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DOCUMENTATION OF FOUR HITHERTO UNREPORTED WILD EDIBLE MACRO FUNGI FROM CHIRANG DISTRICT OF ASSAM, NORTH-EAST INDIA

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Abstract

Wild edible fungi are fleshy, edible fruit bodies of macro fungi which are literally consumed by humans for their nutritional and medicinal values since time immemorial. The present study aims to document ecological relationship and utilization pattern of wild edible fungi as an important source of food consumed by the Bodo tribes of Chirang district of Assam, North-east India. Owing to their rich biodiversity, a variety of wild edible macro fungi have been collected from forest fringe areas of Chirang reserve forest during rainy period. A total of 14 *macro fungal species representing* 12 *genera from* 10 *families belonging to the order Agaricales* (64.3%), *Polyporales* (21.4%), *Auriculariales and Phallales* (7.2%) *were collected. The ecological relationship shows that maximum species were saprophytic in nature* (10 no's) *along with some parasitic and symbiotic species. Overall four edible and medicinal species were recorded for the first time from Chirang district of Assam. Among them* ***Termitomyces sp.*** (83.3%) *showed maximum frequency whereas* ***Dictyophora sp.*** *and* ***Ganoderma applanatum*** *showed minimum frequency* (16.6%). *Maximum density was recorded for* ***Macrolepiota procera*** (7.6) *and minimum density was recorded for* ***Ganoderma applanatum*** (0.16.).

Keywords: *Wild edible fungi; Ethnic tribes; Biodiversity; Chirang district; Assam*.

Introduction

Wild edible fungi (WEF) are fleshy fungal spores which are mostly valued as non-wood forest products and are consumed as food sources due to their rich nutrition along with their supposed medicinal values. They therefore contribute towards diet, human health and income. Many species also plays a vital ecological role through the symbiotic relationships known as mycorrhizas forming mutual association with trees. Numerous varieties of edible mushrooms exist in nature with more than 1100 species recorded so far [1], however less than 25 percent are widely accepted as food sources and only a few have attained the level of an item of commerce [2]. Significant quantities of these fungi are eaten through personal collections from wild that go unrecorded. WEF are reported to be a good source of proteins and minerals [3-5] contributing substantiality to the diets of rural poor peoples. Studies confirm that they are used as an increasing source of income for small-scale enterprises in developing as well as developed countries [6, 7].

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The use of highly valued WEF has been reported in ancient Greek and Roman times [8] and in different continents and countries including India. Probably in China, the consumption of wild fungi was first reliably noted several hundred years before the birth of Christ [9]. WEF are utilised in more than 80 countries and a huge range of wild fungi collected from forests or fields are also marketed widely [10]. India is known for its varied cultures, languages and is inhabited by more than 2000 ethnic tribes who eat and exploit WEF since age-old times. Since the tribal people live very close to nature, they have tremendous knowledge about the utilization of various forest products, possess adequate knowledge about wild macro fungi and are able to distinguish the edible fungi from the poisonous ones. The macro fungi consumed by the people are seasonally harvested from forest areas every year but no efforts have been yet made to cultivate these varieties on a commercial scale. The local people collect the macro fungi directly from forests for their consumption because of their taste and health benefits. However, the ancient tradition of gathering and consuming mushrooms from the wild is gradually on the decline which may be due to their non-availability at all times, fondness of people leading to immediate harvesting from wild and their host specific nature. The uses of WEF have been documented from different parts of India [11-17]. Despite having favorable climates for fungal growth only few are reported from north eastern region of India which may be due to the ignorance of the people regarding their benefits and nutritional values. In Northeast India, wild edible macro fungi have been reported from Assam [18, 19], Manipur [20] and from Meghalaya [21]. The Indian state of Assam, which lies in the northeast of Himalaya, is a rich repository of the unexplored macro fungal wealth due to its varied climatic and topographic conditions, thus providing congenial environment for the lavish growth of this heterogeneous group of fungi. The present study therefore aims at documenting and identifying the most widely collected and consumed macro fungi consumed by the ethnic Bodo tribes of Chirang district of Assam, Northeast India along with some traditional and contemporary uses of these macro fungi as sources of food or medicine.

