

DIVERSITY OF WILD MUSHROOMS FROM JAMMU AND KASHMIR (INDIA)

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ABSTRACT

Jammu and Kashmir state is stretched between 32°17'-37°03' N latitude and 72°03'-80°20' E longitude, and covers a total area of 222,235 km², with an average annual rainfall between 60-80 cm. It is bordered to the north and east by the main Himalayan ranges and Punjab plains to the south. The state exhibits varied climatic and topographic conditions and provide pleasant environment for the lavish growth of diverse group of plants. However, information on the species of wild mushrooms from this state is limited. In this backdrop, a systematic study of wild mushroom diversity from various locations of Jammu and Kashmir was undertaken. During the course of intensive field research over the last four-five years in the forests of some regions of the state, the authors collected a number of wild mushrooms belonging to Ascomycetes, Basidiomycetes and Gasteromycetes. During survey, it has also been noticed that the state has the largest concentration of forest dwellers, comprising of about one-fourth of the population of the state. Several tribes and villagers subsist largely on non-traditional and wild food sources especially wild edible mushrooms. Keeping this in view, the ethnomycological information related to these fungi was gathered from several tribal men and women, village heads, and other local informants as well as ayurvedic hakims in order to gain better understanding of the relationship between the fungi, the local people, and the economy. Collection was mainly concentrated in the dense coniferous and mixed forest of *Cedrus deodara* (Roxb.) G. Don, *Pinus wallichiana* A.B.Jackson, *Picea smithiana* (Wallich.)Boiss. *Abies pindrow* Royle, *Quercus* sp. L., *Juglans regia* L., *Alnus nepalensis* D.Don, *Ulmus wallichiana* Planch. etc. Standard methods of collection, preservation and identification have been followed.

Key words: Wild, Diversity, Mushrooms, Edible, Ethnomycology

INTRODUCTION

Mushrooms are cosmopolitan heterotrophic organisms that are quite specific in their nutritional and ecological requirements. As such, they have been generally divided into humicolous, lignicolous, coprophilous, fungicolous, parasitic or saprophytic or may show some mycorrhizal associations with both broad-leaved forest trees and gymnospermous taxa. They constitute the most relished food commodities amongst the number of non-conventional foodstuffs primarily because of their unique flavor and texture. The Indian state of Jammu and Kashmir, which lies in the north-west Himalaya, is a rich repository of the unexplored macrofungal wealth due to its varied climatic and topographic conditions, thus providing congenial environment for the lavish growth of this heterogenous group of fungi.

Wild edible mushrooms have been collected and consumed by people since thousands of years. Archaeological evidences reveal edible species associated with people living 13000 years ago in Chile [1] but it is in China where the eating of wild fungi was first reliably noted several hundred years before birth the of Christ [2]. Many cultures, especially in the Orient, identified that certain mushrooms could have profound health-promoting benefits [3]. Mushrooms have been exploited commercially world over and may be cultivated or gathered from the wild. The size of the gathered wild edible fungus market globally has been estimated as several million tones with a value of at least US\$2 billion in 2004 [4].

Of the 14,000 mushroom species, nearly 7000 species are well studied to possess varying degree of edibility, and more than 3000 species spread over in 31 genera are regarded as prime edible. Thus far, only 200 of them are experimentally cultured, 100 economically cultivated, approximately 60 commercially grown and about 10 have reached an industrial scale [5]. The rate of consumption of fleshy fungi in many countries has increased in recent years and hence it becomes imperative to explore the treasure of wild mushrooms.

Several mycologists have reported ethnomycological usage of this natural resource wealth from some regions of India [6-12]. However, indigenous knowledge about edible and medicinal mushrooms has not been given significant attention in Jammu and Kashmir State and presently no literature on this vital aspect exists in this State.

MATERIALS AND METHODS

Wild edible mushrooms were collected from various locations in North West Himalaya of Jammu and Kashmir state. Standard methods of collection, preservation, and identification were followed. Ethnomycological information was recorded from reliable sources such as hakims, tribals, and local inhabitants who were considered to have good knowledge of the wild resources of the region. They were taken to the forests as guide cum informants. In order to gain better understanding of the relationship between the fungi, the local people, and the economy, field investigations and interviews were conducted in different local languages viz., Bhadarwahi, Kishtwari, Gadaishi and Kashmiri. The interviews were semi-structured having a set of questions which were put forth to the selected locals to ascertain their views on historical background, traditional usage, edibility status, folk taxonomy, methods of drying and preservation, commercial importance etc. of fleshy fungi. An effort was made to reach the key informants, people who were known to collect and sell this natural resource wealth. Repeated interviews were conducted to substantiate and authenticate the information. At times, additional information regarding fleshy fungi was gathered by showing the specimens itself. The photography was accomplished using digital camera (Sony DSC-P92). Each specimen was collected and labeled, indicating number, date of collection, locality and uses. All collections have been deposited in the herbarium of Botany Department, University of Jammu, Jammu with accession numbers.

