



## Research article

## *Calvatia craniiformis* (Schwein.) Fr. ex De Toni (Brain puffball) - New report from North-East India

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[Accepted: 11 December 2020]

**Abstract:** The specimen was collected during the rainy season in June, 2018 from Botanical garden Rain Forest Research Institute, Jorhat. Morphological characters of the specimen were recorded in the field and micromorphological characters were studied in the laboratory under the optical microscope. After a thorough examination of the specimen and its spores and capillitial threads, it is confirmed that the specimen is wild edible puffball named *Calvatia craniiformis* belongs to family Agaricaceae. It is also ensured after consultation with available literature that *Calvatia craniiformis* is the first report in North-East India.

**Keywords:** Agaricaceae - Medicinal - Puffball - Traditional medicine - Wild edible mushroom.

[Cite as: Gogoi G & Kumar R (2020) *Calvatia craniiformis* (Schwein.) Fr. ex De Toni (Brain puffball) - New report from North-East India. *Tropical Plant Research* 7(3): 650–653]

### INTRODUCTION

*Calvatia craniiformis* (Schwein.) Fr. ex De Toni is commonly known as brain puffball or skull-shaped puffball which had already been reported from USA (Zeller & Smith 1964, Miller & Miller 2006, Bates *et al.* 2009), Mexico (Esqueda *et al.* 2009), Japan (Bates *et al.* 2009, Hosaka & Uno 2012), India (Abrar *et al.* 2008, Verma *et al.* 2018), Indonesia (Kasuya 2006), Malaysia, Australia (Hawkeswood 2019), South Korea (Jung 1995) and China (Ma *et al.* 2008). The specific epithet *craniiformis* was derived from two Greek words cranium (brain) and forma (a form) because the puffball looks like a brain of human being. The puffball is not only edible but also it has important medicinal value like antifungal property (Jameel & Ali 2017, Ali *et al.* 2017). They are sources of food and traditional medicine (Coetzee & Van 2009). Antibacterial and antifungal activities of nine Korean wild mushrooms were evaluated by Ahmed & Lee (2007), including *Calvatia craniiformis*. Elias Magnus Fries, a Swedish mycologist reported the Genus *Calvatia* in 1849 that includes one species that is *Calvatia craniiformis* which was originally described as *Bovista craniiformis* Schwein (Fries 1849). Many species in the genus, *Calvatia* are fleshy, edible when young, but a few species for example, *Calvatia fumosa* Zeller, has a very pungent odour and can't be eaten.

In India, *Calvatia craniiformis* was first reported from Shanthi Nagar, Simoga, Karnataka by Adrar *et al.* (2008). Verma *et al.* (2018) were compiled a total of 16 species of *Calvatia* from literatures, Jammu and Kashmir represented the maximum diversity of *Calvatia*. *Calvatia craniiformis* was recently reported from Northern Western Ghat of India by Kshirsagar *et al.* (2020). It is apparent from the available literature the species is very important as a source of food and medicinal point of view. To conserve the species the distribution and its population in the wild condition is very important. Gogoi & Parkash (2015) described 22 gasteroid species from Assam, India. The present species *Calvatia craniiformis* is reported for the first time in North East India from Botanical garden of Rain Forest Research Institute, Jorhat, Assam.

