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Survey and collection of wild edible mushrooms on different forest regions of West Bengal, India

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Abstract

Edible mushrooms present a viable alternative to conventional plant and animal-based food sources. The main issue with food security for the ethnic and tribal people is wild edible mushrooms. Wildly grown edible mushrooms have their impact as the nutraceuticals. Wild edible mushrooms play a crucial role in the ecosystem. The majority of them support the development and sustainability of tropical forests by their symbiotic relationships with flora. A survey was undertaken to explore the diversity of macrofungi in the forests of West Bengal, India. 30 (thirty) isolates of wild edible mushrooms were collected. The isolates were identified based on their morphology. The identified isolate families: *Lyophyllaceae*, *Hymenogstraceae*, *Russulaceae*, *Agaricaceae*, *Pluteaceae*, *Polyporaceae*, *Psathyrellaceae*, *Boletaceae* etc.. The ethnic tribal people have extensive ethnomycological knowledge based on which they collect and eat or sell edible ones. The objective of this research is to survey and collection of wild mushrooms that grows naturally in different areas and different season in Erbil West Bengal, India.

Keywords: Wild edible mushrooms, survey, collection, tribal peoples

Introduction

Mushrooms, being seasonal fungi, which play varied roles in nature across the forest ecology. They primarily occur during both the rainy and spring seasons. Mushrooms are the 'fruit' of the underground fungal mycelium. Macro-fungi may be edible, inedible, medicinal and poisonous. (Singh *et al.*, 2016) ^[31]. Wild edible mushrooms are appraised as components of gourmet cuisines around the world, highly prized by humankind for their culinary marvel, particularly due to their exquisite flavors and aromas. They represent a substantial reservoir of proteins, polysaccharides, and dietary fibers, endowing them with the classification of low-calorie nutraceuticals (Ao and Deb 2019; Deb *et al.*, 2018) ^[4, 12]. Mushroom production in India for the year 2021-2022 is 242 MT while in West Bengal 7.0 MT. (Ministry of Agriculture and Farmers Welfare).

Mushrooms that yield prominent sporocarps are classified into distinct groups, including gilled fungi, bracket fungi, coral fungi, jelly fungi, bird's nest fungi, and puffballs (Ao, Deb and Khruomo, 2016) ^[3]. In North-East India, wild mushrooms are vended in local markets and recognized for offering sustenance to the indigenous populations and forest residents during lean periods, notably the rainy season. Mushrooms have the potential to solve the global food shortage issue due to their positioning above vegetables and legumes, yet below first-class proteins found in meat, fish, and poultry (Boa, 2004) ^[7].

The ecological system greatly benefits from the presence of wild edible mushrooms. Most of them establish symbiotic relationships with trees, aiding in the expansion of native and commercial plants inside tropical forest (Zotti *et al.*, 2013) ^[33]. Saprobic wild edible mushrooms play a pivotal role in nutrient recycling and offer economic advantages to rural and tribal communities. These mushrooms are collected from the wild and sold in markets, contributing to the livelihoods of these populations (Khulakpam & Sharma, 2018) ^[22]. More than 100 medicinal properties of the mushrooms have been identified, including anticancer, antioxidant anti-diabetic, antitumor, anti-inflammatory, antiallergenic, cardiovascular-protective, anti-cholesterolemic immune-modulating, antiviral, antimicrobial, antipruritic, antifungal, removing toxins, and hepato-protective effects (Chang & Wasser, 2012) ^[11] (Panda and Tayung, 2014) ^[23]

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(Panda *et al.*, 2017) ^[24]. Their possession of bioactive compounds with medicinal value equips them to potentially address a significant portion of the world's health challenges (Chang and Miles, 2004) ^[10]. Due to their good nutrition and medicinal values, mushrooms are considered ideal for vulnerable groups in society such as children, breastfeeding mothers, the old and the sick, especially those suffering from diabetes, heart diseases, cancer and HIV/aids. The current estimation places the number of fungi on Earth at around 1,500,000, with only 14,000 identified as mushroom species (Hawksworth, 2001) ^[15] (Kirk *et al.*, 2008) ^[20] (Schmit and Mueller, 2007) ^[30]. However, the documented count of wild edible mushrooms stands at approximately 1154, representing just 8.24% of the projected mushroom species (Boa, 2004) ^[7]. Thus, one might deduce that a significant portion of the identified mushrooms are either non-edible or toxic. As stated by Boa (2004) ^[8], occurrences of poisoning and fatalities are notably infrequent in contrast to the routine and secure consumption of wild edible species. This could be attributed to the relatively limited count of poisonous mushroom species, which constitutes a small minority. However, both in developed and developing nations, the publicity and cultural perceptions surrounding wild mushroom poisoning persistently contribute to an inherent apprehension. Undoubtedly, this has resulted in the creation of potential obstacles for their global utilization and broader marketability (Boa, 2004) ^[8].

