Indian Journal of Traditional Knowledge
Vol 23(9), September 2024, pp 831-842
DOI: 10.56042/ijtk.v23i9.4959

Diversity of wild mushrooms and ethnomycological studies in Mizoram

Jeetendra Kumar Soni[a,b,*], Bawitlung Lalramhlimi[a], Lalhruaitluangi Sailo[a], Sunil Kumar Sunani[c], Lungmuana[a], Ingudum Shakuntala[d] & Sunil Doley[a]

[a]ICAR-RC NEH Region, Mizoram Centre, Kolasib 796 081, Mizoram, India
[b]ICAR-Directorate of Weed Research, Jabalpur 282 004, Madhya Pradesh, India
[c]ICAR-IIPR Regional Station, Khordha 752 055, Orissa, India
[d]College of Veterinary Sciences and Animal Husbandry, Jalukie 797 110, Nagaland, India
[*]E-mail: jeetendra.soni@icar.gov.in

Received 21 September 2023; revised 05 May 2024; accepted 27 August 2024

Mizoram is a hotspot for wild mushrooms and its diversity, serving as an important source of food and income for rural inhabitants. However, extensive exploration, proper identification, documentation of wild mushrooms and ethnomycological studies are still lacking. An attempt has been made for the mass collection of wild mushrooms from 2018 to 2022 in Mizoram, which has yielded 450 specimens, of which 81 species were identified, consisting mainly of Polyporaceae (20.99%), followed by Agaricaceae (9.88%) and Lyophyllaceae (7.41%). The collected mushrooms include 23.56% edible, 48.44% non-edible and the remaining medicinal, poisonous, and other categories. They originate from various habitats, predominantly wood (67.11%) and soil (29.56%). An interview with 609 respondents from the 'Lusei' and 'Chakma' tribes identified three medicinal species (*Auricularia auricula-judae, A. delicata* and *Phallus indusiatus*) and nineteen species for food purpose. The nomenclature of mushrooms depends on the appearance, odour, shape, colour, size, texture and nature of habitat among the tribes and found no well-defined vernacular names at the species level. Consumption of mushroom species is also higher among the Chakma tribe than the Lusei tribe. Mushrooms are collected mostly during monsoon season among the tribes. Price of mushrooms varies depending on species among the tribes. Over 75% of respondents found wild mushrooms declining while 17.24% of respondents did not find a change in wild mushroom populations.

Keywords: Diversity, Ethnomycology, Mizoram, Tribes, Wild mushrooms

IPC Code: Int Cl.[24]: A61K 36/00

Mushrooms are the macro fungi belonging to divisions of Basidiomycota and Ascomycota, either epigeous (grow above the ground) or hypogenous (grow underground) in nature[1]. Ancient civilizations such as Greeks and Egyptians valued mushrooms as a delicacy. The Romans even referred to it as 'Food of the Gods' and the Chinese as an 'elixir of life'[2]. Consumption and use of mushroom dates back to the Palaeolithic period as examination of micro remains in human tooth claimed consumption of bolete mushrooms by Palaeolithic hunter-gatherers[3]. For many different ethnic groups and nationalities, gathering wild edible mushrooms serves as both a pleasure activity and a food source. There are about 1000 recognised edible mushroom species from 110 different countries[4]. Edible mushrooms are rich source of proteins with 20-40% dry weight basis, fibres, minerals and vitamins. Moreover, the low-fat content, with a high proportion of polyunsaturated fatty acids[5] relative to the total content of fatty acids and the presence of secondary metabolites in mushrooms which have antioxidant properties and pharmacological applications play an important role in human health[6]. Another significant aspect of human interaction with fungi is the ethno-medicinal and ritual usage of hallucinogenic mushrooms for divination and healing[7] among indigenous people in various parts of the world.

India is one of the top 12 mega diversity countries in the world despite having only 2.4% of the world's area and around 8% of the global species. It has geographical diversity in the form of mountains, plains, plateaus, deserts and islands, and is a home to 705 ethnic groups, which has more concentration in the North-eastern (NE) region of India. India has documented 850 species out of the 15,000 species of mushrooms identified worldwide[8]. Numerous studies have reported on mushroom consumption by ethnic groups in several states[9] including many NE states like Arunachal Pradesh[10], Assam[11], Manipur[12],

*Corresponding author

Meghalaya[13], Mizoram[14], Nagaland[15], Sikkim[16] and Tripura[17].

The forest cover in Mizoram is about 84.53% of its geographical area which is home to varying pool of wild edible and non-edible mushrooms. Wild mushroom collection among the rural households is common, mainly for sustenance and income generation. Hence, they possess a great wealth of traditional knowledge on mushrooms. Currently, there is little to no scientific documentation of wild diversity of mushrooms in Mizoram. This lack of proper documentation leads to missed opportunities of utilization of wild edible and medicinal species which have many nutraceutical and pharmaceutical benefits for consumption, use and sale. Also, indigenous knowledge on wild edible mushrooms, mushroom recognition, naming, edibility, use, status and perception of wild mushrooms among the tribes in different parts of Mizoram is crucial and have not been well documented. So, considering the importance of wild mushroom species for food and their rich diversity within the state, the research aimed to improve the knowledge on wild edible mushrooms, its diversity in Mizoram and ethnomycology among the tribes of Mizoram.

Materials and Methods

Study area

Mizoram is having a geographical area of 21,081 km^2 with varying in altitude from 30 to 2290 m from mean sea level. It is separated into three agro-climatic zones of humid sub-tropical hill, humid temperate sub-alpine, and humid mild tropical hill[18]. The monsoon rains start in early April and ends in late October, with an average annual precipitation of 1933-2400 mm[19,20]. It is divided into eleven districts, of which Kolasib district was selected for the extensive wild mushroom collection followed by Aizawl, Khawzawl and Champhai districts (Fig. 1). Mizoram is inhabited by major tribes with a population share of 94.8% and their traditional knowledge provides them food, a health care system, and shelter[21].

The ethnomycological study was conducted in Mizoram among the two tribes from different districts *viz.* Kolasib and Lunglei districts (Fig. 1). A survey was carried from five regions *viz*., Thingdawl, Saiphai, Kawnpui, Rengtekawn and Kolasib of Kolasib District in northern Mizoram while in southern Mizoram, one village *viz.*, Marpara South of Lunglei District was selected for conducting the study. As Mizos are broadly divided into two major sub-groups, the Luseis and non-Luseis or Awzia[19]. Members of the Lusei group who speak the Lusei language are mainly concentrated in the northern districts of Mizoram. While the Awzia group, simply means those who speak dialect other than Lusei are mainly concentrated in southern districts of Mizoram. Among Awzia group, the Chakma tribe is one, and their language known as 'Chakma,' is socially distinct, having no common culture or normative patterns with the Lusei tribe. So, to study the nomenclature of wild mushrooms and ethnomycology, the respondents were divided into ‘Lusei’ group (Kolasib district) and ‘Chakma’ group (Lunglei district).