RESULTS AND DISCUSSION

As many as 150 collections of wild mushrooms were made and worked out for their macro- and micro-morphological and ethnomycological features. A total of 66 taxa of wild mushrooms belonging to 33 genera spread over 22 families, 10 orders and 3 classes were identified. The identified species and varieties spread over in following genera viz., *Agaricus* (1), *Astraeus* (1), *Amanita* (1), *Auricularia* (1), *Boletus* (4), *Bovista* (2), *Cantharellus* (2), *Chalciporus* (1),

Clavaria (1) *Clavulina* (2), *Coprinus* (1), *Flammulina* (1), *Geopora* (2), *Gyromitra* (2), *Helvella* (3), *Lactarius* (1), *Lentinus* (1), *Leucopaxillus* (1), *Lycoperdon* (4), *Macrolepiota* (1), *Morchella* (5), *Otidea* (1), *Peziza* (2), *Pleurotus* (2), *Ramaria* (6), *Rhizopogon* (4), *Russula* (3), *Schizophyllum* (1), *Scleroderma* (1), *Sepultaria* (1), *Sparassis* (2), *Termitomyces* (4) and *Verpa* (1).

Indigenous knowledge of edible mushrooms and their utilization by local population is an important component of ethnomycology. Data were gathered during the ethnomycological survey related to collection of wild mushrooms. It was found that the collection of wild mushrooms was undertaken early in the morning, as there was intense competition for mushroom gathering, especially for the morels because of their high commercial value. Women and children from 'Gaddi and Shippi' tribes were frequently involved in these activities then men. Children frequently accompany the women, as they were good at locating mushrooms because of their sharp eyes and proximity to the ground and crevices where the occurrence of the mushroom is highest. A special basket called 'Tokri', 'Keed' or 'Chounlee' or a 'Cotton cloth' (Duppatta) was used for collecting mushrooms (Fig. 1 a-e).

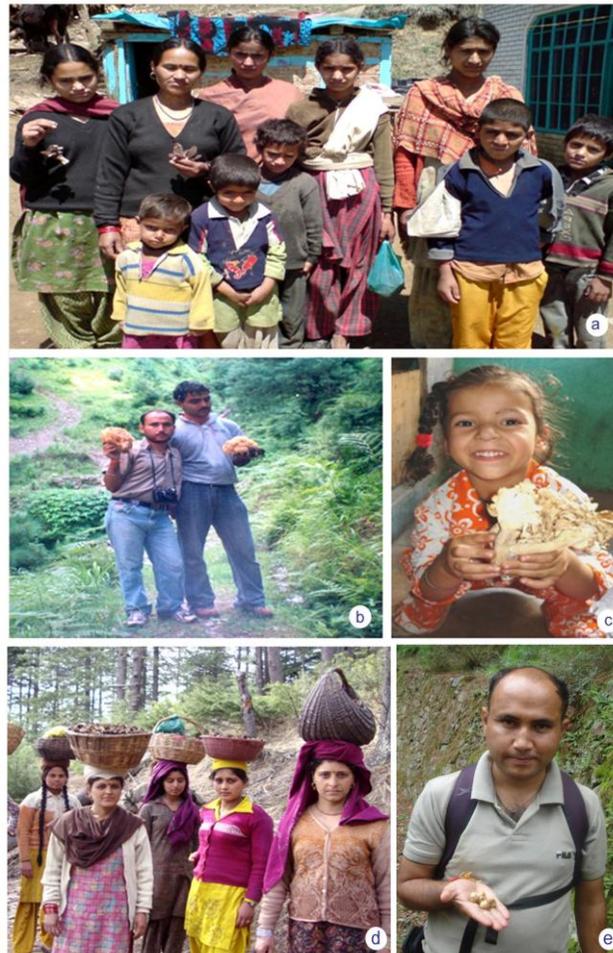


Figure 1 : Wild Edible Mushrooms Harvest : Collectors Delight
a- A Bhadarwahi family of Dugga area displaying morels
b- *Sparassis* spp. in the hands of author and his friend during a collection foray
c- A little girl holds *Pleurotus* sp. in her hands with a pleasant smile