The rural inhabitants of West Bengal are extensively incorporating wild mushrooms into their diet while also augmenting their earnings by trading these mushrooms in various locations. The indigenous communities gather naturally occurring mushrooms, commonly referred to as "chatu." Mushrooms are gaining substantial importance in the current era focused on dietary consciousness, attributed to their nutritional and medicinal worth, as well as their potential as income-generating enterprises (Thatoi, Singdevsachan, 2014) ^[32]. Certain tribes rely entirely on forest resources for their sustenance, engaging in hunting, gathering, and collecting various forest products. These groups serve as traditional collectors and consumers of a diverse range of wild mushrooms. From prehistoric eras, indigenous populations have been consuming wild macrofungi, valuing them as essential sources of natural dietary sustenance and delectable nutritional supplements (Sarma *et al.*, 2010) ^[28]. They have inherited this traditional mycological knowledge from their elders, passed down through oral transmission across generations. Wild edible mushrooms constitute a significant element in the food security of ethnic and tribal communities. Beyond their nutritional worth, these mushrooms also make a substantial contribution as nutraceuticals. A crucial role played by Wild edible mushrooms in ecological system. The majority of these mushrooms form symbiotic partnerships with trees, supporting the development of both native and cultivated plantations within tropical forests.

West Bengal offers a diverse range of forest biodiversity and ecological varieties due to the presence of the coastal region of the Bay of Bengal on one side and the subalpine mountains of the eastern Himalayan region on the other (Saha *et al.*, 2021) ^[29]. In ecological research, edible wild mushrooms are crucial. They collaborate harmoniously with trees to facilitate the growth of indigenous as well as commercial plantations within tropical forests. The saprophytic wild edible mushrooms are essential for recycling nutrients and benefiting rural and tribal populations economically. But, till date no extensive research work on wild edible mushrooms has been taken up in West Bengal, despite, the fact that not many studies have been done on commonly grown edible mushrooms.

The current study was conducted with the aim of offering

holistic insights to the indigenous tribal communities concerning the significance of 30 naturally occurring wild edible mushrooms. The research employs morphological characteristics of fruiting bodies and spores to classify the taxa up to the genus level. Moreover, the investigation encompasses their nutritional attributes and the economic advantages that resonate with the local population.

Materials and Methods

Study areas

The Survey was conducted in six different forest regions (Hanringhata, Santuri, Jaypur, Bangaon, Sonajhuri and Hijuli) of West Bengal (Fig no. 1). A total number of 55 isolates were collected during the rainy season of 2019-2021 (July - November). The data gathered with the assistance of ethnic groups and tribal communities pertains to the habitats, substrates, availability levels, edibility extent, and the methods employed for processing wild mushrooms. Thorough field excursions and engagements with ethnic communities were conducted to amass data concerning each type of mushroom. The isolates/strains were carefully enclosed in brown paper bags and transported to the laboratory for subsequent analysis. Among the initial 55 isolates, a total of thirty (30) isolates/strains were successfully cultured and preserved within the laboratory, designated as BCKV 3362 to BCKV 3391 as shown in (Table no.1) (Fig no. 2 & Fig no. 3). We aggregated the data obtained from ethnic knowledge concerning edible mushrooms across varying habitats, substrates, and tree species, utilizing a specific questionnaire. The indigenous names of mushrooms are contingent upon the specific habitat and the tribes residing in diverse forest regions, where woody (and monocot stub) substrates like logs, bark, twigs, nutshells, and roots are used for ectomycorrhizal relationships. These names can also relate to local tree species (utilizing the dead parts of trees and tree holes), soil types (such as termite mounds, humus, and bunds of paddy fields), the manner of mushroom growth (considering the overall nature of the mushroom group), the abundance of mushroom biomass (ranging from rare to moderate and profuse), and the degree of edibility (ranging from low to moderate and high). Various wild mushrooms are commercialized by ethnic groups and tribal communities as a means of sustaining their livelihoods. Tribal women actively gather naturally occurring mushrooms, commonly referred to as "chhatu," from the forest and then vend them in local markets.