Materials and method

During recent ecological and botanical inventories, field tours were undertaken at Chirang reserve forest that lies between 26° 0.06´ 56.05½ N to 26° 0.54´ 21.95½ N latitude and 90° 0.12´ 03.76½ E to 90°0 29´ 07.02½ E longitude under Ripu-Chirang reserve forest of Assam, India. Chirang district is one of the four districts of Bodoland Territorial Area District (BTAD) under the Government of Assam (Fig 1). Inventorizations of macro fungi were done for a period of three months during two consecutive years i.e., June to August, 2013 & 2014. Based on information from local peoples, two village areas within Chirang forests namely Kumarsali and Subhaijhar were surveyed at weekly intervals. Information regarding their edibility and mode of preparation were collected by semi-structured open ended questionnaire and continued discussions with the local village people. Ethno mycological information was recorded from reliable sources such as Ojhas, elderly persons and local inhabitants who were considered to have good knowledge of these wild resources of the region who accompanied us to the forests as guide cum informants. Samples were collected and identified with the help of standard literatures [22, 23] and in consultation with internet site (www.mycoweb.com/CAF/skey/html) to facilitate proper identification. Frequent interviews were conducted to verify and authenticate the information. Specimens were photographed (Fig. 1 and 2) and the substrates for macro fungi on which the samples were growing were also recorded with identification confirmed by studying the microscopic characters as well as by their spore prints. Each specimen were collected and labeled indicating their number, date of collection, locality and ethno mycological uses. All samples have been deposited in the herbarium of Forestry Department, NERIST, Itanagar for further authencity.

Frequency and density of occurrence of macro fungi was observed and calculated by using standard formula given below.

Frequency study

Frequency of fungal species (%) = Number of sites in which the species is present X 100 Total number of sites

Density study

Density of fungal species (%) = Total number of individuals of species X 100 Total number of sites

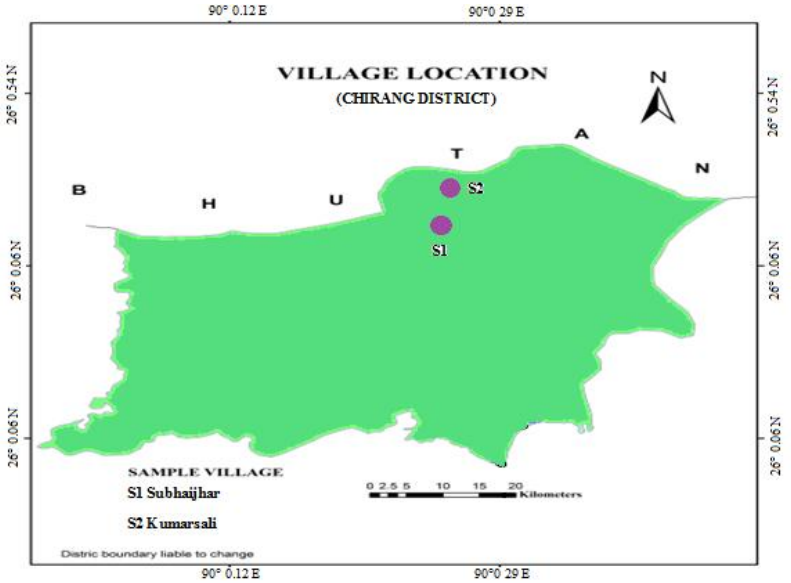

Fig. 1. Map of the study site surveyed in Chirang forest range for macro fungal diversity

Results

The diversity of macro fungi is determined by the type of habitat in which it occurs. Many factors like geographic location, elevation, humidity, light, temperature as well as the flora of the surrounding area greatly influences the growth and development of macro fungi. From the present study fourteen macro fungal species representing twelve genera and nine families were recorded. Study of diversity revealed that maximum frequency was recorded for *Termitomyces* sp. (83.3%) followed by *Macrolepiota procera* (66.6%) and *Auricularia judae* (50%). The frequency of the rest of the species ranged between 16.6% to 33.3%. Similarly maximum density was recorded for *Bovista plumbea* (20%) followed by *Macrolepiota procera* (7.6%) and by *Bjerkandera* sp. (5.5%) (Table 1).