- d- Womenfolk on their way back to homes after rich mushroom gathering from the woods.
- e- *Rhizopogon* sp. in the hands of author

Collection of wild edible mushrooms. Collection forays were more frequent in March and April and July and August months. However, the best period for wild mushroom collection in the study area starts with the onset of rains, the period when the conditions are conducive for the mushroom growth and they are available in plenty. This activity also coincides with the gathering of fallen pine needles used in roof topping of mud houses and firewood to be stored for winter months as the weather conditions during this period are harsh due to snow and fuel shortage.

The study also indicated that several reasons probably enabled rural folks to participate successfully in the harvest of wild edible mushrooms. These were:

- 1) Open and unrestricted access to the forests and grasslands.
- 2) No expenditure was involved for mushroom gathering.
- 3) Economic benefits in which income generated from the sale of collected mushroom resources goes directly to these inhabitants. As a result, majority of the rural people (e.g. Gaddis, Shippis etc.) besides practicing traditional subsistence herding and agriculture also participate in wild mushroom collection.
- 4) As a nutritional supplement, mushrooms could help diversify an otherwise monotonous diet during the rainy season when there was a paucity of other food resources.
- 5) There could be several other social and cultural benefits including the healthy bonding between the families and the market place.

Edibility status. The ethnomycological survey related to edibility status of mushrooms was also undertaken and the results revealed that sixty two potential wild edible fleshy fungi from different locations of study area were recorded. Out of these, as many as 41 mushrooms were preferentially consumed by the native populations of the area while remaining 22 species, although having reported edibility elsewhere, did not find place in the list of edible mushrooms.

While confirming the edibility status of these mushrooms, the consumer's preference (range of palatability) was ominous. Species such as *Agaricus arvensis*, *Boletus luridus*, *Geopora arenicola*, *Gyromitra* spp., *Morchella* spp., *Pleurotus* spp., *Rhizopogon* spp., *Sepultaria sumneriana*, *Sparassis* spp. and *Termitomyces* spp. are considered highly delicious, while *Boletus edulis*, *B. granulatus*, *Helvella* spp., *Ramaria* spp. have good acceptability for consumption. Remaining species namely, *Clavaria vermicularis*, *Clavulina* spp., *Coprinus comatus*, *Macrolepiota procera*, *Ramaria* spp. are not much sought after mushroom species in the region. Edibility of some of these most popular and widely consumed wild macromycetes has been reported throughout the northern hemisphere, South Africa and New Zealand [13, 14]. The usage of these fruiting bodies both commercially and domestically may be in part a result of their appealing taste, their frequent occurrence and the fact that they are easily identifiable by the locals as safe for consumption.

Several mycologists in India have also reported the edibility of these species from various states [15- 21].

Drying and preservation. Fresh wild edible mushrooms have a short period during which they can be eaten or consumed. Owing to their perishable nature, they quickly deteriorate, rot, or shrivel up. On questioning local people about this aspect, it was realized that they consumed

large number of the mushrooms in fresh form and only a few are preserved after sun-drying, smoke drying or salting. Mushroom species such as *Geopora arenicola*, *Sepultaria sumneriana*, *Morchella* spp., *Pleurotus* spp., *Russula* sp. and *Sparassis* spp. are sun-dried in open and then stored in gunny bags, polythene bags or jars. In addition, a unique method for the preservation of *Geopora arenicola* and *Sepultaria sumneriana* is followed. These hypogeous mushrooms are thoroughly washed in water to remove soil debris adhering to the apothecia, sun-dried, salted and then mixed with turmeric powder for enhancing shelf-life in storage and off-season consumption (Fig. 2 a-h and Fig. 3 a-e).



Figure 2: Wild Edible Mushrooms : Traditional Drying and Storage methods.

