Ethnomycological Knowledge on Wild Mushrooms by tribes of Mokokchung, Nagaland, North East India

Rajesh Kumar, Shailesh Pandey, Ashwani Tapwal, R Raja Rishi, Krishna Giri, Gaurav Mishra

Abstract
The tribal people of Mokokchung district, Nagaland, India have been using wild edible mushrooms as a potential medicinal and supplementary food source. Present paper documents the hidden knowledge on edible, medicinal and poisonous macrofungi by the ethnic tribes of this district. Our study revealed that twenty edible macrofungi belonging to thirteen families are used by tribals as supplementary food. Family Agaricaceae had four species, Lyophyllaceae had three species, Tricholomataceae and Pleurotaceae had two species while all other nine families had one species each. Cantherallus cibarius, Termitomyces mammiformis, Termitomyces albuminosus, Termitomyces heimii, Hypsizygus tessellates, Pleurotus pulmonarius and Pleurotus ostreatus were found to be most significant supplementary food source. Many edible macrofungi such as Russula nobilis, Russula fragrantissima, Amanita pantherina, Amanita rubrovolvata, Coprinus disseminates, Hygrocybe miniata, Clitocybe odora, Armillaria tabescens and Clitocybe fragans were considered as poisonous by more than eighty percent respondents interviewed. Auricularia auricular, Ganoderma lucidum, Hypsizygus tessellates and Entoloma bloxami are in current medicinal use for the treatment of different diseases. Further, the mushroom species collected from the market and the forest areas were identified authentically. Our study thus, emphasizes the need to document the traditional knowledge pertaining to the use of wild mushrooms for more benefit to mankind.

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Of the 2,000 mushroom species, nearly 700 species are well studied to possess varying degree of edibility and more than 300 species spread over in 31 genera are regarded as prime edible. Thus far, only 200 of them are experimentally cultured, 100 economically cultivated, approximately 60 commercially grown and about 10 have reached an industrial scale (Chang et al., 2004). Recent reports showed a tradition of wild mushroom picking, their consumption and sale in the market in countries like Mexico, Italy, Australia and many others (Arora, 2008; Guzman, 2008; Sitta and Floriani, 2008). However, the ecological data available on some of the taxa is still not enough and systematics of wild mushrooms has received more attention than other threatened aspects like conservation. Ethnomycological aspects were also dealt with by few workers in different parts of India and world over (Harsh et al., 1993; Bulakh, 2001; Didukh, 2001; Adhikary et al., 2005). Some of the wild edible mushrooms have also been reported from Manipur, Arunachal Pradesh and Nagaland state of North East India (Kumar et al., 2013; Sing and Sing 1993; Sing et al., 2002, Tanti et al., 2011). Information on the wild edible, poisonous and medicinal mushrooms used by the local tribes of Nagaland, India is very scanty. Therefore, the present study was designed to decipher the diversity of wild edible/medicinal mushrooms used by the ethnic tribes of Mokokchung, Nagaland, India and their scientific identification.

1.1 Study area
Nagaland is situated in the North-eastern part of India within the longitude of 25° 6' E to 93° 15' E and Latitude 25°10' N to 27°4' N. It comprises of eleven districts with an area of 16,579 sq. km. The altitude ranges between 194-3826 m and the forest cover is about 80.33% of state's geographic area (ISFR, 2011). Mokokchung, one of the districts of Nagaland covers an area of 1,615 sq km. It is bounded by Assam to its north, Wokha to its west, Tuensang to its east, and Zunheboto to its south. Mokokchung is mainly inhabited by the Aoo Naga tribe. The Ao’s belong to three dialectical groups, namely, Chungli, Mongsen and Changki with the exception of Merinokpo Village whose dialect is somewhat akin to that of the Phom Nagas of Longleng area. Other communities have also settled in this District.