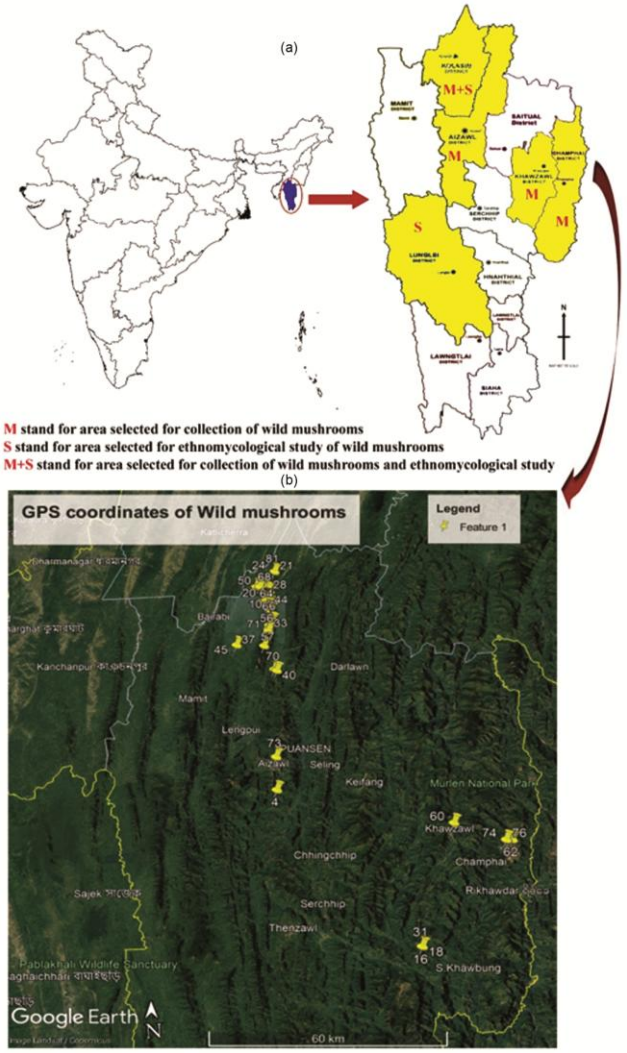

Fig. 1 — Photo depicting study area. (a) sites for wild mushrooms collection and its ethanomycological study; (b) GPS coordinates of wild mushrooms collected from Mizoram

Collection of wild mushrooms

The collection of wild mushrooms was carried out in Kolasib, Aizawl, Khawzawl and Champhai districts of Mizoram from different habitats *viz.*, Jhum field, forest land, trees, decaying woods, roadside, river belts and markets etc., from 2018 to 2022 (Fig. 2). Collecting trips (n = 105) were made during the rainy season (April-October). Mushrooms were photographed in their natural habitat and characteristics were noted in fresh condition. Samples were carefully taken to the AICRP Mushroom laboratory of ICAR RC NEH Region Mizoram Centre Kolasib in sterile plastic bags after carefully wrapped in aluminium foil with detailed labelling. In the laboratory, morphological details such as presence and absence of various parts, along with characteristics such as colour, size, shape and texture of the pileus, stipe and lamellae were examined. Spore prints were determined and microscopic observations were also carried out. The collected specimens were identified according to standard macroscopic and microscopic characteristics through consultation with appropriate literature[22]. Twenty-one wild edible mushroom specimens were selected as representatives to study the human-fungi interactions based on prevalence, familiarity and edibility of wild mushrooms.

Data collection and analysis

The information was acquired following prior informed consent (PIC) from the respondents, adhering to the International Society of Ethnobiology (ISE) code of ethics. Semi-structured interviews[23] and informal interviews[24] were conducted with 609 respondents (60-108 individuals from each of the six regions) using a random sampling method from the two districts. The interviews were conducted with the aid of dried and/or fresh specimens, as well as coloured photographs of all twenty-one representative mushrooms. It mostly took place in the respondent's houses or farms. Interviews were carried out for each recognized species relating to its local/folk name, status of edibility, form of use (food or medicinal), methods of preparation for food, marketability, season of availability, habitat and current status of representative mushrooms in Mizoram, possible reasons and their perception over status. For studying the nomenclature of mushrooms, the 'Lusei' group represented 546 respondents while 63 respondents represented the 'Chakma' group. The sample was biased towards 'Lusei' group as it was more populous as compared to 'Chakma' group. The respondents belong to different professions majority of them engage in agriculture while others are teachers, students and unemployed.

Results and Discussion

Diversity of mushroom collection

This study has identified 81 species from 450 wild mushroom collections. The identified species consists of 4 classes, 11 orders, 30 families and 50 genera as listed in Table 1. Among the collected wild

Fig. 2 — Exploration of wild mushrooms. (a) a place for exploration of wild mushrooms; (b) persons engaged in collection of wild mushrooms; (c) a lady collecting bucket of wild edible mushroom; (d) spore print

Table 1 — List of eighty-one species identified from 450 collections of wild mushrooms.

