stages of *Mutinus caninus.*

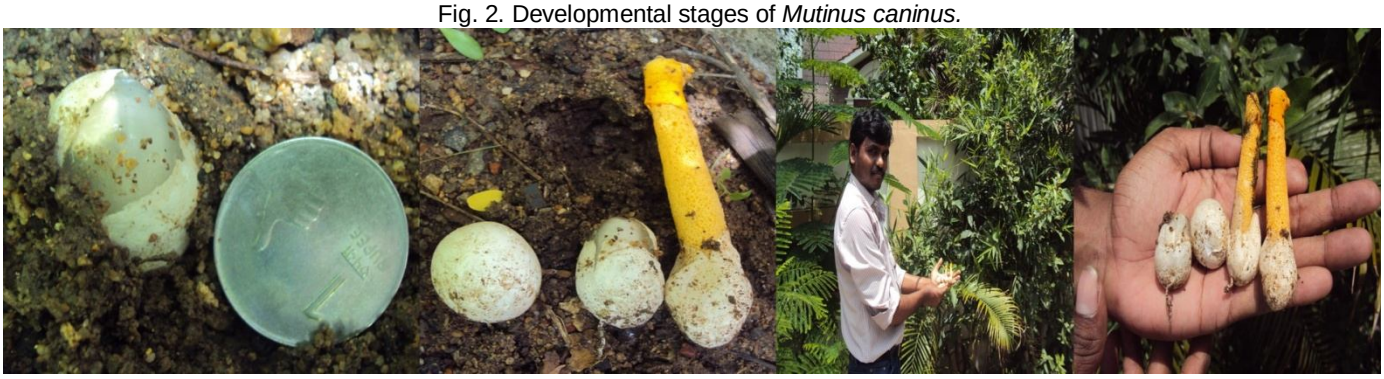


Fig. 3. Habitat of *Mutinus caninus* under Bamboo tree ground soil in Loyola College, Nungambakkam (Collection site – II).

The identification features were compared with standard monographs. The specimens were preserved in 10% formaldehyde and kept in the biodiversity laboratory of Entomology Research Institute, Loyola College (Voucher No. ERIM 38 ERIM 56 and ERIM 112).

Morphological studies

Macroscopic characters: Macroscopic characters including size, shape, colour, surface ornamentation and habitat of fruit body (cap, stipe and volva) were recorded from fresh specimens. Colour terms are fixed using the Methuen Handbook of Colour (Kornerup and Wanscher, 1978).

Microscopic characters: Dried specimens were studied for micromorphological characters using a compound light microscope (Nikon Model Eclipse Ci–s).

Hand sections were made under a dissection microscope (Shanghai Instrument Manufacturer) and mounted in 3% KOH for examination. All microscopic structures were photographed at 200×, 400× and 1000× using a Nikon compound microscope (Nikon Model Eclipse Ci–s).

Results

The morphological and microscopical traits of *Mutinus caninus* are described below.

Habitat and distribution: The species *Mutinus caninus* was recorded under bamboo tree, decomposed wood and leaf debris in soil inside the Loyola college campus and some other places of Chennai city. The immature eggs were abundantly dispersed in the soil gregariously. Mostly the species was abundantly found during the northeast monsoon (September to December) and seems to generate its unique unpleasant smell when crossing across their habitats (Figs. 1-3).

Fig. 4. Developmental stages and insect feeding on the gleba. Matured egg buried in the soil (A); Flies and Ants in fruiting body (B).

