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Diversity of edible and medicinal wild mushrooms of Bilaspur District of Chhattisgarh in Central India

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Abstract

India is a tropical country with a wide range of climatic conditions; it is a natural habitat for a large range of wild mushrooms. Chhattisgarh, which is the central part of India, has Tropical Forests providing ideal growing conditions for diverse wild mushrooms flora including many edible and therapeutic fungi. The present study explores the biodiversity of naturally growing wild edible and medicinal fungi from the different forest-associated tribal/rural areas in Bilaspur. A total of 15 species of wild edible mushrooms including 8 fungi having therapeutic properties were collected and identified. The identified species were found saprophytic and mycorrhizal. Moreover, the majority of popular edible mushroom species were recorded during either the early or the late rainy season. Therefore, the present study generated a database on mushrooms diversity in the Bilaspur District of Chhattisgarh that will help for its sustainable management.

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Introduction

Wild edible fungi have been collected and consumed by people for thousands of years but in recent decades, there has been a surge in global interest in the utilization of wild edible fungi (FAO 2004). Because they are a valuable medicinal, socioeconomic resource, and food safety and, security in many parts of the globe. Wild edible fungi are considered a healthy food because their mineral content is higher than that of meat or fish and most vegetables (Chan, 1981). Furthermore, fresh edible fungi have roughly twice the protein amount of veggies (Chan, 1981). They have rich nutritional value with high content of vitamins, protein and minerals, fibers, trace elements, and contain no or low calories cholesterol (Agahar-Murugkar and Subbulakshmi2005; Wani *et al.*, 2010; Okoro I.O. *et al.*, 2012). Moreover, many researchers have conducted nutritional analyses of various mushroom species, finding that they are high in protein (30–48%), carbohydrate (125–40%), fat (1–4%), ash (7–17%), and fiber (16% - 20%), etc. (Pushpa & Purushothama, 2010; Manikandan, 2011). Apart from their use as food, a variety of edible and non-edible fungi have been utilized for therapeutic purposes (Wasser and Weis, 1999; Hobbs, 1995), as they contain a good amount of secondary metabolites and have antioxidant, anticancer, anti-mutagenic, antimicrobial, and antiradical properties (Barros L *et al.,* 2007), that may help to prevent or lessen the risk of cancer, heart disease, diabetes, and viral infections (Oei, 1991). Moreover, the presence or absence of mushroom species can be used to determine whether an ecosystem is degrading or developing, they also play a crucial role in nutrient reprocessing, plant growth, and establishment in forests (Tapwal *et al.*, 2013). More than 2,000 fungi have been identified as producing edible sporocarps around the world (Boa, 2004), and 283 edible species from India (Purkayastha and Chandra, 1985; Adhikari, 2000) among them have been cultivated.

The consumption of fleshy fungi has expanded in many nations in recent years, making it necessary to investigate the treasure trove of wild mushrooms. India is a tropical country with a wide range of climatic conditions; it is a natural habitat for a large range of wild mushrooms. Chhattisgarh, which is the central part of India, has Tropical Forests providing ideal growing conditions for diverse wild mushroom flora including many edible and therapeutic fungi. The forests of this state have a high reservoir of unexplored macro-fungal wealth, as the knowledge about various edible and medicinal fungi in different tribal/rural areas has not received significant attention. Therefore, the present study has undertaken to explore the biodiversity of naturally growing wild edible and medicinal fungi from the different forest-associated tribal/rural areas in Bilaspur. This paper reports the wild edible and medicinal mushrooms diversity from Bilaspur district of Chhattisgarh, India

Materials and method

Study area

Fig. 1. Bilaspur Forest Division Map.

Bilaspur district is located at 22°.09'N 82°.15' E. It is 264 meters above sea level on average (866 ft.). The district is bordered on the north by the Gaurela-Pendra-Marwahi district, on the west by the Anuppur district, and the Dindori district of Madhya Pradesh, on the southwest by Kabirdham, on the south by Durg and Raipur, and the east by Korba and Janjgir-Champa. The district covers a total area of 6377km2. The district has a population of 2,663,629 people, according to the 2011 census. The population of Scheduled Castes and Tribes is 20.76% and 14.43%, respectively. Tribal communities such as the Koel, Gond, Korwa, Baiga, and others make up about 20% of the population. Timber trees of this district are sal, saj, amla, teak, tendu, and tinsa.