Class	Order	Family	Genera	Species	GPS
Agaricomycetes	Agaricales	Agaricaceae	*Chlorophyllum*	*molybdites*	24°12'47.0"N 92°40'32.0"E / 624m
			Clarkeinda	*trachodes*	24°13'06.0°N 92°40'52.0"E/ 655m
			Cyathus	*olla*	24°12'37.5"N 92°40'35.5"E/ 138m
			Leucocoprinus	*birnbaumii*	23°37'58.0"N 92°43'16.0"E/ 847m
				cepistipes	24°12'46.6"N 92°40'23.6"E/ 662m
				cretaceus	24°12'46.6"N 92°40'23.6"E/ 662m
				fragilissimus	24°12'47.0"N 92°40'32.0"E/ 624m
			Macrolepiota	*procera*	24°12'50.2"N 92°40'30.6"E/ 592m
		Amanitaceae	*Limacella*	sp.	24°12'26.1"N 92°40'24.9"E/ 590m
		Crepidotaceae	*Crepidotus*	*mollis*	24°10'32.6"N 92°41'40.9"E/ 649m
		Hygrophoraceae	*Hygrocybe*	*aurantiosplendens*	24°14'23.9"N 92°41'24.5"E/ 408m
				miniata	24°12'45.4"N 92°40'27.6"E/ 578m
			Neohygrocybe	*ovina*	24°12'47.0"N 92°40'32.0"E/ 624m
		Lichenomphalioideae	*Lichenomphalia*	sp.	24°12'49.7"N 92°40'30.7"E/ 598m
		Lyophyllaceae	*Calocybe*	*gambosa*	24°12'33.2"N 92°40'36.1"E/ 671m
			Termitomyces	*clypeatus*	23°12'12.1"N 93°05'36.7"E/ 1370m
				fragilis	24°12'25.7"N 92°40'25.3"E/ 584m
				heimii	23°12'12.1"N 93°05'36.7"E/ 448m
				microcarpus	24°12'47.0"N 92°40'32.0"E/ 624m
				robustus	24°12'45.7"N 92°40'34.6"E/ 765m
		Marasmiaceae	*Campanella*	*buettneri*	24°18'12.6"N 92°42'11.2"E/ 430m
			Gerronema	*strombodes*	24°12'46.3"N 92°40'24.4"E/ 618m
			Marasmius	*elegans*	24°12'27.4"N 92°40'19.4"E/ 422m
				sp.	24°18'18.2"N 92°42'03.9"E/ 542m
		Omphalotaceae	*Omphalotus*	sp.	24°18'18.2"N 92°42'04.1"E/ 486m
		Phyllotopsidaceae	*Pleurocybella*	*porrigens*	24°12'25.7"N 92°40'25.5"E/ 594m
		Physalacriaceae	*Oudemansiella*	sp.	24°12'35.9"N 92°40'01.2"E/ 537m
		Pleurotaceae	*Pleurotus*	*giganteus*	24°14'24.6"N 92°41'06.0"E/ 487m
				sp.	24°08'37.7"N 92°41'58.0"E/ 653m
		Pluteaceae	*Volvariella*	*taylorii*	24°12'46.3"N 92°40'24.4"E/ 615m
				volvacea	23°12'12.1"N 93°05'36.6"E/ 448m
		Psathyrellaceae	*Candolleomyces*	*candolleana*	24°12'40.4"N 92°40'33.9"E/ 626m
			Coprinellus	*disseminatus*	24°06'48.8"N 92°41'22.3"E/ 898m
			Cystoagaricus	sp.	24°12'45.1"N 92°40'31.6"E/ 604m
			Psathyrella	sp.	24°12'26.9"N 92°40'24.4"E/ 602m
		Schizophyllaceae	*Schizophyllum*	*commune*	24°12'26.7"N 92°40'24.8"E/ 603m
		Strophariaceae	*Gymnopilus*	*dilepis*	24°03'44.4"N 92°40'42.8"E / 875m
				palmicola	24°12'59.8"N 92°40'40.4"E/ 621m
				penetrans	24°11'27.4"N 92°41'23.0"E/ 603m
				sp.	23°59'06.2"N 92°42'54.6"E/ 683m
		Tricholomataceae	*Clitocybe*	sp.	24°10'43.8"N 92°41'17.0"E/ 586m
			Infundibulicybe	*gibba*	24°12'09.8"N 92°40'25.6"E/ 505m
			Pseudoclitocybe	*cyathiformis*	24°15'20.6"N 92°39'01.6"E/ 131m
			Tricolomopsis	*rutilans*	24°11'26.5"N 92°41'22.9"E/ 604m
	Auriculariales	Auriculariaceae	*Auricularia*	*auricula-judae*	24°04'09.7" N 92°36'00.0"E/ 448m
				delicata	24°11'29.3"N 92°41'23.1"E/ 596m
				mesenterica	24°12'59.8"N 92°40'40.4"E/ 620m
	Boletales	Sclerodermataceae	*Scleroderma*	*citrinum*	24°12'54.0"N 92°40'37.2"E/ 623m
	Cantharellales	Hydnaceae	*Clavulina*	*amethystina*	24°08'30.5"N 92°42'00.2"E/ 646m
	Phallales	Clathraceae	*Clathrus*	*delicatus*	24°15'22.4"N 92°39'37.7"E/ 76m
		Phallaceae	*Phallus*	*indusiatus*	24°08'30.5"N 92°42'00.2"E/ 646m
	Polyporales	Ganodermataceae	*Ganoderma*	*applanatum*	24°07'38.6"N 92°41'30.1"E/ 897m
				lucidum	24°12'58.8"N 92°40'47.1"E/ 561m
		Panaceae	*Panus*	*neostrigosus*	24°12'47.6"N 92°40'32.4"E/ 593m
		Polyporaceae	*Favolus*	*brasiliensis*	24°11'42.0"N 92°41'37.1"E/ 612m
				tenuiculus	24°06'28.4"N 92°41'22.8"E/ 890m
			Lentinus	*cladopus*	24°07'37.1"N 92°41'30.3"E/ 526m

…*Contd*.

Table 1 — List of eighty-one species identified from 450 collections of wild mushrooms.(Contd.)

Class	Order	Family	Genera	Species	GPS
Agaricomycetes	Polyporales	Polyporaceae	*Lentinus*	*crinitus*	24°08'35.6"N 92°41'54.7"E/ 665m
				polychrous	23°28'41.9"N 93°20'14.6"E/ 448m
				sajor-caju	23º31'40.8"N 93º11'14.8"E/ 448m
				squarrosulus	24°08'37.3"N 92°41'58.6"E/ 640m
				tigrinus	23°28'41.2"N 93°20'16.0"E/ 1294m
			Microporus	*xanthopus*	24°11'31.0"N 92°41'22.7"E/ 558m
			Polyporus	*arcularius*	24°11'22.2"N 92°41'12.0"E/ 622m
			Trametes	*coccinea*	24°07'37.8"N 92°41'29.7"E/ 798m
				gibbosa	24°08'49.9"N 92°41'42.5"E/ 172m
				hirsuta	24°08'49.9"N 92°41'42.5"E/ 172m
				lactinea	24°14'36.7"N 92°40'47.2"E/ 520m
				sp.	24°16'85.3"N 92°41'66.7"E/ 574m
				versicolor	23°59'19.2"N 92°42'29.4"E/ 500m
			Trichaptum	*biforme*	24°07'37.5"N 92°41'29.9"E/ 826m
	Russulales	Hericiaceae	*Hericium*	sp.	24°15'31.7"N 92°40'06.1"E/ 190m
		Russulaceae	*Lactifluus*	*corrugis*	23°43'34.8"N 92°43'04.8"E/ 1024m
				volemus	23°28'40.8"N 93°19'16.1"E/ 1535m
			Russula	sp.	24°10'38.8"N 92°41'18.5"E/ 611m
				subfragiliformis	23°28'40.8"N 93°19'16.1"E/ 535m
	Xylariales	Xylariaceae	*Xylaria*	*polymorpha*	24°12'50.4"N 92°40'33.6"E/ 599m
				sp.	24°10'39.5"N 92°41'15.3"E/ 594m
Dacrymycetes	Dacrymycetales	Dacrymycetaceae	*Dacryopinax*	*spathularia*	24°12'42.6"N 92°40'38.1"E/ 636m
Tremellomycetes	Tremellales	Tremellaceae	*Tremella*	*fuciformis*	24°08'38.8"N 92°41'50.8"E/ 629m
Pezizomycetes	Pezizales	Sarcoscyphaceae	*Cookeina*	*tricholoma*	24°18'17.2"N 92°42'04.3"E/ 492m

mushrooms, family Polyporaceae contributed the largest number of collections (20.99%) followed by Agaricaceae (9.88%) and Lyophyllaceae (7.41%). Collected mushrooms consisting of 23.56% edible, 48.44% non-edible, 0.22% medicinal, 1.56% poisonous, 0.44% edible (not recommended) and 25.78% unknown edibility (Fig. 3). These mushrooms have different habitats and maximum collections were made from wood (67.11%) followed by soil (29.56%) (Fig. 3). Conservation of forest resources need to be encouraged where the mushrooms are mostly collected[25]. Out of these collections, two endangered species were identified *viz*. *Hygrocybe aurantiosplendens* and *Volvariella taylorii*.