2. Methodology
The documentation of wild edible macrofungi used as supplementary food was collected through semi-structured questionnaire interviews and discussions with the residents of study area. Frequent field visits were carried throughout the district Mokokchung from July 2011 to November 2013 to document the wild macrofungi. This involved reconnaissance survey and interactions with the village headman and the people in groups, so as to build confidence with them and to get acquainted with the area. After reconnaissance survey, a total of fifteen villages from six blocks viz. Alongkima, Changtongya, Kubulong, Longchem, Mangkolemba and Ongpangkong were selected. Informants/households were first identified through informant referral by other informants as knowledgeable. In order to verify the identity of macrofungi species mentioned by the respondents, field visits were undertaken with the respondent. The
macrofungi specimens were collected and verified from the respondents who had mentioned the species as wild edible. These have been presented here alphabetically with their botanical name, local name, family, part used, distribution and mode of use. The collection of specimens was also done from different markets of the localities in order to gather information in regards to their place of occurrence. Collected samples were wrapped in cellophane paper and brought to the laboratory for their identification. The macrofungi with leathery texture were preserved in 4% formaldehyde solution whereas the samples with soft texture were preserved in 2% formaldehyde solution and kept as herbarium specimens in museum of Forest Protection Division, Rain Forest Research Institute, Jorhat, Assam by assigning identification number. Dried specimens were also preserved for identification, characterization and documentation. The habitat, colour, shape and size, growth, texture, odour and adaptation to the environment considered prior to the preservation of the collected macro fungi. Identification of the specimens were carried out by standard microscopic methods (Roy and De, 1996), and also considering various morphological and anatomical features into account (Zoberl, 1972, Ryvarden and Johansen, 1980, Dickinson and Lucus, 1982, Sharma, 2000).

3. Results and Discussion

During this period of two years the outcome of the regular survey, 20 different species of edible macrofungi belonging to 13 families were identified (Table 1, Figure 1). Family Agaricaceae had four species, Lyophyllaceae had three species, Tricholomataceae and Pleurotaceae had two species while all other nine families had one species each. Cantherallus cibarius, Termitomyces mammiformes, Termitomyces albuminosus, Termitomyces heimii, Hypsizygus tessellates, Pleurotus Pulmonarius and Pleurotus ostreatus were recorded. Mushroom species collected from the local market and the forest areas were identified authentically. The description of the species is as follows.

**Auricularia auricularia** (Hook)
Fruit body was 3-8 cm broad, gelatinous, ear shaped, outer surface brown with minute hairs, and inner surface tan-brown. Spore print was white. Spores measure 14-17×5-8µm, white, sausage shaped basidia cylindrical with three transverse septa.

**Amanita vaginata** (Bull)
Cap up to 5.5-10.5 cm, convex, centrally raised area (an umbo), edge is striated with comb like edges, and flesh was white and firm. Stem was 5-13 cm long, 1.0-2.0 cm thick, hollow, narrower near the cap, unlike many other *Amanita* species, does not have a ring, base enclosed in a sack-like, white volva that fits loosely around the stem. Gills were white, adnexed (narrowly attached to the stem), the edges minutely fringed. Spore print was white. Spores measure 7-11 µm, smooth, thin-walled and rounded.

**Agaricus augustus** (Fr.)
Cap was hemispherical in button stage, and then expands, becoming convex and finally flat, with a diameter of up to 22 cm. Cap cuticle was dry, and densely covered with concentrically arranged, brown-color scales on a white to yellow background. Gills were crowded and pallid at first, and turn pink then dark brown with maturity. Stem was clavate up to 20 cm tall and 4 cm thick. In mature specimens, the partial veil was torn and left behind as a pendulous ring adorning the stem. Above the ring, the stem was white to yellow and smooth. Below, it was covered with numerous small scales. Flesh was thick, white and sometimes has a narrow central hollow. Stem base extends deeply into the substrate. Spores measure 7–10 by 4.5–6.5 µm, ellipsoid and smooth. Basidia were 4-spored.

**Agaricus arvensis** (Schaeff. ex Secr. s.): Cap was 7-20 cm across; convex at first, often with a somewhat flattened center; later broadly convex or flat; dry; white or pale yellowish when young; developing pressed-down fibers or scales; bruising yellow; the margin often with hanging partial veil remnants. Gills were free from the stem, crowded; whitish at first, becoming brown. Stem was 4-12 cm long and 1-2 cm thick; slightly bulbous and smooth. Ring was present with a double membrane, the lower splitting into a star-shape around the stem. Spore print was dark brown. Spores measure 7-8 x 4.5-5.5 µm, ellipsoid and smooth.