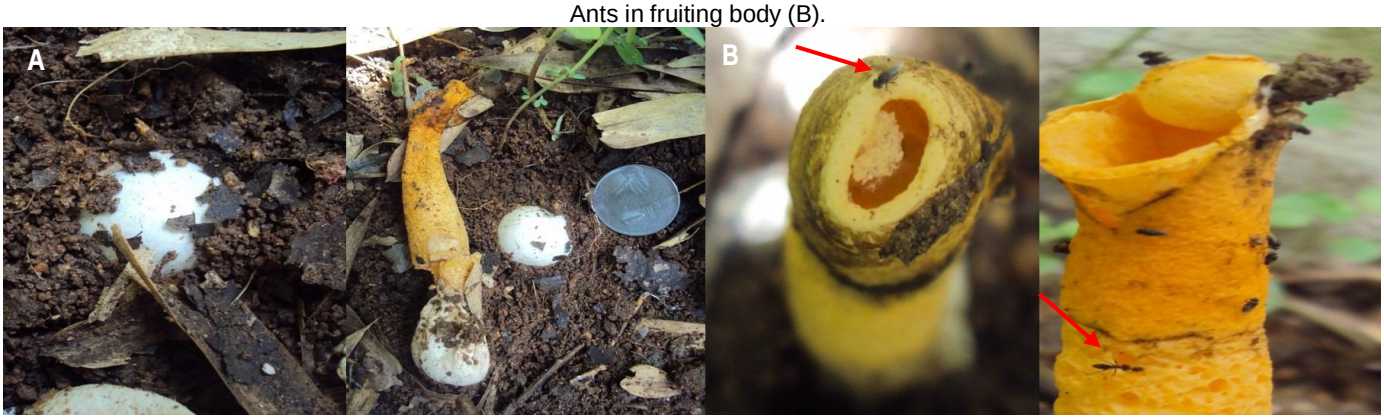
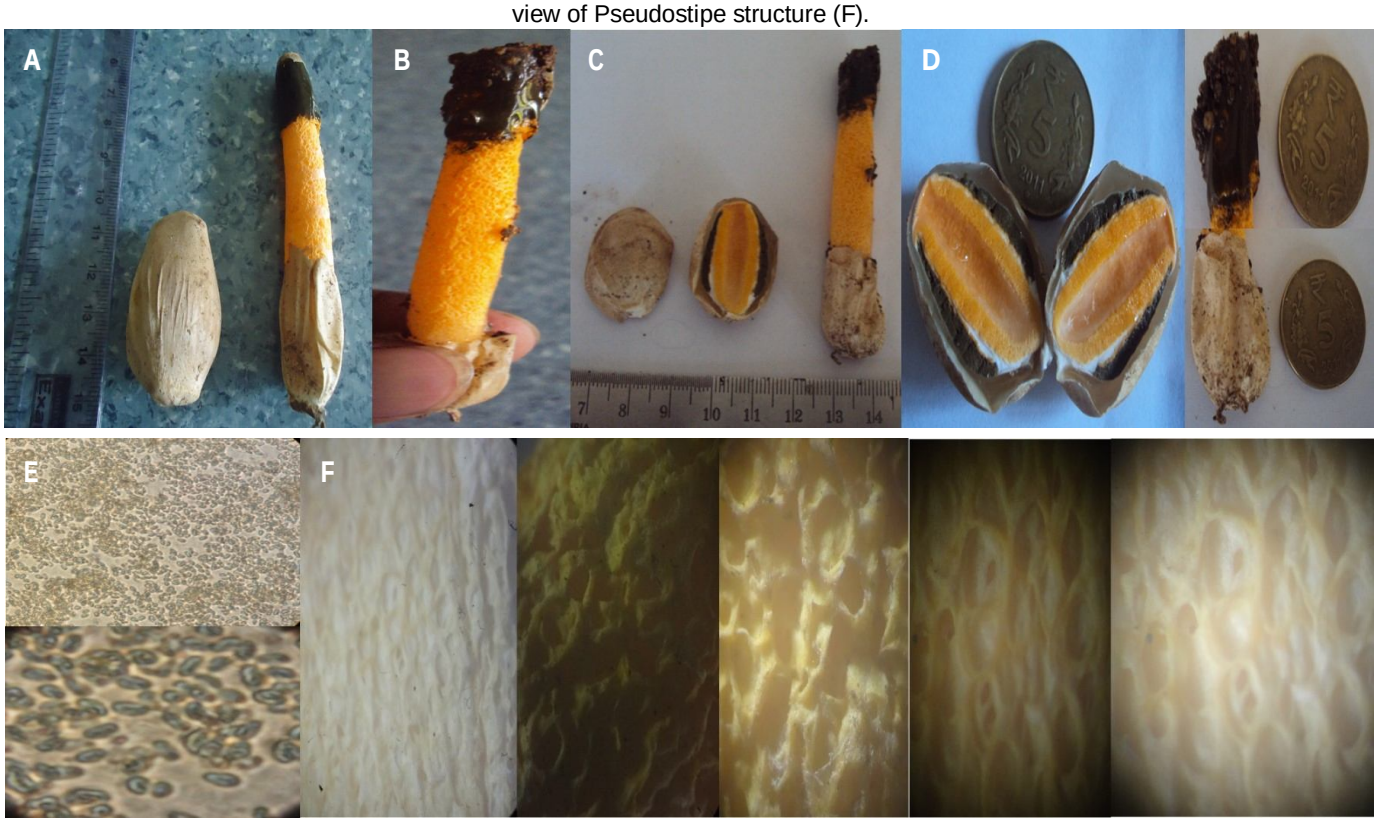


Fig. 5. Morphological and microscopical features of *Mutinus caninus* mushroom: Length of egg and fruiting body (A); width of egg and sporocarp (B); L.S. of matured egg (C); Gleba and Volva (D); Spore (E) and Microscopic view of Pseudostipe structure (F).