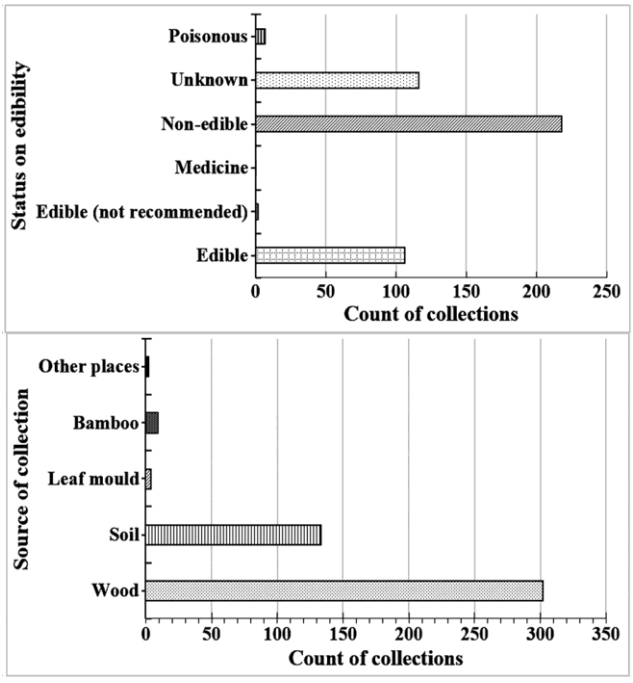

Fig. 3 — Classification of 450 wild mushroom collections based on edibility and source of collection

Identification, nomenclature and and ethnomycological study

From the 81 collected species of wild mushrooms, the identification and nomenclature of 21 representative mushrooms including their ethnomycology among the two tribes are given in Table 2, Figure 4. From 21 species representatives among the two groups *viz.*, 'Lusei' and 'Chakma' have yielded vernacular names of eighteen mushrooms (Table 2). The generic name of mushroom among the Lusei group is '*Pa*' while among the Chakma group '*ull*'. The general terms used for non-edible mushroom are '*Pachhia*' and '*Bish ull*' by the 'Lusei' and 'Chakma' groups, respectively. It was found that mushrooms are given names mostly based on their appearance, odour, colour, shape, size, texture and nature of habitat.

Table 2 — Twenty-one representative species for ethnomycological studies among the tribes in Mizoram

Latin	Name of mushrooms			Season of availability		Source of collection		Form of use		Mode of use		Market price	
	English names	Lusei	Chakma	Lusei	Chakma	Lusei	Chakma	Lusei	Chakma	Lusei	Chakma	Lusei	Chakma
		group	group	group	group	group	group	group	group	group	group	group	group
Auricularia	Wood Ear, Jelly	*Pu Vana*	*Undur*	June-Sept	June-	Forest	Forest	Food,	Food	Boiled and consumed	Fry, boil	Rs. 100-	Rs. 150-
auricula judae	Ear, Judas's Ear or Jew's Ear	*beng*	*han ull*		August	trees	trees	medicine		for treatment of stomachache, dysentery and cancer.		500/ kg	300/kg
Auricularia delicata	Wood Ear mushroom	*Pu Vana beng*	*	Monsoon	June-August	Forest trees	Woods	Food, medicine	Food	Fry, bai, porridge. Bai, boil, fry	Boil	50-400/ kg	Rs. 200/ kg
Calocybe gambosa	St. George's mushroom	*Bawng ek pa*	*Hola ull/ Atpoza ull*	Monsoon	May-Aug	Soil, near forest trees	Soil, wood	Food	Food	Fry, boil, vaipaden	Boil	100-500/ kg	100/kg
Daeryopinax spathularia	Fan-shaped Jelly Fungus	*	*	Monsoon	Monsoon	Forest trees, soil	Wood, soil	Food	Food	Fry	Boil	Unknown	400/kg
Favolus brasilensis	Unknown	*Pa ardang*	*Sadi ull*	Monsoon	June-Sept	Soil	Soil, wood	Food	Food	Bai, porridge, fry, boil, vaipaden	Boil	100-500/ kg	50-200/ kg
Ganoderma lucidum	Reishi mushroom	*Pachhia*	*Sambad ull*	Monsoon, spring	Throughout the year, Monsoon	Forest trees, woods	Woods	food	food	Bai	Boil	Unknown	Unknown
Lactifluus cornugis	Corrugated-cap milky	*Pa uithin*	*Gach ull*	Monsoon	June-Sept, March-April	Woods, soil	Soil, bamboo, woods	Food	Food	Bawl, bai, boil, fry	Boil, fry	350/kg	100-400/ kg
Lactifluus volemus	Weeping Milk Cap	*Pa uithin*	*	Monsoon to spring	Monsoon to spring	Soil, wood	Soil	Food	Food	Raw, boil, fry, bai, porridge	Boil	Unknown	100-400/ kg
Lentinus cladopus	Unknown	*Pa hnahkhar*	*Bash ull*	Monsoon	June-Oct	Woods	Bamboo, woods	Food	Food	Vaipaden, Boil, fry, bai, porridge	Boil, fry	100-300/ kg	100-400/ kg
Lentinus sajor-caju	White-rot fungus	*Pa Khangbun/ Pachang*	*Gach ull*	Monsoon (April-Aug)	Monsoon	Soil, woods	Woods	Food	Food	Bai, boil, fry	Boil	50-250/ kg	150-200/ kg
Lentinus squarrosulus	Unknown	*	*Gach ull*	April-August	May-Sept	Forest woods	Woods	Food	Food	Boil, bai, fry	Boil	50-250/ kg	100-300/ kg
Lentinus tigrinus	Tiger Sawgill	*Pa hnahkhar*	*Buro gach ull*	Monsoon	Monsoon (May-Sept)	Bamboo, woods	Soil, wood	Food	Food	Bai, porridge, boil, fry	Boil, fry	80-300/ kg	100-300/ kg
Phallus indusiatus	Bamboo mushrooms, Bamboo Pith	*Phungsalmin/ Pa len*	*Buisagoi ull*	March-August	July-Sept	Soil	Soil	Food	Medicine	Fry	Dry powder and fresh paste are used for treatment of skin infections	100/kg	Unknown
Pleurotus giganteus	Unknown	*Pa Bang*	*Bor ull*	Monsoon	April-Aug	Forest woods	Soil	Food	Food	Bai, boil, fry	Bai	100-400/ kg	200/ kg
Russula subfragiliformis	*Pa lengsen*	*Pa uithin*	*Bash ull/oring bash ull*	June-August, Jan-Feb	May-August	Forest, farmland & garden soil	Bamboo, banana, soil, wood	Food	Food	Bai. Boil, fry	Boil, bai, raw, fry	100-600/ kg	200-400/ kg
Schizophyllum commune	Splitgill mushroom	*Pasi*	*Hokkeng ull*	May-Oct	May-August	Forest woods	Woods	Food	Food	Boil, bawl, salad, bai, fry	Boil, fry	20-50/cup	50/cup, 100-200/ kg
Termitomyces clypeatus	Termite mushroom	*Papar*	*Sammo ull*	Monsoon	Monsoon (April-Aug)	Forest soil	Soil	Food	Food	Bai, fry, boil	Boil, fry	100-600/ kg	100-400/ kg
Termitomyces heimii	Termite mushroom	*Pasawnthung*	*Sambo ull/ Sammo ull*	April-December	March-August	Forest & farmland soil	Soil	Food	Food	Boil, fry	Boil, fry	100-400/ kg	200-400/ kg
Termitomyces microcarpus	Termite mushroom	*	*Atpoja ull*	March-August	June-August	Forest soil	Soil, wood	Food	Food	Bai, boil, fry	Boil	50/cup	100-200/ kg
Vohariella taylorii	Silky Sheath, Silky Rosegill, Silver-Silk Straw mushroom, or Tree mushroom	*Changel pa*	*Hola ull*	Monsoon	May-August	Forest & farmland soil	Near banana, cow dung, soil	Food	Food	Boil, fry	Boil, fry	unknown	100-300/ kg
Vohariella vohaceae	Straw mushroom, Chinese mushroom	*Changel pa*	*Gobor ull*	Monsoon	June-July	Forest soil	Soil, cow dung	Food	Food	Bai, boil, fry	Boil	50-400/ kg	200/kg

* Indicate unknown

***Auricularia auricula-judae* (Bull.) Quél**

This mushroom has fruiting bodies similar to a jelly, ear-like or even cup shaped. It is a small brown fungus and ranges between 10-50 mm wide. It is without stalk or gills (Fig. 4a). It is called by different names like Wood Ear or Jelly Ear mushroom while '*Pu Vana Beng*' by the 'Lusei' group and '*Undur han ull*' by the 'Chakma' group. '*Pu Vana*' is a reference to God and 'beng' means ear while '*Undur han ull*' means 'rat ear mushroom'. It is one of the most

common wild edible medicinal mushroom species in Mizoram. Research in the use of the species for cancer treatment or anti-cancer properties is fairly recent but numerous with promising findings by several researchers[26,27]. This mushroom is commonly used in the form of boiled, fried, porridge and bai. Bai is a local dish which is prepared by boiling mushroom with or without other vegetables mixed with baking soda or ash filtrate (chingal) and fermented pig lard (saum), stirred until it gets cooked.

