RESEARCH ARTICLE

Calvatia Species: Wild Edible Puff Balls from Amravati Region (M.S.)

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ABSTRACT

India has a rich treasure of natural resources and macromycetes is one of them. Studies on wild mushrooms with special reference to their edibility, utility and medicinal value with the early references on larger fungi may be beneficial for humanity. Traditional aborigines knew the medicinal importance of edible and wild mushrooms and these are now being screened for their bioactivity in various ailments. From several bio-geographical regions of India, at least 2000 edible species of larger fungi were reported. But, the Central India region has not been investigated extensively for mushroom flora. Therefore, mycofloristic surveys were undertaken. During mycofloristic study two Calvatia species (puff-balls) viz Calvatia cyathiformis and Calvatia fragilis were investigated from Amravati region. Reviewed literature on Calvatia species predicts that these species are new for Vidarbha (M.S.) and are edible in nature with good therapeutic potential. Edibility was confirmed by the interaction with tribal people of Korku and Pardhi community. Taxonomic identification, edibility, nutritional status and therapeutic potential of Calvatia-complex were noted by referring the standard literature. In developing countries like India, mushrooms like Calvatia are boon for progress in the fields of food, medicine and unemployment.

Keywords: Calvatia cyathiformis, Calvatia fragilis, Amravati, Edibility, Therapeutic potential
INTRODUCTION

_Calvatia_ Fr. (Basidiomycotina, Gasteromycetes) is a cosmopolitan Lycoperdaceae member of about 35-45 species of mostly medium to large-sized epigee puff balls. The name _Calvatia_ derives from the word calvus (Latin) meaning “bald”. The genus is soft and is characterized by stalked sessile, globose subglobose, pyriform-subpyriform sporophore. Fruiting body dehisces by irregular fragmentation of the peridium.

The basis of taxonomic analysis of macromycetes is still morphological, since structure is relatively easy to observe and record. Followed by synthesis consists of examining the data critically in order to classify it in a useful way. The basic taxonomic category is the species, comprising individuals separated from others by discontinuities. Such taxonomic studies will lay the foundation and path for futuristic meaningful investigations. There are 140 records of _Calvatia_ species available on website, out of them 58 are valid names under the genus (http://www.indexfungorum.org).

Traditional mycological knowledge of most of Indian ethnic groups has proven to be extensive and profound, consuming nearly 283 species of wild mushrooms out of 2000 species recorded world over (Purkayastha and Chandra, 1985). The nutritional and medicinal properties of many macrofungi are well known and documented in Europe, China, Japan and several other Asian countries where mushrooms are still used in traditional and modern medicine for treatment of major diseases (Dickinson and Lucas, 1983).

MATERIALS AND METHODS

Fruiting bodies of _Calvatia_ were collected from Amravati (M.S.) during mushroom survey in the month of July-August. Standard techniques for collection, preservation and description were followed (Atri and Saini, 2000). Morphological observations were based on fresh specimens. Drying of specimens and microscopic observations was done by implementing standard techniques (Thind and Thind, 1982; Kaul, 1999). Identification, edibility and medicinal properties were noted by referring the standard literature (Atkinson, 1961; Cunningham, 1979; Purkayastha and Chandra, 1985; Lange, 1993; Rai et al., 2005; Hedawoo and Gawande, 2010; Verma et al., 2018; Gunasekaran et al., 2018). Edibility was confirmed by interacting with tribal people who consume specific mushroom of that region (Hedawoo and Mohite, 2008). The specimens were deposited in the museum, P.G. Department of Botany, Amravati (M.S.).

RESULTS AND DISCUSSION

During mycofloristic survey of Amravati-Melghat region, diversified mushroom forms were collected and studied viz. gill fungi, coral fungi, bracket fungi, jelly fungi, saddle fungi, teeth fungi, sponges, puff balls, earth stars, stink horns and bird's nest fungi (Hedawoo, 2010). Amongst them the morpho-taxonomic characters of two larger puff ball species were studied. The description of identified _Calvatia_ species is as follows.

Taxonomic description of collected species

1. _Calvatia cyathiformis_ (Bosc.) Morgan [Syn._Lycoperdon lilacinum_ (Berk.) Massee]

_Sporophores_ found in small group on sandy, grassy, barren land in the month of July-August. _Fruiting body_ 8.0-9.5 cm. high and 6.5-8.0 cm. in diameter, pyriform to turbinate in shape at maturity, tapering abruptly into a large, well developed, strongly crenulate rooting base. It was white, creamy in developing stage, but turning brown with pinkish tinge at maturit. _Peridium_ exterior smooth or more frequently floccose, cream coloured or bay brown, often areolate, thin, fragile, fugacious, flaking away irregularly from the apical portion. Sterile rooting base well developed, deeply wrinkled, composed of spongy mycelium, persistent, cellular at the periphery, semi-compact within, separated by a prominent diaphragm. _Gleba_ white when young and purplish at maturity, sometimes with a grayish tinge, at first compact, soon pulverulent. _Sub-gleba_ persistent as a cup-like base even after the dispersion of the spores. _Capillitium_ threads long, branched, septate, equal, pallid olivaceous. _Basidiospores_ globose to elliptical, rough, covered with prominent irregular warts, purple brown, 4.5-6.2 µm in diameter. Spore mass dark purple with age. Epithet _cyathiformis_ means shaped like a flask. It is edible when young and the internal flesh is completely white.

_Collected from-_ Goshala of Tapovan region.