Fig 1: Map depicting the study areas of West Bengal

Results and Discussion

Approximately 55 wild edible mushroom isolates/strains were collected from different forest areas of West Bengal viz., Nadia (Haringhata forest, Habra forest) Purulia (Santuri forest), Bankura (Joypur forest), Birbhum (Sonajhuri forest) and North 24 Parganas (Bangaon forest) which have perfect climatic zones for the growth of mushrooms. The collection of wild edible mushroom isolates/strains was commenced from July to November 2019 – 2021 during the rainy season. Out of these 55 collected isolates/strains, thirty could be cultured and a few have been identified in consultation with the Directorate of Mushroom Research, Solan, HP.

The collected wild edible mushroom isolates/strains characterization was used to identify isolates/strains belonging to various families. Out of which, fourteen mushroom isolates/stains (BCKV - 3362, BCKV - 3363, BCKV - 3364, BCKV - 3365, BCKV - 3368, BCKV - 3369, BCKV - 3370,

BCKV - 3373, BCKV - 3381, BCKV - 3383, BCKV - 3385, BCKV - 3386, BCKV-3390, and BCKV-3391) belonged to *Lentinus* sp. and family: *Polyporaceae*; BCKV - 3366 and BCKV - 3384 were *Gymnopilus* sp. - family: *Hymenogastraceae*; BCKV - 3367 – *Volvariella volvaceae*-family - *Pluteaceae*; BCKV-3371 and BCKV- 3372 were *Termitomyces* spp - family: *Lyophyllaceae*; BCKV -3374-*Russula delica*- family - *Russulaceae*; BCKV-3375-*Russula rosea* – family - *Russulaceae*; BCKV-3376 –*Termitomyces heimi*- family - *Lyophyllaceae*; BCKV-3377 and BCKV-3379 – *Russula* spp - family - *Russulaceae*; BCKV - 3378 and BCKV - 3389 were *Agaricus bisporus* - family - *Agaricaceae*; BCKV-3380 – *Xerocomellus* sp. - family - *Boletaceae*; BCKV-3382 – *Psathyrella* sp. - family - *Psathyrellaceae*; BCKV-3387 – *Termitomyces microporus* – family - *Lyophyllaceae*, BCKV-3388 - *Termitomyces heimii* - family – *Lyophyllaceae* (Fig no 2 and Fig no 3).

Table 1: Survey and collection of different of wild edible mushroom isolates from different forest areas of West Bengal