Fig. 4 — Photos of twenty-one representative wild mushrooms. (a) *Auricularia auricula-judae;* (b) *Auricularia delicate*; (c) *Calocybe gambosa*; (d) *Dacryopinax spathularia*; (e) *Favolus brasiliensis*; (f) *Ganoderma lucidum*; (g) *Lactifluus corrugis*; (h) *Lactifluus volemus*; (i) *Lentinus cladopus*; (j) *Lentinus sajor-caju*; (k) *Lentinus squarrosulus*; (l) *Lentinus tigrinus*; (m) *Phallus indusiatus*; (n) *Pleurotus giganteuss*; (o) *Russula subfragiliformis*; (p) *Schizophyllum commune*; (q) *Termitomyces clypeatus*; (r) *Termitomyces heimii*; (s) *Termitomyces microcarpus*; (t) *Volvariella taylorii*; (u) *Volvariella volvacea*

***Auricularia delicata* (Mont. ex Fr.) Henn**

The fruiting bodies are thin, rubbery and ear shaped. This edible fungus grows up to 120 mm wide. The underside is wrinkled, veined and smooth (Fig. 4b). It is also called '*Pu Vana Beng*' by 'Lusei', while 'Chakma' people do not have a specific name. It is used for medicinal purposes like stomachache, dysentery and cancer medication among the Lusei tribe while for food purpose among the Chakma tribe.

***Calocybe gambosa* (Fr.) Donk**

It is an edible fungus with white pileus, brown tinges and shaped convex to flat. Its pileus ranges from 50 to 100 mm wide and stalk around 20-90 mm long (Fig. 4c). It is called '*Bawng ek pa*' by Lusei group in which '*Bawng ek*' means cow dung signifying its habitat. While it is called as '*Hola ull/Atpoza ull*' by the Chakma group which means 'Banana mushroom/Soil mushroom which breaks when touched' referring to the place of mushroom habitat. It is used for food purposes, in preparation by boiling, and frying, and also for 'vaipaden' among the Lusei tribe. It is used by the ethnic tribes of Uttar Pradesh to increase immunity[28].

***Dacryopinax spathularia* (Schwein.) G. W. Martin**

The fruiting bodies are fan-shaped, orange to yellow and are small in size around 10-12 mm (Fig. 4d). None of the groups have a specific name for it. It is used for food purpose by both tribes. The ethnic groups of Assam have reported use of this mushroom as food[29].

***Favolus brasiliensis* (Fr.) Fr.**

The pileus is convex to flat and white to yellowish. Pileus ranges from 60-100 mm wide and eccentrically attached stipes up to 15 mm long (Fig. 4e). It is called '*Pa-ardang'* by the Lusei people which means the choanal cleft of poultry referring to the texture of the mushroom lamellae and '*Sadi ull*' which means umbrella-shaped mushroom by the Chakma people. It is used for food purpose by both the tribes in preparation of boiled dishes, bai, porridge, fry and vaipaden. The Yonomamo Indians of Brazil were

reported to consume this mushroom as part of their diet[30].

***Ganoderma lucidum* (Fr.) P. Karst**

Shiny caps, which grow up to 250 mm wide and 40 mm thick, are of brown, red and purple colours with concentric groves and white margins. Brackets are kidney shaped and attached laterally or centrally without stalk (Fig. 4f). It is generally called '*Pachhia*' which means 'Non-edible mushroom' by the Lusei group while it is called '*Sambad ull*' by the Chakma people, which means 'Burnt or smoked mushroom'. It has been used for food purposes; however, none of the respondents have known this mushroom to possess medicinal properties. It has been used in China for over 40 years to treat neurosis, polymyositis, dermatomyositis, atrophic myotonia, and muscular dystrophy[31]. While it is used to treat diabetes, dizziness, poisoning from toxic mushrooms among ethnic groups of Uttar Pradesh[32].

***Lactifluus corrugis* (Peck) Kuntze**

It is initially convex then becomes depressed. It is dark reddish in colour and easily become wrinkled and corrugated having white milk. Pileus and stipe size around 40-200 mm wide and 30-110 mm long (Fig. 4g). It is called '*Pa uithin*' by the Lusei people as per its morphological resemblance with dog's liver. '*Ui*' refers to dog and '*thin*' refers to liver. While it is called '*Gach ull*' by the Chakma tribe which means 'Tree mushroom' as it mainly appears near the basal region of trees. Among the Lusei tribe, boil, fry, bawl and bai are common while it is eaten as boil and fry among the Chakma tribe. This mushroom is reported as non-edible in Jammu and Kashmir but reported to be edible from some parts of the world[33].

***Lactifluus volemus* (Fr.) Kuntze**

It has brownish orange colour with white milk. Pileus is initially convex and turns flat with a central depression. It ranges from 30-130 mm wide. Stalk grows up to 100 mm long (Fig. 4h). *Lactifluus volemus* is also called '*Pa uithin*' by majority of Lusei tribe without vernacular names at species level while 'Chakma' people do not have a specific name. It is consumed by both tribes in various forms. This mushroom is reported as non-edible in Jammu and Kashmir but reported to be edible in Uttarakhand[33].

***Lentinus cladopus* Lev.**

This species is white, its pileus is around 50 mm wide and convex to infundibuliform shaped. Stipe ranges from 20-40 mm long (Fig. 4i). It is called '*Pa-hnahkhar*' by the Lusei group which is a reference to 'Hnahkhar', an evergreen plant, *Macaranga indica*, commonly found in Mizoram, while Chakma people called it as '*Bass ull*' meaning 'Bamboo mushroom' referring to the habitat on bamboos. It is used for food purpose by both the tribes. *Lentinus* sp. is stored throughout the year as powder and added in soups for better health by the Dangi tribe of Gujarat[34].

***Lentinus sajor-caju* (Fr.) Fr.**

The pileus is yellowish brown, funnel shaped and ranges up to 160 mm wide. Stipe is usually between 25-35 mm long with or without an annulus ring (Fig. 4j). It is known as '*Pa Khangbun/Pachang*' by Lusei which means 'Mushrooms wearing a ring/Solid textured mushroom' referring to the annulus ring on stipe of mushroom and the rigid texture of the pileus. Likewise, Chakma group called it as '*Gach ull*' which means 'Tree mushroom' referring to the habitat of the mushroom. It is used for food purpose by both the tribes and mainly eaten as a boiled dish.

***Lentinus squarrosulus* (Mont.) Singer**

It is edible mushroom with pileus ranging from 20-45 mm wide and stipe lengthens up to 70 mm long. Convex to funnel shaped with creamy to light brown (Fig. 4k). Chakma group called it '*Gach ull*' which means 'Tree mushroom' while Lusei group do not have a specific name. It is used for food purposes by both tribes.