In addition to this, dhawda, bija, lencha, hardu, and koha are common trees found throughout the district. A periodic collection of mushrooms was done in five ranges of Bilaspur Forest Division during the rainy season (July to October) in 2020. Surveys and collections were carried out in five ranges *viz*- Belgahna, Ratanpur, Takhatpur, Bilaspur, and Kota. Moreover, local markets were examined to learn more about the wild mushroom kinds consumed by the locals.

Ethno-mycological Survey

The information was gathered by semi-structured questionnaires and pictorial demonstrations during an exploratory ethno-mycological survey. These settlements were chosen because they were close to ethno-mycological knowledge among the region's aboriginal tribal populations. These groups were chosen because they were close to ethno-mycological expertise (Singha *et al*., 2020).

In total, 175 people from 10 villages representing various age groups were questioned, and the information gathered was double-checked by cross-questioning the informants individually. Traditional healers from diverse tribal cultures were asked to describe the ways for preparing and administering various medicinal mushrooms for disease diagnosis and treatment. All acquired data was examined and the responses were sorted into descriptive tables after lively interpretations with the interviewees. Interactions with mushroom collectors and sellers revealed market transaction and commercial information about the mushrooms.

Collection and Identification of Specimens

The collected samples were wrapped in wax paper and brought to the laboratory for identification. The macroscopic characteristics like shape, size, color, texture, attachment of stipe, smell, spore print, habit, and habitat have been documented during the survey and collection work. The taxonomy has been worked based on macro and microscopic characteristics following available literature pictorial atlas of soil and seed fungi (Watanabe, 1937) was used to verify macroscopic and microscopic characteristics of collected specimens. Under the supervision of local traditional healers, an opportunistic sampling approach was used to collect and identify mushrooms. Mushrooms were taken from a variety of environments in Bilaspur Forest Division's woodland areas, including moist holes, rotting woods, plant litter, and termite nests. To avoid tissue damage, the specimens were carefully uprooted.

Because some features may alter after preservation, photographs of each species were obtained in their natural habitat. The utilization of different mushroom species for food and as medicine has been documented in the available literature. The frequency and density of different species have been determined by the following formulas:

$$\text{Frequency of Mushroom Species (\%)} = \frac{\text{No. of the site in which the species is present}}{\text{Total no. of sites}} \times 100$$

$$\text{Density} = \frac{\text{Total no. of individuals of a particular species}}{\text{Total no. of species}} \times 100$$

To avoid tissue damage, the specimens were carefully uprooted. Because some features may alter after preservation, photographs of each species were taken in their natural habitat. Authentic identification manuals, standard literature, and a specimen, some of the Mushroom specimens were kept in 4 percent formaldehyde solution and placed at the Department of Forestry, Wildlife, & Environmental Sciences, GGV, Bilaspur, (C.G.) for further references.

Result and Discussion

In the present study, a total of 15 species belonging to 9 families were recorded and identified of which two species were identified at the genera level. The detailed information is listed in Table 1 Overall 15 species were found edible including eight species having medicinal utilization. During the investigation, ten species were discovered to be saprophytic (growing on the dead and decaying matter) and five species were found to be mycorrhizal (growing on living things) symbiotic association.

Table 1. List of Wild Edible Mushrooms in Bilaspur Forest Division.

Name of the Mushroom	Family	Period of occurrence	Ecological Association	Occurrence Frequency
Termitomyces heimii Natarajan (1979)	Lyophyllaceae	June-August	Saprophytic	Abundant
Termitomyces clypeatus R.Heim (1951)	Lyophyllaceae	September-October	Saprophytic	Abundant
Boletus edulis. Bull. (1782)	Boletaceae	June-August	Mycorrhizal	Common
Astraeus hygrometricus (Pers).Morgan (1889)	Sclerodermataceae	June-August	Mycorrhizal	Abundant
Auricularia auricula-judae (Bull).J.Schrot.	Auriculariaceae	July-September	Saprophytic	Abundant
Ganoderma lucidum (Curtis) P. Karst. (1881)	Ganodermataceae	June-September	Saprophytic	Common
Russula virescens (Schaeff)Fr. (1836)	Russulaceae	July-September	Mycorrhizal	Common
Russula rosea Pers.(1796)	Russulaceae	July-September	Mycorrhizal	Common
Russula senecis S.Imai	Russulaceae	June-September	Mycorrhizal	Common
Volvariella volvaceae (Bull.)Singer(1951)	Pluteaceae	May-September	Saprophytic	Abundant
Schyzophyllum commune Fr. (1815)	Schizophyllaceae	June-September	Saprophytic	Common
Calocybe indica Purkay. & A.Chandra,1974	Lyophyllaceae	May-August	Saprophytic	Common
Termitomyces sp.*(bhadoputu)*	Amanitaceae	June-August	Saprophytic	Abundant
Termitomyces sp.*(bhimoraphutu)*	Amanitaceae	June-August	Saprophytic	Abundant
Termitomyces microcarpus (Berk. & Broome) R. Heim (1942)	Lyophyllaceae	June-August	Saprophytic	Abundant

Table 2. List of Medicinal Mushrooms in Bilaspur Forest Division.