- a- Drying of morels in open
- b- Fruiting bodies of *Geopora* spp. & *Sepultaria sumneriana* collected in baskets (Tokries)
- c&d- Fruiting bodies of *Rhizopogon* spp. gathered from the forests
- e- *Geopora arenicola* & *Sepultaria sumneriana* in 'Chajjh' for removing soil
- f- Dried form of *Sparassis* spp. and morels
- g- *Geopora arenicola* & *Sepultaria sumneriana* ready for cooking after proper washing

h- Morels packed in jars and polythene bags in a local market

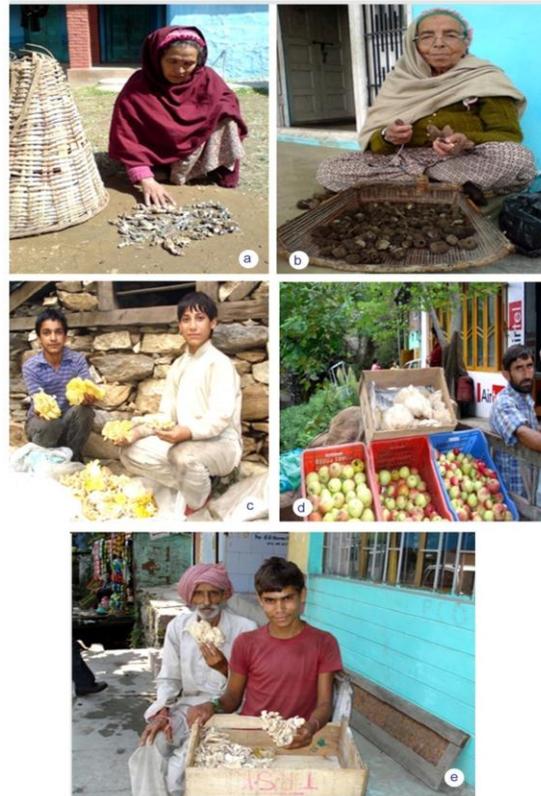


Figure 3: Wild Edible Mushrooms: Drying and Sale

- a- Sun drying of morels on a cow dung coated floor
- b- Elderly women putting morels in a string for drying. Also seen are the fruiting bodies of *Geopora* spp. & *Sepultaria sumneriana* in 'Chajjh' for cleaning
- c-e- *Pleurotus* spp. for sale at local shops in the study area

Culinary potential. Outcome of the survey on the culinary potential of the edible mushrooms revealed that mushrooms in the study area represented a longed for culinary innovation and find a remarkable utility in the culinary traditions of the area. Majority of the people questioned showed deep affection for the taste and preparation of wild mushrooms while only a few respondents showed aversion towards them. It was observed that the larger quantities of mushrooms are being consumed in the area and are regarded by many as wholesome food and in certain cases, an equivalent of meat. The inventory of consumption pattern of wild edible mushrooms extracted from the inhabitants of Bhadarwah, Kishtwar, Poonch, Jammu, Rajouri etc. The mushrooms that are consumed as fresh vegetables include *Agaricus arvensis*, *Boletus* spp., *Coprinus comatus*, *Peziza badia*, *Clavaria vermicularis*, *Clavulina* spp. *Geopora arenicola*, *Gyromitra* spp., *Helvella* spp., *Macrolepiota procera*, *Morchella* spp., *Otidea leporina*, *Pleurotus* spp., *Ramaria* spp., *Sparassis* spp., *Sepultaria sumneriana*, *Russula* sp. and *Termitomyces* spp. These are usually cooked with tomatoes and onions while others are dried (*Morchella* spp., *Geopora arenicola*, *Sepultaria sumneriana*, *Sparassis* spp. *Pleurotus* spp., *Verpa conica* etc.) and consumed in off-season particularly during winter months during which

the availability of vegetables is scarce in the hilly inhabitations and movement of the local people is restricted due to snowfall and harsh weather.

Several mushrooms (*Rhizopogon* spp.) are eaten uncooked after cleaning and washing or after brief roasting on fire (*Boletus luridus*). Likewise, the morels are used in making several traditional recipes prominent amongst which are ‘Chaschni’ (a local dessert), ‘Thunthoo Pulloo’ (rice + morels), ‘Thunthoo Kheer’ (milk + morels), and ‘Thunthoo Yakhni’ (curd + morels). Therefore, the study indicates that wild mushrooms play an important dietary role as they are considered as a substitute of ‘meat’, a key ingredient in vegetables, flavouring agent or even as a condiment. Like spices and sauces, they could transform a routine monotonous diet into a feast.