The ecological preference of this macro fungi revealed that maximum species were saprophytic i.e., ten out of fourteen were found to be saprophytic, two were parasitic and one mycorrhizal. The parasitic fungi are *Bjerkandera* sp. and *Ganoderma applanatum*. *Termitomyces* sp. exhibits obligate symbiosis with termite and they survive only in association with termites and in turn the termites also depend on the fungus for its sustenance. A total of four edible species namely *Agrocybe pediades*, *Bovista plumbea*, *Macrolepiota procera* and *Termitomyces sp.* was recorded for first time from Chirang district. This fungi were much relished and eaten by this ethnic Bodo tribe of the region and out of this four edible species *Bovista plumbea* was reported to have medicinal use in curing skin ailments (Table 2).

Table 1. Wild macro fungi collected from Chirang **Reserve Forest of Assam**

Sl. No.	Name of the species	Order	Family	Ecological Relationship	Host / Substratum	Uses	Frequency (%)	Density (%)
1.	*Agrocybe pedides* (Fr.) Fayod.	Agaricales	Strophariaceae	Saprophytic	In open area associated with grasses, especially with *Cynodon sp.*	Edible	33.3	4.6
2.	*Auricularia auricula-judae* (Bull. ex St. Amans) Wettst.	Auriculariales	Auriculariaceae	Saprophytic	Both on dead wood and decaying substrates	Non edible	50	1.6
3.	*Bjerkandera* sp.	Polyporales	Meruliaceae	Parasitic	On tree trunk and branches of hardwoods	Non edible	33.3	5.5
4.	*Bovista plumbea* Pers.	Agaricales	Agaricaceae	Saprophytic	Grows on old pastures, on ground as solitary	Edible	33.3	20
5.	*Coprinus comatus* (Fr) Pers.	Agaricales	Agaricaceae	Saprophytic	Grows on lawns or at the edges often in large groups	Non edible	33.3	4.6
6.	*Coprinus plicatilis* (Fr.)	Agaricales	Agaricaceae	Saprophytic	Grows on lawns and other grassy places	Non edible	33.3	2.3
7.	*Coprinus* sp. (Fr.)	Agaricales	Agaricaceae	Saprophytic	Grows on ground at grassy places	Non Edible	33.3	1.3
8.	*Dictyophora* sp. (Desv.)	Phallales	Phallaceae	Saprophytic	On ground amongst leaf litter in damp woodland	Non Edible	16.6	0.86
9.	*Entoloma sp.*(Fr.) P. Kumm	Agaricales	Entolomataceae	Symbiotic	Grows on ground near tree roots	Non Edible	33.3	1.6
10.	*Ganoderma applanatum* Patouillard	Polyporales	Ganodermataceae	Parasitic	Grows on trunk of standing tree	Non Edible	16.6	0.16
11.	*Lepiota* sp.(Pers.) Gray	Agaricales	Agaricaceae	Saprophytic	On ground with rich humus	Non Edible	33.3%	2.5
12.	*Macrolepiota procera* (Scop. ex Fr.) Singer	Agaricales	Agaricaceae	Saprophytic	On old pastures, mixed forest and on woods	Edible	66.6	7.6
13.	*Podoscypha* sp. Pers.	Polyporales	Meruliaceae	Saprophytic	On the ground in deciduous woods	Non-edible	33.3	3.5
14.	*Termitomyces sp.* (Natarajan)	Agaricales	Lyophyllaceae	Obligate Symbiotic	On compost heap of termite nest in evergreen forest	Edible	83.3	3.2

Table 2. Four hitherto unreported wild edible mushrooms reported from the study area

Sl. no	Name of the edible specimen	Local name	Preparation and usage	Medicinal value	Utilization and reference
1	*Agrocybe pedides* (Fr.) Fayod	Mwikhun	Eaten by preparing curry and sometimes cooked with fish.	Not used as a medicine.	It is reported to have antimicrobial and antioxidant properties [29]
2	*Bovista plumbea* Pers.	Mwikhun daudwi	Fresh fruiting bodies are used by the Bodos for making vegetable. They first boil them, decant the water and then fry them in oil.	Used in the treatment of sores, ulcers and skin infection from powdered fruiting bodies	Reported to have anti oxidant property [27]
3	*Macrolepiota procera* (Scop. ex Fr.) Singer	Mwikhun	Eaten by frying the fruit bodies in oil. Sometimes cooked with meat.	Not used as a medicine here.	Reported to demonstrate anti-tumor activity and exhibit an antibiotic activity against gram negative bacteria. As food it is known to sustain physiological homeostasis of the body [10]
4	*Termitomyces* sp. (Natarajan)	Uri mwikhun	They are highly prized mushrooms and are eaten by making curry.	Not used as a medicine here.	Reported to have anti-hypertensive property, used as food and they have higher consumer preferences due to their unique flavor and texture [30]