***Lentinus tigrinus* (Bull.) Fr.**

The pileus is centrally depressed and ranges from 10-30 mm wide and stalk 20-40 mm long. This fungus is white to yellowish and attached centrally or eccentrically (Fig. 4l). It is known as '*Pa Khangbun/Pachang*' by Lusei and '*Buro gach ull*' by Chakma. It is used for food purpose by both the tribes. It is mainly eaten as a boiled and fried dishes by both the tribes, however, the Lusei tribe has more diverse use as bai and porridge. It is used for treatment of diabetic patients among the local people of Kashmir[35].

***Phallus indusiatus* Vent.**

The pileus ranges from 20-40 mm wide and stalk grows up to 250 mm. Fruiting body contains a pileus covered with gleba which is browish in colour and an indusium, a lace-like skirt (Fig. 4m). It is known as '*Phungsahmim/Pa len*' by the 'Lusei' group, where '*Phung*' refers to a demonic or ogre character in Mizo

folktales which further maybe associated with the odour of the species. '*Sahmim*' is derived from Sahmim ipte which is a local-made netted satchel that resembles the indusium of the mushroom. The Chakma group called this mushroom '*Buisagoi ull*' which means 'Arising from soil' referring to the habitat of mushroom appearing from soil with a net. It is considered edible by many Asian cultures but edibility is questionable among the tribes of Mizoram due to the unique structure of the mushroom and the unpleasant odour. Only few respondents have reported as edible and used for medicinal purposes. Few respondents from Lusei tribe have claimed their use as food by frying while Chakma tribe have used as a dry powder or fresh paste for treatment of skin infections and skin ulcers. It has been used in traditional medicine especially by the Chinese to treat inflammatory and other disorders[36].

***Pleurotus giganteus* (Berk.) Karun. & K.D. Hyde**

Edible and one of the largest sized mushroom having convex to flat pileus that ranges 60-300 mm wide. It is dark brown, slightly depressed in the centre with fibrillose scales and lighter margins (Fig. 4n). It is called '*Pa Bung*' by the Lusei group which means 'Banyan Mushroom', while the Chakma group called it '*Bor ull*' which means 'Big mushroom' referring to its size. It is used for food purpose in the preparation of bai, boil and fry. The Dangi tribe of Gujarat used *Pleurotus* sp. for strengthening the body[34], treatment of asthma and lowering high blood pressure by the tribes of Odisha[37].

***Russula subfragiliformis* Murrill**

This mushroom is having a red to pinkish red pileus. It is convex to flat with a slightly sunken centre and incurved margins. The pileus ranges from 50-80 mm wide and with stalk around 20-70 mm long (Fig. 4o). It is called '*Pa-lengsen*' among Lusei group. The term '*sen*' in '*Pa-lengsen*' means red referring to the colour of the mushroom pileus. While the Chakma group called this mushroom '*Oring bash ull*' which means 'Deer colour Bamboo mushroom'. It is consumed as boil, bai, fry among the tribes. *Russula* sp. is used for treatment of malnutrition, weakness and a delicious food item by local tribes of Northern Odisha[9].

***Schizophyllum commune* Fr.**

The pileus ranges from 15-50 mm wide. This edible species is among the smallest, fan shaped with wavy margins. It is brown with a velvety surface. The gills are centrally split (Fig. 4p). It is known as '*Pa-si*' by the Lusei group where 'si' signifies the smallness of the fruiting body while the Chakma group called it as '*Hokkeng appaw ull*' which means 'Gecko mushroom' referring to the sticking nature (appaw) of mushroom onto substrate. It is mainly consumed as food and is one of the most popular mushrooms among the people of Mizoram. It is used as a tonic in West Bengal[38].

***Termitomyces clypeatus* R. Heim**

The pileus is brown colour with fibrils and matures to convex shape. Caps range from 65-80 mm and stalk ranges from 65-100 mm long with pseudorrhiza growing up to 80 mm long (Fig. 4q). It was identified among the Lusei group as '*Pa par*' which means 'Flower mushroom' referring to the appearance of the mushroom like a flower bud from soil. While Chakma group called '*Sammo ull*' which means 'Sammo mushroom' referring to the shape of Sammo, a type of Chakma traditional basket with a big mouth and tapering bottom with no distinction on names at species level. It is used for food purpose among the tribes by making bai, boil and fried dishes. It is used for treatment of pox in West Bengal[38].

***Termitomyces heimii* Natarajan**

Widespread across Mizoram and highly valued edible species, the pileus range from 80-120 mm wide and stipe grows up to 250 mm long. It is whitish brown, convex to plano-convex and with a hump (Fig. 4r). It is called '*Pasawntlung*' by the Lusei group where '*Sawntlung*' refers to termite mounds signifying the species' association with termites and its habitat. While Chakma group called '*Sammo ull*'. It is used for food purposes by both the tribes either as a boiled or fried dishes. *Termitomyces* sp. is reported for treatments of rheumatism, diarrhoea and high blood pressure by different tribes of Odisha[37].

***Termitomyces microcarpus* (Berk. & Broome) R. Heim**

The pileus ranges from 15-30 mm and stipe ranges from 40-80 mm long. It is pale brown to cream colour and bell-shaped with an umbo (Fig. 4s). There are no vernacular names for *Termitomyces microcarpus* among the 'Lusei' group. While chakma people called it as '*Atpoja ull*' which means 'Soft mushroom' which appear from soil and easily break when touched. It is also used for food purpose among the tribes to prepare boiled dishes and also bai and fry among the Lusei tribe. It is consumed by Dangi people of Gujarat to attain good

health during convalescence or specifically during monsoon season[34].

***Volvariella taylorii* (Berk. & Broome) Singer**

The pileus, finely hairy, ranges from 20-60 mm wide. Greyish to brown, their lamellae are white to pinkish. This edible mushroom is initially convex and later turns to broad convex and flat (Fig. 4t). It is known by Lusei group as '*Changel pa*' because of the availability of the species in and around Changel (*Ensete glaucum*). While the Chakma group as '*Gobor ull*' which means 'Cow dung mushroom' based on the habitat of the mushroom. It is mainly used for food purposes by both the tribes. *Volvariella* sp. is used for lowering high blood pressure by the tribes of Northern Odisha[9].

***Volvariella volvacea* (Bull. ex Fr.) Singer**

The pileus grows up to 100 mm wide and stalks up to 90 mm long. The fruiting bodies are white to brown with white spots and may have volva present (Fig. 4u). It is used for food purpose by both the tribes. Earlier findings suggest its edibility among different tribes of Achanakmar-Amarkantak Biosphere Reserve of India[39]. It is know as '*Changel pa*' by Lusei group and '*Oil palm ull'* by Chakma group based on the habitat of the mushroom near oil palm. It is mainly eaten as a boiled dish by both the tribes. This mushroom can be used for cure of anemia[40].

Out of the twenty-one representative mushrooms, most of the mushrooms are used for food purpose and then medicines. Misidentification of mushroom may have drastic consequences if a poisonous species is mistaken for an edible one. Majority of the respondents have mistaken the poisonous *Chlorophyllum molybdites* for *Termotomyces heimii*. The most frequent cause of this misidentification is the similarity between edible and poisonous mushroom species in terms of colour and general morphology. In our study, the respondents (10.99%) have misidentified and named *Russula subfragliformis* for *Lactifluus corrugis* as a result of their similarity in colour and appearance.

