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Tapping into the edible fungi biodiversity of Central India

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ABSTRACT

Karwa A, Rai MK (2010) Tapping into the edible fungi biodiversity of Central India. Biodiversitas 11: 97-101. Melghat forest in Central India was surveyed for occurrence of wild edible fungi and their prevalent favorable ecological factors. Studies were carried out for three consequent years in the months of June to February (2006-2008). A total of 153 species of mushrooms were recorded, collected, photographed and preserved. The enormous biomass in the forest favors variety of edible and medicinal mushrooms. Dominating species belong to genera *Agaricus, Pleurotus, Termitomyces, Cantharellus, Ganoderma, Auricularia, Schizophyllum, Morchella*, etc. The biotechnological potential of these important mushrooms is needed to be exploited. These studies will open new avenues in improvement of breeding programs of commercially cultivated mushroom species.

Key words: biodiversity, mushrooms, *Agaricus, Pleurotus, Ganoderma*, medicinal.

INTRODUCTION

Fungi are considered the largest biotic community after insects (Sarbhoy et al. 1996). Yet only a small fraction of total fungal wealth has been subjected to scientific scrutiny and the new generation hi tech mycologists have to unravel the unexplored and hidden wealth. Out of 1.5 million fungi around the globe, only 50% are characterized until now and one third of total fungal diversity of the globe exists in India (Butler and Bisby 1960; Bilgrami et al. 1979, 1981, 1991; Manoharachary 2002; Manoharachary et al. 2005). Mushrooms comprise largely the group of fleshy fungi, which include bracket fungi, fairy clubs, toadstools, puffballs, stinkhorns, earthstars, bird's nest fungi and jelly fungi. Generally they live as saprophytes however some are serious agents of wood decay. All types of mushrooms are important in decomposition processes, because of their ability to degrade cellulose and other plant polymers. Besides they serve as natures trash burners and soil replenishers and thus help in rejuvenating the ecosystem. Ample species of wild edible and medicinal mushrooms occur in all the biodiversity rich regions during the rainy season. India being the top ten mega diversity has innumerable mushroom species and their ethno mycological importance. The wood of living or dead trees, or the leaf litter or the soil produces mushroom through the branching mycelial infiltration. Some mushrooms are found growing in association with trees of a particular family or genus.

Though India has rich macro fungal biodiversity, most traditional knowledge about mushrooms come from the far East countries like China, Japan, Korea, Russia where mushrooms like *Ganoderma, Lentinus, Grifola* and others were collected and used since time immemorial. Most of the mushrooms grow abundantly in nature and their commercial harvest is being undertaken for benefit in these countries. Recent reports show a tradition of wild mushroom picking, their consumption and sale in the market in countries like Mexico, Italy, Australia and many others (Arora 2008; Guzman 2008; Sitta and Floriani 2008). However, the ecological data available on some of the taxa is still not enough and systematics of wild mushrooms has received more attention than other threatened aspects like conservation.

Melghat forest is a Tiger Reserve situated in Satpuda mountain ranges in Maharashtra State in India and is located on longitude 76^o 54 'E to 77^o 33 'E and latitude 21^{o}15' N to 21^o 45' N and altitude 350 m to 1178 m above sea level. Being a reserve forest much part of it is undisturbed and hence unrevealed. The biodiversity of the region is unique and is attributable to intermingling forests of medicinal plants like *Tectona grandis, Dendrocalamus strictus, Shorea robusta, Terminalia belerica, T. arjuna*, and *Emblica officinalis*. The diversity of geographical and climatic conditions prevalent in this forest makes the region a natural habitat of a number of edible and medicinal mushrooms.

In this paper major groups of fungi of Central India are discussed briefly to highlight the extent of diversity and this is followed by the examples of habitats that are unique and deserve greater attention.

MATERIALS AND METHODS

Frequent visits to the Melghat forest of Maharashtra, India were made during the late summers, pre-monsoon, monsoon and post-monsoon times from June to February for three consecutive years (2006-2008). Mushrooms were carefully picked and primary identifications based on

morphology were carried out. Fruit bodies of different stages were collected for better understanding and identification. The location, vegetation around and period of the year were noted down for convenience of repeated visits. Since different species of fungi and their fruiting bodies are associated with certain plants soil porosity, soil type and pH as well as nutrient availability also help determine the species of edible fungus growing in a location. So, all the minute details were recorded. After returning to the laboratory, macroscopic and microscopic examinations were performed for assigning systematic nomenclature to the collection. Help of eminent mycologists/taxonomists were taken in identification of a species when in doubt.