Descriptive vocabulary and folk taxonomy of wild edible mushrooms. Folk biological systems have been in practice throughout the world and they play an important role in local taxonomy. Research was carried out in various locations using four local dialects (Bhadarwahi, Kishtwari, Gaddaishi and Kashmiri). Young informants, usually under the age of 25 years were able to recognize on an average 33% of the mushroom species while middle aged people (usually below 50 years and above 25 years) were familiar with nearly 50-60% of mushrooms, while the people in older age categories could distinguish maximum of collected wild mushrooms locally. Overall, women recognized more species as compared to men. This slightly greater recognition of mushrooms may be attributed to their greater involvement in collecting, cleaning and cooking of these mushrooms.

In English vernacular ethnomycology, mushrooms have been grouped as agarics, morels, puffballs, earthstars, truffles, coral fungi and many more based on their general morphology. Consequently, an extensive descriptive vocabulary relating to mushroom morphology, growth and habit was recovered during the interviews. It was inferred that the descriptive vocabulary used in the area was found to be remarkably comparable to the macro morphological features used in scientific groupings of mushroom.

As many as 37 vernaculars indigenously used for 71 wild mushrooms are recorded and transcribed. Some of the species are monotypic having only single names while others are polytypic i.e. having more than one vernacular. These vernacular names could be categorized based on gross morphology and life forms into main seven types or folk genera. Most of these categories, inadvertently used though, referred to clearly defined biological groups such as ‘Chaltee’ or ‘Sire’ for agarics; ‘Bhutol’, ‘Bhutoo’ or ‘Dailoo’ for boletes; ‘Shairee’, ‘Gaub’ or ‘Gabor’ for coral fungi. Similarly, puffballs are locally referred to as ‘Dudh Katt’; earthstars as ‘Sapp Nasvar’; morels as ‘Thunthoo’ and cup fungi are locally recognised by the folk genus ‘Kundii’.

Several other miscellaneous vernaculars (folk taxa) based on varied attributes were also recorded during the survey. For instance, *Peziza vesiculosa* is recognized as ‘Kann Kutch’ which means ear like fungus in Kishtwari and Kashmiri. Similarly, *P. badia* is recognized as ‘Chaber Kann’ (meaning ear like fungus growing in marshy area) in Bhadarwahi. *Morchella conica* and *M. elata* is referred to as ‘Paen Loj’ meaning straight stick like morel in Kishtwari and Kashmiri whereas, *Morchella esculenta* and *M. rotunda* is fondly called as ‘Batt Kutch’ (mushroom consumed with rice) in Kishtwari and Kashmiri. *Geopora arenicola* and *Sepultaria sumneriana* is identified as ‘Kundii’ meaning mortar (made of hard stone) shaped in Bhadarwahi and Gaddaishi. *Boletus* spp. are called ‘Dailoo’ (the fungus that breaks easily into pieces) in Bhadarwahi or ‘Bhutol’ and ‘Bhutoo’ (edible after roasting on fire) in Bhadarwahi and Gaddaishi dialects respectively. *Pleurotus* spp. are named as ‘Saroori’ (meaning growing on

different host plants) in Kishtwari; 'Chur Sirer' (i.e growing on *Juglans regia*) in Kishtwari and Kashmiri languages.

However, a minor variation in the use of vernaculars in four different dialects (Bhadarwahi, Gaddaishi, Kishtwari and Kashmiri) was also observed. The vernacular 'Shairee' is commonly used for many species of *Clavaria*, *Clavulina*, and *Ramaria* in Bhadarwahi and Gaddaishi languages. Similarly, *Agaricus arvensis* is referred to as 'Chaitar' in Kishtwari and *Agaricus arvensis* and *Macrolepiota procera* together as 'Chaltee' in Bhadarwahi and Gaddaishi; *Boletus edulis* and *B. granulatus* as 'Bhutoo' in Bhadarwahi and Gaddaishi; 'Dailoo' in Bhadarwahi; *Boletus luridus* as 'Bhutol' and 'Dailoo' in Bhadarwahi and 'Bhutoo' in Bhadarwahi and Gaddaishi dialects. Like wise, *Geopora arenicola* and *Sepultaria* sp. has various names in different dialects such as 'Kundii' in Bhadarwahi and Gaddaishi; 'Kutch' in Kishtwari; 'Gav Padur' or 'Khuduz' in Kashmiri and 'Kann Kutch' in Kishtwari and Kashmiri parlance. Species of *Helvella* are referred to as 'Thunthoo' in Bhadarwahi and Gaddaishi while *Rhizopogon* spp. are identified as 'Dudh Katt' and 'Moraii Dudh Katt' in Bhadarwahi and Gaddaishi and 'Matij' in Kishtwari and Kashmiri. Two species of *Sparassis* viz., *S. crispa* and *S. radicata* were referred to as 'Bedth Shairee' in Bhadarwahi and 'Rao Gaub' and 'Rao Gabur' in Kashmiri and Kishtwari jargon.

