



## Biodiversity of mushrooms of Amarkantak Biosphere Reserve forest of Central India

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### Abstract

Studies on the taxonomy and diversity of macro fungi are gaining importance as many macro fungi are becoming extinct and facing threat of extinction because of habitat destruction. Present study deals with the diversity of macrofungi in semi evergreen and moist deciduous forest of Amarkantak where more than 50 samples were collected which is situated in Madhya Pradesh in India. Amarkantak is located at 22°40'N 81°45'E/ 22.67°N 81.75°E. It has an average elevation of 1048 meters (3438 ft) More than 85% of annual average rain fall is received during the monsoon month extending from June to September. The mean annual rain fall for Amarkantak is about 1619.9 mm. distributed over ninety two average annual rainy days. The mean daily temperature ranges from 10.9°C (January) to 39.1°C (May) with relative humidity of %. Amarkantak region is known for diverse macro fungal population. Extensive surveys were conducted from July 2010 to September 2010. Where collection, characterization, preservation and photo of macro fungal carried the genera like are *Agaricus*, *Amanita*, *Nyctalis*, *Russula*, *Boletus*, *Macrolapiota*, *Ganoderma*, *Termitomyces* were identified. Out of 50 samples only 16 samples were identified up to species level. This preliminary study shows that the forest is very rich in mushroom diversity.

**Key-Words:** Amarkantak- Biosphere Reserve, Forest, Maccro fungi, Taxonomy, Diversity

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### Introduction

The species diversity of fungi and their natural beauty occupy prime place in the biological world and India has been a cradle for these species. Defining the number of fungi on earth has been a point of discussion and several studies have focused on enumerating the worlds fungal diversity (Crous *et. Al.*, 2006). Only a fraction of total fungal wealth has been subjected to scientific scrutiny and mycologists continue to unravel the unexplored and hidden wealth one third of fungal diversity of the globe exists in India and of this only 50 % are characterized until now (Manoharachary *et. Al.*, 2005).

Mushrooms have been extensively studied in the western countries, while tropical countries like India especially in central India (Amarkantak forest) these were are less explored the variety and diversity of basidiomycetes fungi were fond more in Amarkantak region. However no concerted efforts have been made for a detailed study of them. Till today no research have been done on natural mushroom flora. Further attempt on isolation, characterization and maintenance of cell mycelial culture both invitro & exvitro yet to carried out. Mean while in Amarkantak region several mushrooms have been reported and described on morphological basis by the various workers (Rahi 2001, Upadhyay 2004).

Our main objectives was to benchmark diversity of macro fungi, characterize, collect preserve and evaluate edibility of these different species in semi evergreen and deciduous forest of Amarkantak region of central India.

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## Material & Methods

### Study Area

Our study area is Amarkantak Biosphere reserve area which is situated in Madhya Pradesh in India. Amarkantak is located at 22°40'N 81°45'E / 22.67°N 81.75°E. It has an average elevation of 1048 meters (3438 ft).

The fungal surveys depend on timing and location of observations. The survey methods were adopted according to techniques adopted by Natrajan *et al.*, 2005, Susan Metzler and Van Metzler 1992 and Lodge *et al.* 2004.

### Collection of mushrooms

Systematic and periodical survey of different forest and other habitats rich with organic matters of Amarkantak forest were undertaken during July 2010 to September 2010. Necessary materials and equipments such as isolation kit, slants, petridishes containing medium, isolation chamber, typed data sheet, digital camera for photography, digging equipment, heat convector card board, chemical reagents for biochemical analysis were arranged and collection of samples were usually made during day time and field characteristics of mushrooms were recorded in the data sheet which prepared as per (Nair and Devi, 1995). Simultaneously a spore print was prepared by placing the pileus downwards where a black and white paper (half white and half black) was covered with bell jar (Singer 1975, Grimes 1994) further biochemical spot test and other necessary processing were carried out (Spoerke, 1994).

The standardization of specific media (solid and liquid) and various conditions for cultivation of specific fungi are major steps as done by other workers Rahi 2001, Upadhyay 2004.

### Results and Discussion

The details result of the identified wild mushrooms is presented in Table 1 and morphological characters are in Table 2. During the systematic surveys at different parts of Amarkantak region forest, total 52 mushroom samples were collected these samples belonging to different genera out of which only 14 mushroom samples were identified up to species level. Rests were identified only up to the genus level. The identified mushroom up to species level belongs to 5 orders, 7 families, and 9 genera. These are *Nyctalis* (1 species), *Amanita* (total 5 species but only 3 species could be identified.), *Agaricus* (1 species), *Boletus* (2 species), *Rassula* (3 species), *Ganoderma* (1 species) and *Tricholoma* (2 species). Out of 14 only 10 mushroom species were obtained as a pure culture these include both edible and non edible.

Medicinal mushrooms like species of *Ganoderma Lucidum* and many other Polypores were collected in different seasons. This region of Central India has a rich myco biodiversity that is yet to be fully explored. This study was an attempt to survey and collect valuable wild forms of mushrooms to know the myco treasure in association and on surface of the forest lands.

The study of biodiversity of mushrooms revealed that *A. pantherina* & *A. caessaria* were recorded for the first time from this region. In vitro culture revealed that PDA & Malt extract agar were supported maximum growth of *Rassula*, *Macrolepiota*, *Agaricus*, *Boletus*. Among the collections the family Tricholomataceae was found to be dominant in this forest. After this Russulaceae and Amanitaceae found to be second and third dominant families subsequently. We found that environmental factors like light, temperature, nutrients and relative humidity to greatly influence the growth.