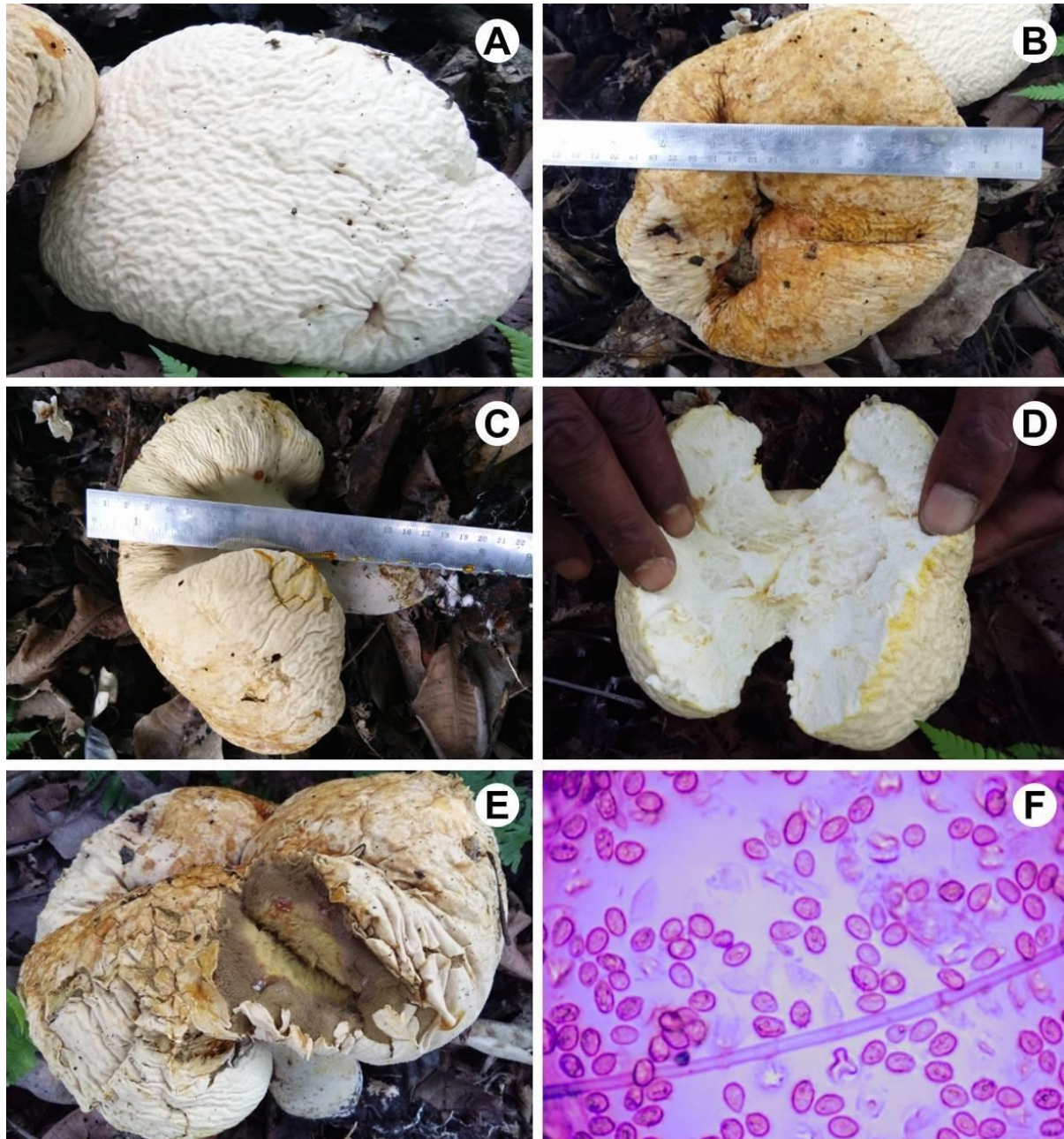
### MATERIALS AND METHODS

The specimen was collected by Girish Gogoi from land covered with dead leaf litter of the Botanical garden, Rain Forest Research Institute (RFRI), Jorhat on 04 May 2018. The specimen was photographed (Fig. 1A–E), measured and recorded the different morphological characteristics in natural habitat. Morphological characters such as colour, odour, texture, substratum and size of the fruit body/basidiocarp/basidiomata are most important characteristics for identification. The internal features of an immature and a mature specimen/basidiocarp of

*Calvatia craniiformis* was observed. A mature specimen was brought to the Mycology Laboratory, RFRI, Jorhat for microscopic study under optical microscope (Fig. 1F). An oven-dried specimen and other in a FAA (Formalin, Alcohol and Acetic Acid) solution were preserved for further study. Under the optical microscope the shape and size of spores and capillitial hyphae were observed, identification was done by the method described by Kornerup & Wanscher (1978).