Taxonomy of these fungi are described as follows:

1. *Agrocybe pediades* (Fr.) Fayod:

This mushroom was found inhabited in grassy forest area and are mostly saprobic in nature growing scattered alone or gregariously in grass. Cap is plano convex, 1.0-3.0cm broad, broadly convex or nearly flat, yellow brown or paler, margin at first slightly incurved, then decurved, nearly plane at maturity; margin surface smooth, sticky when moist. Gills adnate to adnexed, moderately broad, attached to the stem; pale grayish brown to rusty or cinnamon brown at maturity, covered by an ephemeral white partial veil when young, slender and equal, stipe 3-4cm long, 1-2mm broad, stem 2-6cm long, 1.5-2mm thick; more or less equal; smooth; concolorous with the cap and sometimes twisted grooved. Flesh usually pale and thin, found scattered in grasses and fruit in summer. Spores are elliptical with cellular cuticle, smooth with an apical pore. Spore print is brown. Spores are 10-13×8-9µm. They are eaten by the ethnic tribes soon after collection as fresh when the gleba is white.

2. *Bovista plumbea* (Pers.):

It is commonly called as the rolling puffball, mostly grows amongst short grasses and pastures, fruit body is sub-spherical, smooth 2-5cm across, stem less, the outer scale or the exoperidium is white at first which gradually turns greyish laterally splitting revealing a greyish inner peridium. The inner peridium forms a roughly circular apical hole on bursting with white gleba that turns olive brown as the spore mass matures revealing brownish spores. Capillitium thread was 2mm thick with reddish brown thick wall, dichotomously branched, branches terminate in sharp tapered tips without septa or pores. Spores sub-globose to broadly ellipsoidal with a very warted surface, 4.5-7.2×5-5.8µm tapering freely creating a tadpole like appearance, thick-walled and nearly smooth. Sprouting period May to October and are edible when young.

Both young and old sporocarps of *Bovista* are eaten but young ones are preferred more than the old ones. They are also sometimes sundried to preserve and eaten later. It is used medicinally in the treatment of sores and skin ulcers.

3. *Macrolepiota procera* (Scop.):

It is a basidiomycete's fungus with a large, prominent fruiting body resembling a parasol. Its cap is 5-8cm and more oval in young stage which later becomes convex to broadly convex with age along with a dark central bump, initially spherical and brown with a dark brown area at the apex, coarsely scaly, but crown smooth, not sharply scaly. When mature it expands into a flattened structure with an umbo. Cap flesh is white, ring membranous, on drying moving freely and spores usually over 7µm usually with clamps. Gills are white and free from the stems (stipe) which becomes movable. A ring persists on the stipe. Stipe is smooth and white with brown scales. Stipe is 14-20cm in length or 0.5-1.5cm broad, with long stems, slender with an enlarged base, pale above the ring but below the ring it consists of small brown scales that break up as the mushroom matures creating zones or sometimes disappearing with a double edge drying that moves freely up and down the stem. Spores are ellipsoid and smooth with a germ pore. It is 12-17×9-12 µm. The fruiting bodies of this macro fungus are eaten fried.

4. *Termitomyces heimii* (Heim.):

It is a rare and highly sought edible mushroom that grows seasonally and in symbiosis with other termites. Pileus 7 cm in diameter, surface smooth, convex, when young prominently subumbonate, margin uncurved, white with the umbo region when young, grey and brownish grey when mature, context fleshy white, lamellae free, white becoming pink, up to 8 mm broad, margin serrate, lamellulae present, stipe up to 19 cm long and up to 1.5 cm wide, white, smooth, cylindrical and stuffed with a thick annulus. Stipe is 15cm long and up to 1.5cm wide, smooth

and cylindrical. Pseudorhiza present up to 12cm below the ground level. Spores 7.0-8.3×4.3×5.4µm, ellipsoid, smooth and hyaline. The fruiting bodies of this macro fungus are eaten fried.