Fruit bodies at young stage were used for regeneration of mycelial culture in synthetic medium. Spore prints were taken, dried and preserved. All the basidiomycetes fruit body collection was preserved mostly dried and a few were kept in formalin-glycerol-ethanol. The successful mycelial cultures were maintained.

RESULT AND DISCUSSION

As mushrooms make micronutrients available as food for the trees and other plants with which they co exist, and since those trees and other plants provide nutrients for the fungi, acid rain and the changes that occur in ecosystems, because of the acidity seem to create problems for these fungi. In the top four to eight inches of the forest floor acid rain adversely affects the natural pH of the environment, which in turn adversely affects the fungi's ability to convert nutrients into useful forms.

Radically changing an ecosystem as is done with clear cutting and so many other financially driven environmental policies also adversely affect the survival of fungi and their fruiting bodies. Fungal ecology as concerns the majority of species has more to do with sustainable land use practices than it does with currently fashionable agricultural and forest methodologies. A majority of fungal species including many good edible ones have not been successfully cultivated because it is not feasible to re-create their growing conditions in isolation from their normal environment. Mushrooms act as a sponge holding water for forest. As the forest covers sod and diverse biological associations in which they are living is altered, then their ability to reproduce and survive is jeopardized.

Mushrooms are a nutritionally functional food and a source of physiologically beneficial and non-inventive medicines. 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. Deshmukh (2004) has compiled the folk medicine value of the Indian Basidiomycetes besides recording nearly 60 wild mushrooms, representing 54 species in 36 genera around Mumbai.

Among fungi, basidiomycetes in particular have attracted considerable attention as a source of new and novel metabolites with antibiotic, antiviral, phytotoxic and cytistatic activity. Among the new targets used in the medicinal value 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 Lakhanpal (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, Lakhanpal (1997) has recorded that in a survey conducted in the North-Western Himalayas during 1976-1987, 300 species of mushrooms and toadstools were recovered; of these, nearly 72 species in 15 fungal genera were observed to enter into mycorrhizal relationship with *Abies pindrow* Royle, *Betula utilis* D.Don, *Cedrus deodara* (Roxb.) Loud, *Picea smithiana* (Wall.) Boiss, *Pinus roxburghii* Sarg, *Pinus wallichiana* A.B. Jackson, *Rhododendron arboreum* Smith, *Quercus incana* Roxb. and *Quercus semecarpifolia* Smith. As many as 24 fungal species were found to be associated with *Q. incana* alone. In terms of the relative number of species, Ectomycorrhizal genera declined in the order; *Amanita* > *Boletus* > *Lactarius* > *Hygrophorus* > *Cortinarius*. There was clear-cut host specificity as well, with Amanitas primarily associated with conifers and *Boletus* and *Russula* with oaks; forests exhibiting dominance of Ectomycorrhizal hosts, however, had low tree diversity.

While many mushrooms have a cosmopolitan distribution (Suryanarayanan and Hawksworth 2004), certain species of mushroom producing fungi are associated with particular kinds of trees and plants (Hawksworth 1991; Ananda et al. 2002). Little explored and extreme habitats are the good places to search for edible and medicinal mushrooms. During our surveys, looking for a certain type of mushroom, we commonly seeked out associated trees or forest types of Central India as good hunting locations, e.g. *Cantharellus cibarius* was always found in mossy sloping hardwood forests. The thick-footed morel was typically found in rich hardwood forests especially in flood plains. Field mushrooms *Agaricus campestris* and fairy ring mushrooms or scotch bonnets *Marasmius oreades* were found growing in fertilized meadows and pastures, lawns often abundant and forming fairy rings or arcs from early monsoons to winter. *Agaricus* species could be found throughout the monsoons scattered in grassy areas and lawns. *Boletus edulis* was found during late summer and early rains as sparsely distributed and generally associated with pines. Scattered to gregarious *Lycoperdons* are widely distributed typically under hardwoods and occasionally with pine and found during the late summer throughout the monsoon and extending to winters.

Figure 1. Mushroom collection showing mostly basidiomycetes and a group of Lycoperdons on top right.