Mushroom species	Medicinal uses	Reference
Auricularia auricula-judae	Anti-tumor, anticoagulant, hypocholesterolemic	Das (2010)
Ganoderma lucidum	Anti-viral, antibacterial, antifungal, anti-cancer	Das (2010)
Schizophyllum commune	Anti-cancer (drug Schizophyllan)	Das (2010)
Russula virescens	Antioxidant, Cholesterol-lowering	Das (2010)
Astraeus hygrometricus	Immunoanhancing activity	Chakraborty *et al.* (2004)
Termitomyces heimii	Wound healing, fever, coughs, and fungal infections	Chandrawati *et al.* (2014); Venkatachalapathi and Paulsamy (2016)
Termitomyces microcarpus	Wound healing	Chandrawati *et al.* (2014)
Calocybe indica	Diabetes	Sun (2014)

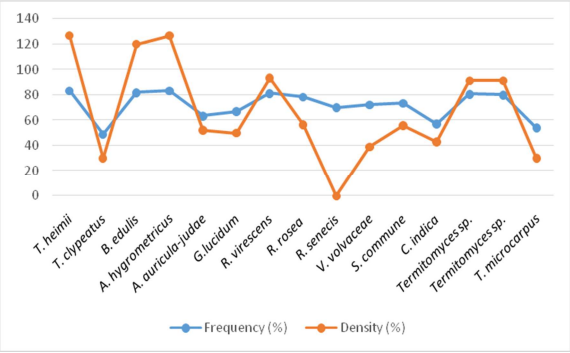

Fig. 1. Diversity of Mushroom in Bilaspur Forest Division.

The examined tribal societies used sensory features such as colour, scent, and, most importantly, habitat to locate edible mushrooms. Fruit bodies are larger in *Astraeus hygrometricus* (Pers). Morgan (1889), *Boletus edulis*. Bull. (1782), *Calocybe indica* Purkay. & *A. Chandra*, 1974, *Volvariella volvaceae, Termitomyces heimii* Natarajan (1979), *Termitomyces clypeatus* R. Heim (1951), *Termitomyces* sp. *(Bhado putu), Termitomyces* sp. *(Bhimora phutu)* and *Boletus edulis*. Bull. (1782) but smaller in *Astraeus hygrometricus* and *Schizophyllum commune*. Some species were plentiful (*Astraeus hygrometricus* (Pers). Morgan (1889), *Auricularia auricula-judae* (Bull). J. Schrot.), some were prevalent all year (*Ganoderma lucidum* (Curtis) P. Karst. (1881), *Volvariella volvaceae* (Bull.) Singer (1951), and a few were rare (*Russula senecis* S.Imai , *Russula rosea* Pers. (1796). The members of the *Russula* genus had striking hues. The majority of popular edible mushroom species were discovered during either the early or the late rainy season.

Plate 1. *Volvariella volvaceae*.

Plate 2. Different Species of Mushrooms in Bilaspur forest division.

The maximum frequency of occurrence was exhibited by *Astraeus hygrometricus* and *Termitomyces heimii* (83.33%), followed by *Boletus edulis*. (82%), *Russula virescens* (81.21%) and *Russula rosea* (78.54%). The rest of the species exhibited a frequency distribution ranging between 49% and 80.72%. The maximum density was recorded for *Termitomyces heimii* and *Astraeus hygrometricus* (126.67%) followed by *Boletus edulis*. (120%) and *Russula virescens* (93.33%). The density of the rest of the species ranged between 30.33 to 56.67%.

Conclusion

Mushrooms are a chief source of nutrient-rich food, therapeutic medicine, and income among the tribal communities of Chhattisgarh, as well as India. The significance of mushrooms diversity is as not only a source of healthy food, medicine, and income generation but also for the ecosystem as they play a crucial role in nutrient reprocessing, plant growth, and establishment in forests and these are the necessary reason for conservation.

However, the present study generated a database on mushroom diversity in the Bilaspur district of Chhattisgarh that will help for its conservation. In addition, many edible, medicinal valuable macrofungal species have not been yet identified in a different region. Therefore, it is necessary to investigate the treasure trove of wild mushrooms in that area for sustainable utilization and conservation.

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