1. *Agrocybe pediades* in field and after collection

2. *Bovista plumbea* in field and after collection

3. *Macrolepiota procera* in the field and after collection

4. *Termitomyces sp.* in the field and after collection

Fig. 2. Photographs of four unreported wild edible fungi reported from Chirang district of Assam

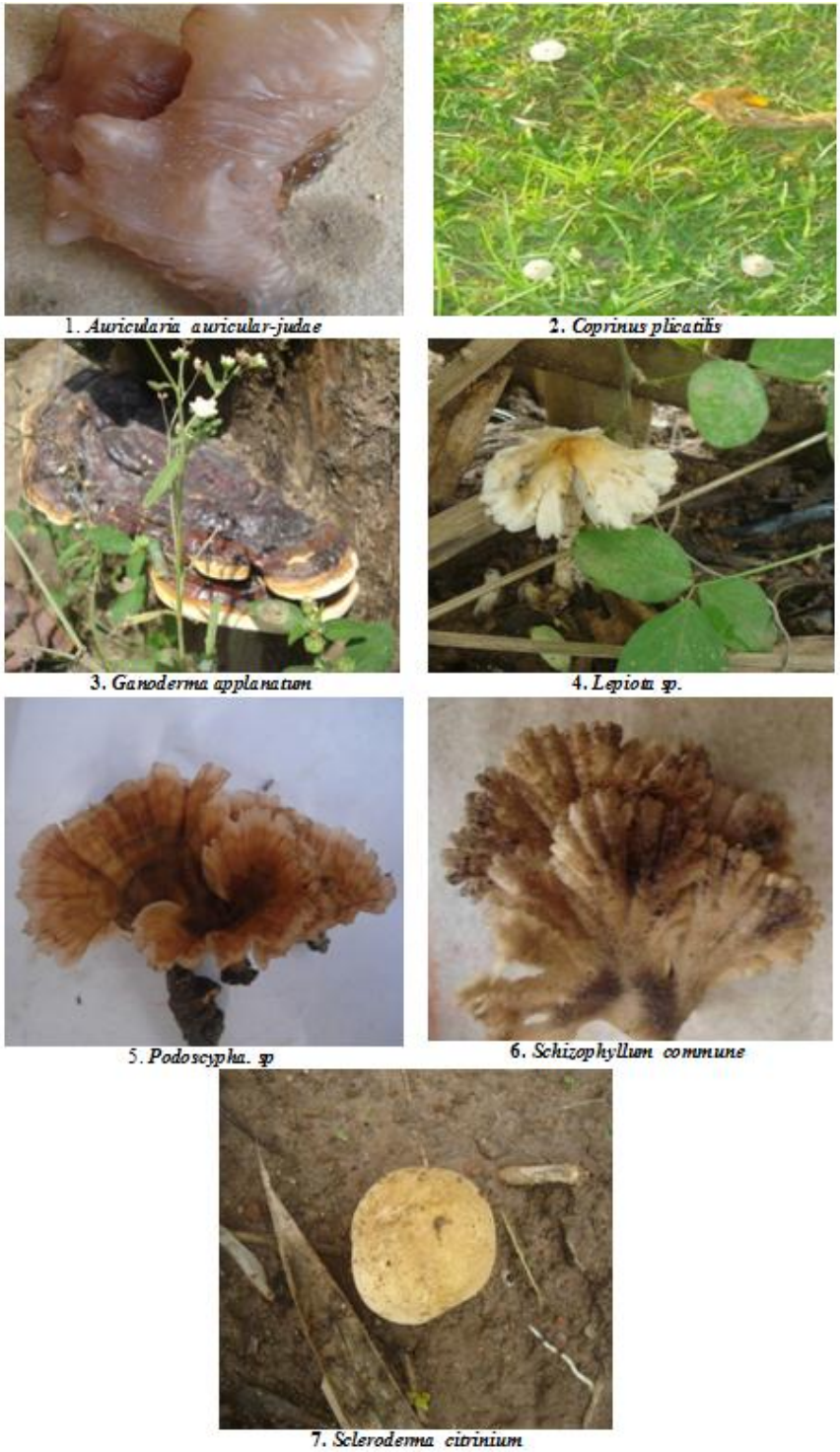

Fig. 3. Photographs of some wild edible fungi recorded from Chirang district of Assam