It is apparent from these results that extensive descriptive vocabulary and folk nomenclature for wild edible mushrooms is in practice in the area. Though a few researchers from other states of India have conducted similar kinds of studies yet the intensity of vernaculars usage was quite rare. Sagar *et al.* [22] made ethnobotanical survey in tribal district of Kinnaur of Himachal Pradesh and found the recognition of some epigeous gilled agarics on the basis of colour only. In addition, a few agarics like *Russula brevipes* were identified locally as 'Kaithno' or 'Kaithmuh'. Kamat [11] while working on ethnomycology of Goa recorded that local wild edible mushroom were commonly called as 'Olmī'; bolete species which sprout with forest showers as 'Bhuifod' (earth boil) or 'Fuge' (baloon mushroom) and termitophillic species were known as 'Roen Olmi' (termite hill mushroom). Many such significant contributions in the ethnomycological classification of the macrofungi world over have been reported recently [23-26]. Therefore, the study indicates the cultural importance and long traditional use of wild mushrooms in the studied area.

Market sale of edible mushrooms. Traditionally, fleshy fungi were being collected for home consumption and any commercialization was strictly at the local market except for *Morchella* spp. During survey, it was observed that wild edible fleshy fungi are usually available in the village shops or town markets for sale in monsoon season. Most of the edible species are sold in fresh form while others such as *Morchella* spp. and *Pleurotus* spp. are put up for sale in both fresh and dried forms (Fig. 2 a-h & Fig. 3 a-e). Several economically downtrodden natives also vend these mushrooms to well-to-do families in exchange for goods such as used woollen clothes, rice, flour etc.

These species are marketed at different rates. *Agaricus arvensis*, *Clavaria vermicularis*, *Clavulina* spp. *Otidea leporina*, *Macrolepiota procera*, *Rhizopogon* spp., are sold @ rupees 20-30 per kg while *Coprinus comatus*, *Ramaria* spp., are available at rupees 30-40 per kg. Correspondingly, *Geopora arenicola*, *Pleurotus* spp., *Sepultaria summeriana*, *Sparassis* spp. and *Termitomyces* spp. were sold at marginally higher price of rupees 40-50 per kilogram.

Many of these observations follow the earlier studies of Atri and Kaur [27] who observed that in Punjab and the adjoining border areas of Himachal Pradesh, the local people collected the

mushrooms in bulk and further sold these through their sale counters @ Rs. 60-80/kg. Harsh *et al.* [8] observed *Termitomyces heimii* alone was sold by the tribals of Madhya Pradesh in 15 local markets during the season fetching a total price of Rs. 25,000 (approx.). Sharma *et al.* [28] made a socioeconomic study in the Amarkantek Plateau of Madhya Pradesh and found that the sale of edible fungi contributes about 2% to the annual income of tribal family signifying the role of macrofungi in alleviating poverty and serving as a vital ingredient of the nutrition supplements.

CONCLUSION

In conclusion, the present investigation stresses upon a great need for thorough, careful and comprehensive macrofungal forays for further collection of these important group of organisms existing in various locations of the state. The study also recommends regular surveys over an extended period in order to assess the patterns of abundance of mushrooms in different seasons. From such information, harvesting strategies and management plans can be formulated and implemented to ensure the lasting presence of these socially and economically important species.

In view of the increasing commercialization of the wild edible mushrooms, more studies on the ethnomycology of mushrooms in the State are called for. Further, it will be worthwhile to gather different views of the local populace about the value of mushrooms, which would pave a way for the introduction of some known wild edible mushrooms in the diet of rural population. In addition, introduction of simple and appropriate low cost technology for utilization and production of some of these socio-economically important indigenous species can be undertaken in the area. This becomes even more relevant when Food and Agricultural Organization has recommended the use of edible mushrooms as food supplement for protein deficient populations of developing and underdeveloped countries.

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