Isolates no	Mushroom species	family	Host	Place of collection	Date of collection	GPS data
BCKV-3362	<i>Lentinus</i> sp	<i>polyporaceae</i>	wood	Mohanpur, Nadia	15/07/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL
BCKV-3363	<i>L.sajor caju</i>	<i>Polyporaceae</i>	tree	IISER campus, Haringhata, Nadia	21/07/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL
BCKV-3364	<i>L.squarrosulus</i>	<i>Polyporaceae</i>	wood	Mondouri farm, Nadia	21/07/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL
BCKV-3365	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Tree stump	BCKV, Central Library, Nadia	21/07/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL
BCKV-3366	<i>Gymnopilus</i> sp	<i>Hymenogastraceae</i>	wood	Hijuli Forest, Ranaghat, Nadia	03/08/21	Lat:23.1842257, Lng:88.5775 Altd:26ft MSL
BCKV-3367	<i>V.volvaceae</i>	<i>Pluteaceae</i>	Paddy straw	Baluka, N-24 Paraganas	11/08/21	Lat:23.07000, Lng:88.820000 Altd:7 MSL
BCKV-3368	<i>Lentinus</i> sp	<i>Polyporaceae</i>	wood	Haringhata Forest, Nadia	23/07/21	Lat:22.94952, Lng:88.52526 Altd:10 MSL
BCKV-3369	<i>L.squarrosulus</i>	<i>Polyporaceae</i>	Mango tree	Bongaon Forest, N-24 Paragans	27/08/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3370	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Tree stump	Bongaon Forest, N-24 Paragans	27/08/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3371	<i>Termitomyces</i> spp	<i>Lyophyllaceae</i>	Ashka tree bark	Bongaon Forest, N-24 Paragans	27/08/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3372	<i>Termitomyces</i> spp	<i>Lyophyllaceae</i>	Soil	Bongaon Forest, N-24 Paragans	27/08/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3373	<i>L.squarrosulus</i>	<i>Polyporaceae</i>	Tree stump	Chutkapara, N-24 Paragans	29/08/21	Lat:23.32085, Lng:87.39425 Altd:38 MSL
BCKV-3374	<i>Russula delica</i>	<i>Russulaceae</i>	Soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3375	<i>Russula rosea</i>	<i>Russulaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3376	<i>T. heimi</i>	<i>Lyophyllaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3377	<i>Russula</i> spp	<i>Russulaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3378	<i>A. bisporus</i>	<i>Agaricaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3379	<i>Russula</i> spp	<i>Russulaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3380	<i>Xerocomellus</i> sp	<i>Boletaceae</i>	soil	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3381	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Tree stump	Santuri forest, Purulia	05/09/21	Lat:23.342257, Lng:86.362839 Altd:1 MSL
BCKV-3382	<i>Psathyrella</i> sp	<i>Psathyrellaceae</i>	soil	Sonajhuri Forest, Birbhum	12/09/21	Lat:23.840168, Lng: 87.618638, Altd:54 MSL
BCKV-3383	<i>L.squarrosulus</i>	<i>Polyporaceae</i>	mangotree	Sonajhuri Forest, Birbhum	12/09/21	Lat:23.840168, Lng: 87.618638, Altd:54 MSL
BCKV-3384	<i>Gymnopilus</i> sp	<i>Hymenogastraceae</i>	Bambo tree stump	Sonajhuri Forest, Birbhum	12/09/21	Lat:23.840168, Lng: 87.618638, Altd:54 MSL

BCKV-3385	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Tree stump	Sonajhuri Forest, Birbhum	12/09/21	Lat:23.840168, Lng: 87.618638, Altd:54 MSL
BCKV-3386	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Bambo tree stump	Sonajhuri Forest, Birbhum	12/09/21	Lat:23.840168, Lng: 87.618638, Altd:54 MSL
BCKV-3387	<i>T. microporus</i>	<i>Lyophyllaceae</i>	Soil	Baluka, N-24 Paraganas	18/09/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3388	<i>T.heimi</i>	<i>Lyophyllaceae</i>	soil	Baluka, N-24 Paraganas	27/09/21	Lat:23.07000, Lng:88.820000, Altd:7 MSL
BCKV-3389	<i>A. bisporus</i>	<i>Agaricaeaea</i>	soil	Chutkapara, N-24 Paragans	29/09/21	Lat:23.32085, Lng:87.39425 Altd:38 MSL
BCKV-3390	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Neem tree root	Mondouri Farm, Nadia	30/08/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL
BCKV-3391	<i>Lentinus</i> sp	<i>Polyporaceae</i>	Coconut tree stump	Mondouri Farm, Nadia	30/08/21	Lat:22.93554, Lng:88.51108, Altd:427 MSL



Fig 2: Collected wild Edible mushroom isolates/ strains from different districts of West Bengal.



Fig 3: Collected wild Edible mushroom isolates/ strains from different districts of West Bengal.

Conclusion

For ages, wild mushrooms are utilized for food and medicinal purposes. They are said to be one of the important sources of food for tribal communities who mostly reside in the forest and depend on natural resources for their livelihood. In recent times, accompanying many reasons, the depletion of forest areas, drastic climatic change and changing lifestyles of tribal people have limited production and the usage of wild edible mushrooms for food and medicines. Demands for wild edible mushrooms are also very low because of ignorance and perception among the people on their use and edibility. This has changed the mindset of tribal communities to exploit them as a

source of livelihood. Therefore, it is very important to document and generate the indigenous knowledge system on wild edible mushrooms to exploit them for the well-being of mankind. Further, scientific study on their nutritional contents and bioactivities may enhance the market demand for wild edible mushroom species that might help the tribal communities in income generation for their livelihood.

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Conflict of Interest: None

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