Discussion

Diversity studies on macro fungi were done both in India as well as in north east India. Forty macro fungal species were identified [24] from the forests of Garhwal Himalaya. Further 39 species were reported from the Coromandel Coast of Tamil Nadu, South India [25] and 29 species were recorded from West Assam [26]. Potential antioxidant activity of mushrooms growing in Kashmir valley were determined [27] and the mushrooms which were found to have anti oxidant activity were *Cantharellus cibarius*, *Bovista plumbea*, *Coprinus comatus* and *C. atramentarius* with parasitic species of *G. applanatum* showing to have antioxidant, hypoglycemic and anti hypertension activity [28].

Conclusion

The present investigation focuses upon a great need for thorough, careful and comprehensive macro fungal investigation in locations of Chirang district in Assam state of India. This ethno-mycological study is the first documentation about the use of four macro fungi by Bodo tribes of Assam. Seeing increasing importance of the wild edible mushrooms to fulfill dietary requirement of rural populace, we recommend regular surveys to be done over an extended period in order to assess the patterns of abundance of these wild edible mushrooms in different seasons. Through studies, the harvesting strategies and management plans may be formulated and implemented to ensure maximum use of these socially, ecologically and economically important species. Since FAO has recommended the use of edible mushrooms as major food supplement for protein deficient masses, simple and efficient low cost technology can also be introduced for utilization and production of these socio economical species.

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References

[1] E. Boa, *Wild edible fungi - A global overview of their use and importance to people*, **Non Wood Forest Product** (FAO, Rome), **17,** 2004, pp. 1-147.
[2] J. Smith, *Commercial mushroom production*, **Process Biochemistry, 7**, 1972, pp. 24-26.
[3] F. Senator, *Fatty acid and free amino acid content of some mushrooms*, **Journal of Science Food Agriculture, 51**, 1990, pp.91-96.
[4] S.R.A. Adewusi, F.V. Alofe, O. Odeyami, O.A. Afolabi, O.L. Oke, *Studies on some edible wild mushrooms from Nigeria:1, Nutritional, teratogenic and toxic consideration*, **Plant Food and Human Nutrition**, **43,** 1993, pp. 115-121.
[5] V.A. Aletor, O.O. Aladetimi, *Compositional studies on edible tropical species of mushroom*, **Food Chemistry, 54**(3), 1995, pp. 256-268.
[6] D. Hosford, D. Pilz, R. Molina, M. Amaranthus, *Ecology and management of commercially harvested American Matsutake mushroom*, **General Technical Report PNW-GTR-412, US Department of Agriculture, Forest Service**, Pacific Northwest Research Station, 1997, p. 68.