In nature, mushrooms grow wild in almost all types of soils, on decaying organic matter, wooden stumps, etc. They appear in all seasons; however rains favor rapid growth when organic matter or its decomposition products are easily available. About 10,000 species within the overall fungal estimates of 1.5 million belong to this group. Mushrooms alone are represented by about 41,000 species, of which approximately 850 species are recorded from India (Manoharachary *et al.* 2005). More than 2000 species of edible species are reported in the literature from different parts of the world. Singer (1989) had reported 1320 species belonging to 129 genera under Agaricales fungi, acid rain and the changes that occur in ecosystems among fungi, basidiomycetes in particular have attracted considerable attention as a source of new and novel metabolites with antibiotic, antiviral, phytotoxic and cytostatic activity. Among the new targets used in the medicinal values are antitumour and immunomodulatory actions of unusual polysaccharides of these macrofungi (Berochers 1999; Ooi and Liu 2000). Besides extensive surveys of the Himalayan region that are compiled by Lakhnpal (1996), records from Punjab, Kerala and Western Ghats have been published during the last decade (Pradeep *et al.* 1998; Atri *et al.* 2000). What is noteworthy is the component of macro fungi that is mycorrhizal and therefore determines ecosystem dynamics of forests. For example, Lakhnpal (1997) has recorded that in a survey conducted in the North-Western Himalayas during 1976-1987, 300 species of mushrooms and toadstools were recovered.

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**Table 1: List of identified wild mushrooms of Amarkantak region forest**

Order	Family	Genus	Species	Edibility
Boletales	Boletaceae	<i>Boletus</i>	<i>Xyrocomus chrysenteron</i> (1)	Non edible
			<i>Suilleus spragaei</i> (2)	Non edible
Russulales	Russulaceae	<i>Russula</i>	<i>Russula aquosq</i> (3)	Edible
			<i>Russula solaris</i> (2)	Edible
			<i>Russula violacea</i> (2)	Edible
Tricholomatales	Hygrophoraceae	<i>Nyctalis</i>	<i>Nictalis asterophora</i> (1)	Not clearly known
Agaricales	Agaricaceae	<i>Agaricus</i>	<i>Agaricus campestris</i> (4)	Edible
		<i>Macrolapiota</i>	<i>Macrolapiota procera</i> (5)	Edible
	Amanitaceae	<i>Amanita</i>	<i>Amanita veginata</i> (4)	Edible but should never be eaten raw
			<i>Amanita pantherina</i> (1)	Extremely poisonous
			<i>Amanita caesarea</i> (1)	Edible but should not be eaten raw
	Lyophyllaceae	<i>Termytomyces</i>	<i>Termytomyces microcarpus</i> (15)	Edible
<i>Termytomyces hemi</i> (5)			Edible	
Polyporales	Polyporaceae	<i>Ganoderma</i>	<i>Ganoderma lucidum</i> (5)	Edible

**Table 2: Characterization on the morphology of some identified mushroom samples**

Name of the species	macroscopic and microscopic characters
<i>Xerocomus chrysentrion</i>	Cap is not fleshy, convex and varies in color from brown to olive. cap surface dry and velvety in young specimen but cracks open with age. Tubes are yellow turning dull green with age .Stem is slender, tough and solid spores are brown in color.
<i>Macrolapiota procera</i>	It is largest of edible mushroom. The cap which is ovoid at first tops a tall stem, so that whole mushrooms looks like large brown drum stick. The central umbo is always retained; grayish brown scales present on surface of cap. Stem is cylindrical swollen at the base .gills are free widely spaced, white at first then turning gray or darkening brown with age. Double ring present in the stem. Spores are white in color.
<i>Amanita pantherina</i>	Cap is of medium size and is not very fleshy. White gills are slightly swollen crowded and free. The stem is thick in young specimen. Spores are white in color.
<i>Amanita caesarea</i>	Cap is fleshy, large hemi spherical at first but remains convex for a long time .Gills are free and are golden yellow in color. Stem thickness towards the base. Gills are uneven, free and white in color .stem is large and narrows at the top and has no ring .A large white membranous volva sheaths the base. spore color is white in color.
<i>Nyctalis asterophora</i>	Cap is gobose to hemispherical ,white at first but soon the top becoming covering with a thick layer of dust. These are the spores produced by the cap. Gills are rudimentary, reduced to few folds grayish in color stem is curved; only 1-2 cm long. spores are white in color.
<i>Agaricus campestris</i>	Cap is of average size, quite thick and fleshy .The margin remains for a long time. Gills are free, crowded and tight. They are deep pink in color. They subsequently turn purplish brown then black as the gills ripen. Stem is cylindrical 14-10 cm in size. White ring present near the top which is single .Spores are brown in color.
<i>Ganoderma lucidum</i>	Cap when young is simply a pale pro of the small reddish column which constitutes the stem .it then develops in to a kidney shape or consist of a tough crust which is elastic at first then coriaceous .Tubes are white at first but they soon turn brown when mature .Stem is lateral uneven and compressed and covered in same shiny, leathery substance at the cap Spores are brown in color.

Photographs of Mushroom samples



*Agaricus*



*Unidentified*



*Termitomyces*



*Amanita caesarea*



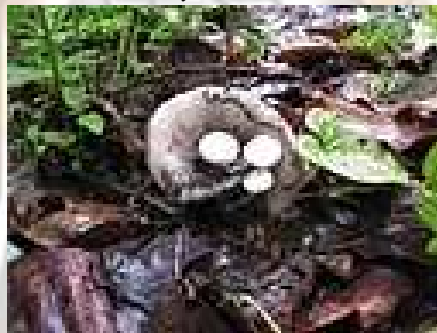
*Termitomyces*



*Suillus spragaei*



*Amanita pantherina*



*Nictalis asterophora*



*Russula*



*Xerocomus chrysen*



*Lepiota*