Mushroom familiarity and consumption

More than fifty percent of the respondents among the Lusei group are familiar with seven species (Fig. 5). However, only five species were consumed by >50% of the respondents. *A. auricula-judae* and *P. indusiatus* are highly identifiable among the tribes due to their unique morphology while their consumption is lower as majority assumed. More than fifty percent of the respondents among the Chakma group are familiar with twelve species (Fig. 5). However, only nine species were consumed by >50% of the respondents. The mushroom *P. indusiatus* is consumed by 9.52% only as against 90.47% of the respondents being familiar in identification of the mushroom while *T. microcarpus* is also consumed by only 4.76% of the respondents.

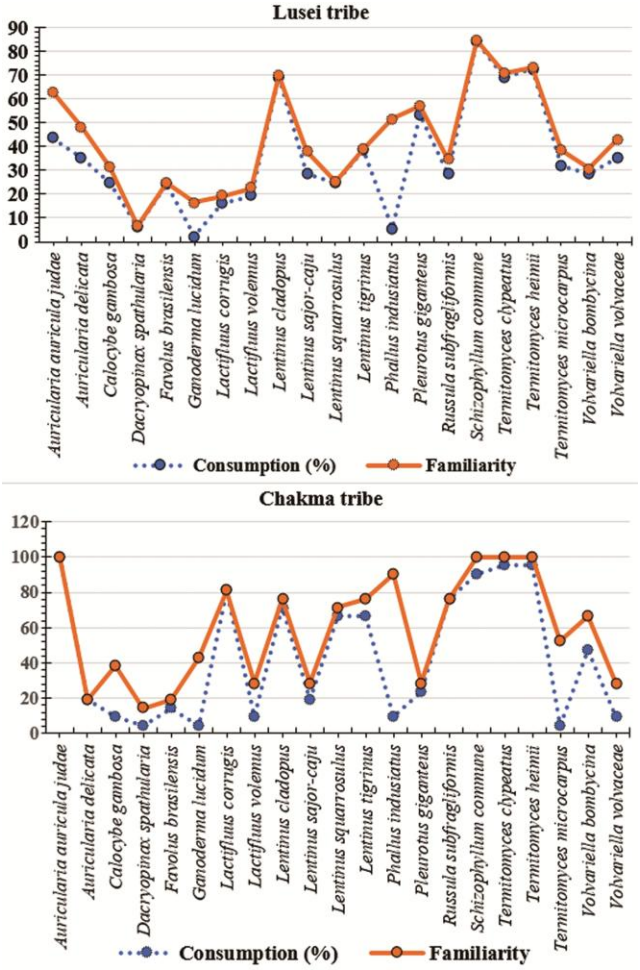

Fig. 5 — Familiarity in identification and consumption of representative mushrooms among the tribes of Mizoram

Status of wild mushroom population

More than 75% of the respondents found wild mushrooms declining while 17.24% of the respondents did not find change in wild mushroom populations. And the rest 6.90% of the respondents are impartial and did not communicate any perception towards the decline or rise in wild mushroom population (Fig. 6). The expansion of agricultural land, urbanization, deforestation, shifting

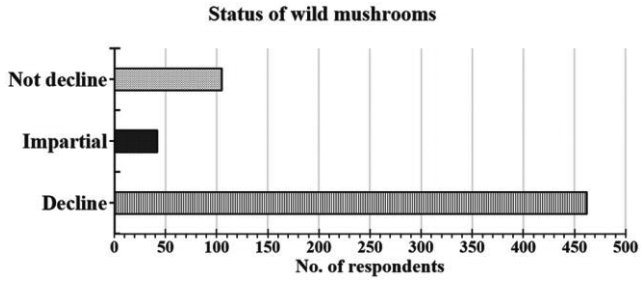

Fig. 6 — Perception on status of wild mushrooms in Mizoram

cultivation, climate change, extreme collection of wild mushrooms from their natural habitat and ignorant people have contributed to declining of wild mushrooms[41].

Conclusion

Despite the vast diversity of wild mushrooms, there's limited indigenous knowledge and poorly documented identification methods passed down through generations. Locals need a scientific approach to identify wild fungi, preferably in their local dialects. Widespread fear of wild mushroom consumption persists due to reported poisoning cases in rural areas. To address this irrational fear and educate mycophobic populations, we need information and awareness. Exploration of wild mushroom has yielded 450 collections in Kolasib and its nearby Districts of Mizoram. This includes 81 species of wild mushrooms from which 21 representative mushrooms for their ethnomycology were documented. This will help local mushroom hunters, mycologists, researchers, commercial mushroom enterprises, *etc*. in understanding our mushroom diversity, proper identification with nutritional and medicinal properties which can be exploited for effective utilization at industrial level. It is the need of the hour for extensive mushroom collection, characterization, identification considering the declining of mushroom habitat. This could lead to missed opportunity in identification of new species confined to specific regions while placing other species at risk of extinction.

Acknowledgement

The authors extend gratefulness to the Director, ICAR RC for NEH Region, Umiam, for providing all kinds of support to conduct field surveys and lab analysis. We express our sincere gratitude towards AICRP on Mushroom (OXX01937) for providing financial support. Also, authors are immensely grateful to Dr. Babita Kumari from ICAR-DMR, Solan, for her valuable recommendations and suggestions in the identification of wild mushrooms. Furthermore, authors are thankful to all respondents for providing detailed ethnobotanical information about wild mushrooms.

Conflict of Interest

The authors declared that they had no conflict of interest.

Author Contributions

Conceptualization, JKS, IS, BL and LS; Data collection and analysis, JKS, BL and LS; Validation and Visualization, BL and LS; Writing – original draft, BL and LS; Writing – review & editing, JKS, SKS, LS, IS and SD.

Prior Informed Consent

All respondents provided prior informed consent. Additionally, permission was obtained from individuals whose images are used in this paper.

Declaration

In this paper, all copyright requirements have been addressed and required permission have been obtained.

Data Availability

Data will be made available by the corresponding author upon reasonable request.

References

1 Chang S T & Miles P G, Mushroom biology-a new discipline, *Mycologist*, 6 (1992) 64-65.

2 Valverde M E, Hernández-Pérez T & Paredes-López O, Edible mushrooms: improving human health and promoting quality life, *Int J Microbiol*, (2015) 376387.

3 Power R C, Salazar-García D C, Straus L G, Morales M R G & Henry A G, Microremains from El Mirón Cave human dental calculus suggest a mixed plant–animal subsistence economy during the Magdalenian in Northern Iberia, *J Archaeol Sci*, 60 (2015) 39-46.

4 Boa E R, Wild edible fungi: A global overview of their use and importance to people, In: *Non-Wood Forest Products*, (Food and Agriculture Organization of the united nations, Rome), 17 (2004) 1-297.

5 Teferi Y, Muleta D & Woyessa D, Mushroom consumption habits of Wacha Kebele residents, Southwestern Ethiopia, *Int J Agric Biol Sci*, 4 (2013) 6-16.

6 Barros L, Baptista P, Correia D M, Casal S, Oliveira B, *et al*., Fatty acid and sugar compositions, and nutritional value of five wild edible mushrooms from Northeast Portugal, *Food Chem*, 105 (2007) 140-145.

7 Lampman A M, Tzeltal ethnomycology: naming, classification and use of mushrooms in the highlands of Chiapas, Mexico, PhD. Thesis, University of Georgia, (2004).