Figure 2. Mushroom collection showing species belonging to different families

The diversity spectrum of mushrooms varies greatly as Morels do not generally occur in dry weather and low altitude. A number of morel species are recorded all over the north western Himalayas. *Morchella* occurs at an altitude of 1100-2700 m from sea level. Such area is an excellent location for collecting fresh specimens in early rainy season. Here in Central India the Melghat forest region *Morchella conica* was collected from two sites during late monsoons. The wild edible gasteromycetous mushroom species like *Podaxis pistillaris* and *Phellorina inquinans* thrive well in North western arid part of Rajasthan (Doshi and Sharma 1997). *Podaxis pistillaris* was abundantly spotted during the pre-monsoon climate in Melghat region and is eaten raw by some people. *Calvatia cyathiformis* is widely distributed in meadows, grassy areas lawns and open woods during late summer to early winter. *Cantharellus cibarius* is often found in groups in mixed woods, or in association with *Dendrocalamus strictus*. The duration of occurrence of *Cantharellus* is only for 15 days during mid-August. Four species of Termitomyces are found during the heavy and thundering rains widely distributed and often abundant scattered or in arcs on the ground in deciduous and mixed woods, as well as in fields. These are *Termitomyces heimii, T. microcarpus, T. medius* and *T. species.*

Pleurotus ostreatus or the oyster mushroom is found through rainy season throughout winters during cool wet weather and is widely distributed in dense clusters or in shelving masses on a variety of hardwoods both living and dead. *Hericium erinaceus* the Hedgehog mushroom was located usually solitary arising from trees stumps and logs of broad leaved trees during late winter. *Lactarius* is found during hot weather in late summer scattered to gregarious in deciduous and pine woods in shaded lawns as well as in deciduous or mixed woods. *Volvariella volvacea* was found in early monsoon during hot weather and is solitary to gregarious often growing from wounds on living trees as well as on dead trees and logs of hardwood or on piles of decaying vegetable matter or piles of leaves and compost heaps.

Medicinal mushrooms like species of *Ganoderma, Trametes, Daldinia, Geastrum, Scleroderma, Ramaria, Auricularia, Schizophyllum* and many other Polypores were collected in different seasons. This region of Central India has a rich mycobiodiversity that is yet to be fully explored. This study was an attempt to survey and collect valuable wild forms of mushrooms to know the mycotreasure in association and on surface of the forest lands. A total of 153 mushrooms were located at different places, collected and taxonomically identified, some of them being reported for the first time. These were keyed to 47 genera and 26 families (paper communicated). This paper deals with few important of them indicating the richness of the region. The important mushrooms are shown in Figures 1 and 2.

Toadstools, which are associated with trees, form mycorrhiza, a symbiotic association (Harley 1969) while others are severe parasites, e.g. *Armillaria mellea* that destroys a wide range of woody and herbaceous plants. A few fleshy fungi are notorious in being poisonous, however, a majority is harmless and many are good to eat (Ramsbottom 1953). Mushrooms occur in various shapes, size and color and have attracted the attention of naturalists and are thus prized as drawings, paintings, sculptures, etc. Despite of all the interesting features little space is given to study of extent of mushroom biodiversity and the need for its conservation.

The distribution of edible fungi through out the world is closely related to the distribution of green plants. These fungi in combination with bacteria play an active part in the natural decomposition of organic matter. In addition, soil fungi store carbon dioxide and cause various chemical reactions and water fungi help purify polluted waters (Kumaresan and Satyanarayanan 2001; Maria and Sridhar 2002). Mushrooms grow in diverse environments of soil as well as water. All species of mushrooms reduce ground water and moisture. Different mushrooms grow on organic matter in different stages of decay. Thus a species that can be found in a certain location depends greatly upon the type of decomposing matter available and its current state of decomposition.

CONCLUSIONS

It was strongly felt that amongst the vast number of living forms very little attention has been paid to conservation of fungal biodiversity. Many fungal species are on threat due to loss of natural habitats, soil and air pollution, expansion of mono-cropping and loss of genetic diversity. For the smooth functioning of this terrestrial ecosystem, the conservation of mushroom diversity is critical. Keeping in view this enormous mushroom treasure it is the high time to fully conserve this biodiversity. And hence a timely research regarding isolation, identification and characterization of the existing mushroom flora is essential. Biotechnological tools can be employed in order to achieve the in situ and ex situ conservation of many of the mushroom species. This region of Central India has a rich mycodiversity that is yet to be fully explored. This study was an attempt to survey and collect valuable wild forms of mushrooms to know the mycotreasure in association and on surface of the forest lands.

At the same time there are certain mushroom species that can be cultivated on a variety of substrates. For example due to its ability to degrade lignin, cellulose and hemi cellulose, *Pleurotus sajor-caju* is grown on a variety of agro waste. This biodegradation of lignocelluloses is mediated through the production of extracellular degradative enzymes like laccase, polyphenol oxidase, peroxidase, exoglucanase, endoglucanase, β-glucoxidase, xylanases and laminarinase. Thus, there is need to develop indigenous technologies for utilizing the residues which originate from agricultural, industrial and municipal sources and serious efforts are essential for achievement of biodegradation through mushroom cultivation.

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