[7] J.L.G. Wong, K. Thornber, N. Baker, *Resource Assessment of Non Wood Forest Products*. Experience and Biometric Principles, **Non Wood Forest Products** (FAO Rome), Vol. **13**, 2001, p. 221.
[8] A.H.R. Buller, **The Fungus Lores of the Greeks and Romans,** Transactions of the British Mycological Society, 1914, pp. 21-66.
[9] S. Aaronson, *Fungi*, **The Cambridge World History of Food** (Editors: K.F. Kiple and K.C. Omelas), Cambridge University Press, 2000, pp. 313-336.
[10] S.M. Shim, Y.H. Oh, K.R. Lee, S.H. Kim, K.H. Im, J.W. Kim, U. Lee, J.O. Shim, M.J. Shim, M.W. Lee, H.S. Le, T.S. Lee, *The Characteristics of Cultural conditions for the mycelial growth of Macrolepiota procera*, **Mycobiology**, **33**(1), 2005, pp. 15–18.
[11] P.A. Sheikh, G.H. Dar, M.A. Beig, S. Kousar, *Two hitherto unreported macrofungi from Zabarvan Range of Kashmir Himalaya, India*, **Caribbean Journal of Science and Technology**, **2**, 2014, pp. 399-404.
[12] S. Kumar, Y.P. Sharma, *Some potential wild edible macrofungi of Jammu Province (Jammu and Kashmir), India*, **Indian Journal of Forestry**, **32**(1), 2009, pp. 113-118.
[13] S.S. Lahiria, M.D. Shuklab, M.B. Shaha, H.A. Modi, *Documentation and Analysis of Certain Macro fungal Traditional Practices from Western-India (Gujarat)*, **Ethnobotanical Leaflets**, **14**(5), 2010, pp. 626-641.
[14] P. Vishwakarma, P. Singh, P. Mishra, N.N. Tripathi, *Diversity of wild edible mushroom from Gorakpur, Uttar Pradesh, India*, **International Journal of Pharmacy and Life Sciences**, **5**(7), 2014, pp. 3643-3647.
[15] J. Chauhan, A.K. Negi, A. Rajasekaran, A.P. Nazir, *Wild edible macro-fungi- A source of supplementary food in Kinnaur District, Himachal Pradesh, India*, **Journal of Medicinal Plants Studies**, **2**(1), 2014, pp. 40-44.
[16] N. Usha, G.R. Janardhana, *Diversity of Macro fungi in the Western Ghats of Karnataka (India)*, **The Indian Forester**, **140**(5), 2104, pp. 531-536.
[17] K. Moses, *Mushrooms and Macro fungi from Jnanadweepa*, **Proceedings of National Conference on Biodiversity: Status and Challenges in Conservation** - 'FAVEO', 2013. pp. 184-188.
[18] A. Tapwal, R. Kumar, S. Pandey, *Diversity and frequency of macrofungi associated with wet ever green tropical forest in Assam, India*, **Biodiversitas**, **14**(2), 2013, pp. 73-78.
[19] T.C. Sarma, I. Sarma, B.N. Patiri, *Wild edible mushrooms used by some ethnic tribes of Western Assam*, **Bioscan**, **3**, 2010, pp. 613-625.
[20] M.N. Singh, G.K.N. Chhetry, *Biodiversity of macro fungi in Imphal, India-1*, **Indian Phytopathology**, **63**(1), 2010, pp. 79-82.
[21] P. Khaund, S.R. Joshi, *Wild edible macro fungal species consumed by the Khasi tribe of Meghalaya, India*, **Indian Journal of Natural Products and Resources**, **4**(2), 2013, pp. 197-204.
[22] G.J. Keizer, **The Complete Encyclopedia of Mushrooms**, Rebo Publishers, Netherland, 1998, pp. 268.
[23] J.L. Lamaison, J.M. Polese, **The Great Encyclopedia of Mushrooms**, Cologne, Konemann, Germany, 2005, pp. 20-21.
[24] M.P. Vishwakarma, R.P. Bhatt, S. Joshi, *Macro fungal Diversity in Moist Temperate Forests of Garhwal Himalaya*, **Indian Journal of Science and Technology**, **5**(1), 2012, pp. 1928-1932.
[25] S. Mani, V. Kumaresan, *Occurrence of macro fungi on the Coromandel coast of Tamil Nadu, Southern India*, **Journal of Threatened Taxa**, **1**(1), 2009, pp. 54-57.
[26] R. Sullivan, J.E. Smith, N.J. Rowan, "*Medicinal mushrooms and cancer therapy: translating a traditional practice into Western medicine"*, **Perspectives in Biology and Medicine, 49**(2), 2006, pp. 159–170.

[27] A.H. Wani, R.H. Boda, Taskeen-un-Nisa, L.A. Peer, *Potential antioxidant activity of some mushrooms growing in Kashmir Valley*, **Mycopath**, **8**(2), 2010, pp. 71-75.
[28] O.V. Oyetayo, *Medicinal uses of mushrooms in Nigeria: Towards full and sustainable exploitation*, **African Journal of Traditional, Complementary and Alternative Medicines**, **8**(3), 2011, pp. 267-274.
[29] M. Al-Fatimi, G. Schroder, H. Kreisel and U. Lindequist, *Biological activities of selected basidiomycetes from Yemen*, **Pharmazie**, **68**(3), 2013, pp. 221-226.
[30] R. Walting, *Assessment of fungal diversity; Macromycetes, the problems*, **Canadian Journal of Botany**, **73**(1), 1995, pp. 15- 24.

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