2. _Calvatia fragilis_ (Vitt.) Morgan

_Sporophores_ scattered on grassy, sandy soil with composting matter in the month of July-August. _Fruiting body_ 4.0-5.2 cm. high and 5.0-5.5 cm. in diameter, ovate but the basal region abruptly ending into a blunt tip, straw coloured. _Peridium_ two layered, inner layer thick when young and fresh and becomes thin with age, usually deep purple brown, brittle and sometimes withered irregularly from upper region. _Gleba_ soft, purple brown with age. _Sub-gleba_ reduced to almost nil. _Capillitium_ branched, tapering at both ends, short, segmented and brown.
Basidiospores- usually spherical, brownish, smooth, sometimes minutely verrucose, 3.0-4.2 μm in diameter.

Collected from- Base of Tapovan hill.

Family Lycoperdaceae includes the genus Lycoperdon, Calvatia (puff balls) and Geastrum (Earth stars). Calvatia is differ from Lycoperdon by showing the following distinguishing characters. The characters of the Calvatia species are the prominent sterile base, conspicuous diaphragm, purple coloured and large mass of irregularly verrucose spores. It dehisces by irregular rapture of the exoperidium. The peridium and gleba are decidedly fragile and readily disappear with maturity, consequently the sterile base is often the only remaining portion of some species like Calvatia cyathiformis (FIGURE-1). Calvatia cyathiformis sporophores were collected from barren field of Tapovan Goshala area, where the soil quality was light, sandy, organic rich, grassy and intermixed with weedy plant debris. Calvatia fragilis species were occurred at the basal region of Tapovan hill where similar soil ecology was existed with respect to pedology. Collected species are terrestrial saprophytes and as such responsible for the breakdown and recycling of organic matter naturally.

Several research studies have been conducted on taxonomic works on the genus Calvatia ( Khare, 1976; Cunningham, 1979; Lange,1993; Martin, 1997; Coetzee, 2006; Kshirsagar et al., 2020). Recently, Verma et al. (2018) made compilation on Calvatia species reported from different parts of India. He recorded total 16 Calvatia species from 8 different states of India. The states and reported species are as follows- Jammu and Kashmir represents the maximum diversity of Calvatia and 5 species were reported, followed by Himachal Pradesh (3 species), Assam, Madhya Pradesh and Uttarakhnad (2 species each), West Bengal and Meghalaya (Ispecies each). Calvatia cyathiformis found common and are reported from the states of Gujrat, Assam and West Bengal, while Calvatia fragilis was reported from Himachal Pradesh only. References regarding distribution of Calvatia species in Central India showed that these two species were previously recorded by researchers from Chhattisgarh (Ahlawat et al., 2008) and Maharashtra (Nair and Patil, 1977; Chavan and Barge, 1977). But Calvatia cyathiformis and Calvatia fragilis are new reports from Vidarbha (M.S.). Calvatia cyathiformis is one of the most easily recognized and widely reported species from India, which showed identifying character with persistent cup-like sterile sub-gleba even after the dispersion of spores. However, Calvatia fragilis is clearly distinguished by having a distinctly ovate sporophore with reduced to almost nil sub-gleba.

Edibility

All Calvatia species are edible (Morris, 1987), but only in the immature state before the commencement of spores maturation and while the gleba is still firm and white (Gray, 1973; Grigson, 1978). Edibility of Calvatia cyathiformis and Calvatia fragilis is supported by many researchers (Christensen, 1955; Atkinson, 1961; Krieger, 1967; Purkayasta and Chandra, 1985; Coetzee and Wyk, 2009). Edibility of above species was reported by the interaction with tribal people of Korku and Pardhi community and confirmed myself by eating the dish.

Nutritional Status

Alehor (1995) estimated 13.2% - 46% crude protein and had a gross energy value of 3.07 kcal/g. for Calvatia cyathiformis. Vetter (1990) compared the potassium, copper, manganese, zinc and phosphorus contents of Calvatia- complex with a large number of other edible macrofungi and found higher values of these elements in Calvatia- complex than other edible macrofungi.

Therapeutic potential

Calvatia species have found widespread use in the folk medicines. Barkley (1857), who reported that, Calvatia- complex can be used in burnt cases due to their anaesthetic nature, also used to stop bleeding from wounds. In Nigeria, puff balls are used to cure sores, abrasion or buries, deep cuts, haemorrhages and urinary infections (Buswell and Chang, 1993). Calvatia species came into prominence with the discovery of Calvacin an antitumor agent in basidiocarps (Beneke, 1963; Lam et al., 2001). The discovery of the oncostatic properties of Calvatia species directly inspired an investigation into their possible antiviral activity (Cochran, 1978). According to Vitezbro et al. (1975), calvatic acid displays antibacterial, antifungal as well as antitumor effect. Wild mushrooms like Calvatia represent a major and untapped source of potent new pharmaceutical products. Traditional aboriginals knew the medicinal importance of edible and wild mushrooms and these are now been screened for their bioactivity in various ailments (Rai et al., 2005).

CONCLUSION

Mushrooms are important natural source of foods and medicines. In developing countries like India, mushrooms such as Calvatia species are boon for progress in the fields of food, medicine and unemployment. The mechanism of action of various secondary metabolites isolated from medicinal and wild edible Calvatia species like Calvatia cyathiformis and Calvatia fragilis is yet to be elucidated.
Reviewed literature on Calvatia species predicts that these species are new for Vidarbha (M.S.). In future, it may stimulate more research with regard to the food, nutritional value, medicinal properties and biotechnological investigations of this genus.

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Plate I

**FIGURE I:** A. Sporophore of *Calvatia cyathiformis* B. Sporophore of *Calvatia fragilis*  
C. Scattered sporophores on grassy habitat  
D. Dehiscence by irregular fragmentation  
E. Dehisced purplish mass of basidiospores  
F. Persistent cup-like base (sub-gleba)