Rhizomorphs: Immature eggs were found fully buried in the collection sites. The white mycelial cords of tiny root-like structures were often noticeable beneath the egg, which act as substratum in ground soil. The rhizomorph connects all the eggs in the ground adjoined together.

Egg: The pale whitish young eggs looked spherical and oval shape like a whitish dove egg. The immature egg had a rough and leathery outer skin (peridium), which covered a gelatinous jelly-like flesh inside. The outer covering protected the fully formed, but unexpanded colorful fruiting body (Fig. 4).

The size of the egg was 2-4 cm in height and 1-2 cm in breadth. Longitudinal section of eggs showed three portions: fairly brown gelatinous layer; dark creamy spore cap layer and papaya fruit stipe-like layer. The two halves of cut egg had concave shaped center.

Mature fruiting body: When the egg becomes matured, the inner side of gelatinous jelly portion burst to emerge the honey comb pseudo stipe towards the eggs and remaining portion of ruptured egg coat staying up in slimy spores of cap. Spike-like with a saclike volva at the base, the hollow tubed soft net-like stipe occupies more place in the fruiting body than eggs and cap region.

The stipe size range was 10-12 cm high and 0.5-1.5 cm wide in natural conditions, white to yellowish orange; white below, fenced by the narrow conical yellow-white head covered in dark olive slime which contains the spores and has a very slight sickly smell (Fig. 5).

Spore: The gleba, which is dark olive, contains pale yellow spores. Under microscope, the spores were in dark brown, oblong and slightly elliptical with 3.5-5 x 1.5-2 µm in size.

Edibility: The edibility of this species was ascertained in the collection site. People do not eat this. The dog stinkhorn is probably edible at the egg stage, but it is not confirmed. At least one report from the eastern United States strongly recommends the 'eggs' peeled and fried as a tasty dish (Arora, 1986). Many authors state that stinkhorn's eggs puffballs and gasteromycete's eggs are preferred for eating. Although they are not known to be seriously poisonous, these are definitely not palatable at mature stage. In China, the dried eggs of dog stinkhorn are readily available in marketplaces as edible fungi, but the enormous attraction is due to the belief on their medicinal values.

Odour and taste: Mutinus caninus offers unpleasant odour, but not as strong as that of the common stinkhorn *Phallus impudicus*. None has experienced the taste of this mushroom.

Insect attractants: Stinkhorns entirely depend on insects (mainly dipteran groups) for their reproduction. The rotting meat smell generated from gleba on the tips of the fruit bodies attracts insects. When the insects feed on the sticky spores in their fruiting, some of the spore-laden gleba to the insects' feet and is ultimately transported to dead wood logs and bamboo bushes in other locations. The stinkhorn is very much helpful for the pollination of flowering plants by insects as the mushroom is growing adjoining flower plants and attracting insects by their odour. As flies visit several stinkhorns the spores are dispersed and new fertile mycelium grows on a suitable natural substrate.

Discussion

According to Flegler *et al*. (1980), *Mutinus caninus* young fruit bodies were differentiated into a peridium and an inner core from which the gleba and pseudostem differentiated. A gelatinous layer developed between the peridium and inner core and gradually increased in thickness during fruit body development. Hymenial differentiation began as a cluster of indistinct chambers. Pseudostem formation occurred after hymenial differentiation. Eight basidiospores were produced on each basidium. The significance and occurrence of the rarely reported eight-spored basidium is not understood. Numerous cells, formed in folds in the wall of the pseudostem early in development, increased in size as development proceeded. Their expansion apparently caused the elongation of the pseudostem. Similar documentation and morphological studies were noticed and confirmed in our recorded species. McNeil (2006) suggested *Mutinus caninus* and *M. ravenelii* are synonyms. Smith (1981) observed that *M. caninus* differs from *M. elegans* in that the latter takes longer to "hatch" from its "egg". *Mutinus caninus* and the common stinkhorn, *Phallus impudicus* are very identical and difficult to identify correctly. *Mutinus caninus* is rather less smelly and much less widespread in its distribution; the fruit body is also smaller than *P. impudicus*. Documentation of similar species in West Bengal of North India has been reported and detailed morphological and microscopical confirmation studies are clearly related to our collected specimen (Dutta *et al*., 2012).

Conclusion

We documented *Mutinus caninus* as a new report from Tamil Nadu in South India. At present, *M. caninus* has become endangered and there is a need for the conservation of this species. This endangered species has unknown medicinal values. In future, some studies are necessary to explore the beneficial role of this species to humanity.

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