8 Deshmukh S K, Biodiversity of tropical Basidiomycetes as sources of novel secondary metabolites, In: *Microbiology and Biotechnology for Sustainable Development*, (CBS Publishers and Distributors, New Delhi), (2004) 121-140.

9 Panda M K & Tayung K, Documentation and ethnomedicinal knowledge on wild edible mushrooms among ethnic tribes of Northern Odisha, India. *Asian J Pharm Clin Res*, 8 (4) (2015) 139-143.

10 Singh R, Bhagawati R & Ngachan S V, Ethno-mycological studies and biodiversity of edible and medicinal mushrooms in West-Siang District of Arunachal Pradesh, India, *Environ Ecol Res*, 35 (2017) 102-105.

11 Parkash V & Girish G, Ethnomycological knowledge of tea tribe and indigenous communities of Upper Assam, India, *Indian J Tradit Know*, 22 (3) (2023) 674-681, DOI: 10.56042/ijtk.v22i3.5758.

12 Khumlianlal J, Sharma K C, Singh L M, Mukherjee P K & Indira S, Nutritional profiling and antioxidant property of three wild edible mushrooms from North East India, *Molecules*, 27 (17) (2022) 5423.

13 Kalita K, Bezbaroa R N, Kumar R & Pandey S, Documentation of wild edible mushrooms from Meghalaya, Northeast India, *Curr Res Environ Appl Mycol*, 6 (4) (2016) 238-247.

14 Singh R, Bhagawati R, Sharma P K & Ramakrishna Y, Wild edible fungal resources: An alternate source of food for Mizoram and Arunachal Pradesh, *Environ Ecol*, 33 (4B) (2015) 1936-1939.

15 Tanti B, Gurung L & Sarma G C, Wild edible fungal resources used by ethnic tribes of Nagaland, India, *Indian J Tradit Know*, 10 (3) (2011) 512-515.

16 Das K, Diversity and conservation of wild mushrooms in Sikkim with special reference to Barsey Rhododendron Sanctuary, *NeBIO*, 1 (2) (2010) 1-13.

17 Debnath S, Upadhyay R C, Das P & Saha A K, Characterization of wild mushrooms from Tripura, Northeast India, *Indian Phytopathol*, 73 (2020) 97-110.

18 Anonymous, *India State of Forest Report*, Published by *Forest Survey* of *India* (Ministry of Environment Forest and Climate Change), 2021.

19 Nunthara C, *Mizoram: Society and polity*, (Indus Publishing Company, New Delhi), 1996.

20 Saha S, Singh S B, Chakrabarty D, Choudhury B U, Das B, *et al*., *Analyzing Mizoram Weather – A Synthesis*, (ICAR Research Complex for NEH Region, Mizoram Centre, Kolasib, 796, 081) (2016) 1-100.

21 Kar A, Bora D, Borthakur S K, Goswami N & Saharia D, Wild edible plant resources used by the Mizos of Mizoram, India, *Kathmandu University J Sci Eng Tech*, 9 (1) (2013) 106-126.

22 Kumari B, Sharma V P, Barh A & Upadhyay R C, *Mushroom: Wealth of India*, (Bishen Singh Mahendra Pal Singh, 23-A, New Connaught Place, Dehradun- 248001), 2022.

23 Campbell J L, Quincy C, Osserman J & Pedersen O K, Coding in-depth semi-structured interviews: problems of unitization and intercoder reliability and agreement, *Sociol Methodol Res*, 42 (3) (2013) 294-320.

24 Moeller G H, Mescher M A, More T A & Shafer E L, The informal interview as a technique for recreation research, *J Leis Res*, 12 (1980) 174-182.

25 Arora D, Wild mushrooms and rural economies, *Br Mycol Soc Symp Ser*, 22 (2001) 105-110.

26 Ping Z, Xu H, Liu T, Huang J, Meng Y, *et al*., Anti-hepatoma activity of the stiff branched β-d-glucan and effects of molecular weight, *J Mater Chem B*, 4 (2016) 4565-4573.

27 Reza M A, Jo W-S & Park S-C, Comparative antitumor activity of jelly ear culinary-medicinal mushroom, *Auricularia auricula-judae* (Bull.) J. Schrot. (higher basidiomycetes) extracts against tumor cells *in vitro*, *Int J Med Mushrooms*, 14 (4) (2012) 403-409.

28 Vishwakarma P, Singh P & Tripathi N N, Nutritional and antioxidant properties of wild edible macrofungi from North-Eastern Uttar Pradesh, India, *Indian J Tradit Know*, 15 (1) (2016) 143-148.

29 Paul M & Sarma T C, Significance of macrofungi among various ethnic tribes residing in and around various forest areas of Assam: An ethnomycological survey, *Curr Res Innova Plant Pathol*, 16 (2022) 71-82.

30 Roman M D, The contribution of wild fungi to diet, income and health: a world review, *Prog Mycol*, (2010) 327-348.

31 Zhang Y, Jiang Y, Zhang M & Zhang L, *Ganoderma sinense* polysaccharide: An adjunctive drug used for cancer treatment, *Prog Mol Biol Transl Sci*, 163 (2019) 165-177.

32 Vishwakarma P & Tripathi N N, Ethnomacrofungal study of some wild macrofungi used by local peoples of Gorakhpur district, Uttar Pradesh, *Indian J Nat Prod Resour*, 10 (1) (2019) 81-89.

33 Verma R K, Pandro V, Mishra S N & Asaiya A J K, Sal forest: a source of wild edible mushrooms for livelihood support to tribal people of Dindori district, Madhya Pradesh, India, *Int J Curr Microbiol Appl Sci*, 8 (1) (2019) 563-575.

34 Lahiri S S, Shukla M D, Shah M B & Modi H A, Documentation and analysis of certain macrofungal traditional practices from Western-India (Gujarat), *Ethnobot leafl*, 5 (2010*)* 9.

35 Pala S A, Wani A H & Bhat M Y, Ethnomycological studies of some wild medicinal and edible mushrooms in the Kashmir Himalayas (India), *Int J Med Mushrooms*, 15 (2) (2013) 211-220.

36 Ker Y B, Chen K-C, Peng C-C, Hsieh C-L & Peng R Y, Structural characteristics and antioxidative capability of the soluble polysaccharides present in *Dictyophora indusiata* (Vent. Ex Pers.) Fish Phallaceae, *Evid Based Complement Altern Med*, 2011 (2011) 396013.

37 Sachan S K S, Patra J K & Thatoi H N, Indigenous knowledge of ethnic tribes for utilization of wild mushrooms as food and medicine in similipal biosphere reserve, Odisha, India, *Int J Agric Technol*, 9 (2) (2013) 403-416.

38 Dutta A K & Acharya K, Traditional and ethno-medicinal knowledge of mushrooms in West Bengal, India, *Asian J Pharm Clin Res*, 7 (4) (2014) 36-41.

39 Dixit B & Ekka R, Mushroom diversity conservation through tribal women in Achanakmar-Amarkantak Biosphere Reserve, *Indian J Tradit Know*, 22 (2) (2023) 444-449, DOI: 10.56042/ijtk.v22i2.32288.

40 Okigbo R N & Nwatu C M, Ethnostudy and usage of edible and medicinal mushrooms in some parts of Anambra state, Nigeria, *Nat Resour*, 6 (1) (2015) 79-89.

41 Ao T, Seb J, Ajungla T & Deb C R, Diversity of wild mushrooms in Nagaland, India, *Open J For*, 6 (5) (2016) 404-419.