## RESULTS AND DISCUSSION

The geo-coordinates of the location from where the specimen was collected, latitude N 26° 46.9267' and longitude E 94° 17.388' with elevation 95 m above sea level. The preserved specimen was allotted accession number as RFRI-GG-18-12 following prescribed methods (Holmgren *et al.* 1990). The *Calvatia craniiformis* was found protruding through the leaf litter (Fig. 1A–E) on land of the botanical garden, RFRI, Jorhat.



**Figures 1.** *Calvatia craniiformis* (Schwein.) Fr. ex De Toni: **A–E**, Basidiocarps; **F**, Basidiospores and Capillitial threads.

Basidiocarp 7–18 cm in diameter (Fig. 1B), 7–20 cm in height (Fig. 1C), lobed, white to tan in colour, ball-shaped when young but soon developing a sterile base and becoming shaped like an inverted pear or a skull. At initially stage the skin (peridium) was smooth, developed wrinkles and folds as it matured, cracking and flaking with age. The peridium was smooth at first but the upper surface developed into indentations and grooves and the whole head looked like a human brain. The fruit body was slightly tapering towards base attached by a thick

branching rhizomorph (Fig. 1C) that is encrusted with particles of soil and leaf litter, ostiole was absent, peridia broke apart to expose the gleba (spore mass). The gleba was violaceous. Exoperidium was white to off-white at young stage and was turning dark yellow (4C8) to yellowish brown (5D8–E6) towards maturity. Endoperidium was slightly paler in comparison to the exoperidium that breaks up and sloughs off just like the exoperidium. Gleba white (Fig. 1D) to off-white (Fig. 1E) in colour and solid at young stage which turns into olive-brown (4D8) to light brown (5D7) in colour (Fig. 1E) and spongy. The gleba persists for a long period even after the peridial layers shed and pieces of the peridia often remain attached in random patches. Subgleba was olive-brown (4D8) in colour.

Basidiospores (Fig. 1F) globose to subglobose, 3.2–4.8  $\mu\text{m}$  in diameter, 4.0–4.8  $\mu\text{m}$  in length, smooth to asperulate, brownish yellow in water mounts and pedicel absent. Paracapillitial threads absent. Capillitial threads were found 2.5–4.0  $\mu\text{m}$  in wide. They were found smooth, thick-walled, septate and slightly swollen on both the sides of the septum.

External morphology of *Calvatia craniiformis* is very close to *Calvatia cyathiformis* (Bosc) Morgan, but it can be differentiated from that species because *Calvatia craniiformis* develops a distinct violaceous gleba. In case of both the species, the basidiocarps that persist for a long time. *Calvatia rugosa* (Berk. & M.A. Curtis) D.A. Reid is also resembles *Calvatia cyathiformis* however, the former stains yellow when fresh and latter develops a strong orange coloration. *Handkea utriformis* (Bull.) Kreisel and *Calvatia craniiformis* are similar in external morphology, but the former species develops a crater-like opening, olive-brown gleba and has distinct sinuous slits in the eucapillitial threads which are not found in the latter species. These types of morphological characters were also described by Bates *et al.* (2009), Abrar *et al.* (2008), Hawkeswood (2019) for *Calvatia craniiformis*.

## CONCLUSION

The specimen is confirmed as *Calvatia craniiformis* after detailed examination and thorough consultation of available literatures. There is a scope for artificial cultivation of *Calvatia craniiformis* in commercial scale, because of its fleshy edible fruit body and medicinal importance.

## ACKNOWLEDGEMENTS

The authors are very thankful to the Director, Rain Forest Research Institute for providing required support during the study.

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