**Cantherallus cibarius**
(L) Fr.: Cap was 3-11 cm wide convex at first with inrolled margin (edges), funnel shaped with a wavy margin with yellow orange color. Stipe was 2-9 cm long and 0.5-3.5 cm thick, length of the stipe was similar to the width of the cap. Gills were ridges that are forked and with blunt edges. Flesh was yellowish white. Spore print was white. Spores measure 8–10 x 4.5–5.5µm, elliptical and smooth.
Table 1: List of edible macro fungi in Mokokchung, Nagaland

<table>
<thead>
<tr>
<th>Name of the species</th>
<th>Class</th>
<th>Family</th>
<th>Host</th>
<th>Uses</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Auricularia auricular</em> (Hook)</td>
<td>Basidiomycetes,</td>
<td>Auriculariaceae</td>
<td>Dead wood</td>
<td>Edible / Medicinal</td>
</tr>
<tr>
<td><em>Amanita vaginata</em> (Bull)</td>
<td>Agaricomycetes</td>
<td>Amanitaceae</td>
<td>Soil</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Agaricus augustus</em> (Fr.)</td>
<td>Agaricomycetes</td>
<td>Agaricaceae</td>
<td>Forest soil</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Agaricus arvensis</em> (Schaeff. ex Secr. s.)</td>
<td>Agaricomycetes</td>
<td>Agaricaceae</td>
<td>Forest soil</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Lepista irina</em> (Fr.) H.E.</td>
<td>Agaricomycetes</td>
<td>Agaricaceae</td>
<td>Forest soil</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Boletus edulis</em> (Fries)</td>
<td>Basidiomycetes</td>
<td>Boletaceae</td>
<td>Dead wood / forest litter</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Cookeina sulcipes</em> (Berk.) Kuntze.</td>
<td>Ascomycota</td>
<td>Sarcoscyphaceae</td>
<td>Dead wood</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Schizophyllum commune</em> (Fr. Gemeiner Spaltblättling)</td>
<td>Basidiomycetes</td>
<td>Schizophyllaceae</td>
<td>On wood</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Ganoderma lucidum</em> (Leys ex Fr.)</td>
<td>Basidiomycetes</td>
<td>Ganodermataceae</td>
<td>In living tree. Fallen Wood</td>
<td>Medicinal</td>
</tr>
<tr>
<td><em>Hypsizygus tessellatus</em> (Bull. ex Fr.)</td>
<td>Agaricomycetes</td>
<td>Lyophyllaceae</td>
<td>wood</td>
<td>Edible/Medicinal</td>
</tr>
<tr>
<td><em>Lentinus edodes</em> (Berk.) Pegler</td>
<td>Basidiomycetes</td>
<td>Marasmiaceae</td>
<td>Dead wood logs</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Lycoperdon pyriforme</em> (Schaeff.).</td>
<td>Basidiomycetes</td>
<td>Lycoperdaceae</td>
<td>Meadows, humus</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Pleurotus ostreatus</em> (Jacq. ex Fr.) P.Kumm.</td>
<td>Agaricomycetes</td>
<td>Pleurotaceae</td>
<td>Dead wood</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Pleurotus Pulmonarius</em> (Fr.) Quélet</td>
<td>Agaricomycetes</td>
<td>Pleurotaceae</td>
<td>Dead wood</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Termitomyces mannimformies</em> (Heim.)</td>
<td>Basidiomycetes</td>
<td>Tricholomataceae</td>
<td>Termites hive</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Termitomyces albuminosus</em> (Berk.) R.Heim</td>
<td>Agaricomycetes</td>
<td>Agaricaceae</td>
<td>Termitaria in grassy fields</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Termitomyces heimii</em> (K. Natarajan)</td>
<td>Agaricomycetes</td>
<td>Lyophyllaceae</td>
<td>Termites hive</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Tricholoma terreum</em> (Scaeff.Fr.)</td>
<td>Basidiomycetes</td>
<td>Tricholomataceae</td>
<td>Leaf litter</td>
<td>Edible</td>
</tr>
<tr>
<td><em>Entoloma bloxami</em> (Berk. &amp; Broome) Sacc.</td>
<td>Agaricomycetes</td>
<td>Entolomataceae</td>
<td>Soil</td>
<td>Edible/MMedicinal</td>
</tr>
</tbody>
</table>

**Boletus edulis** (Fries) Fruit body whitish, greenish at young stage, yellow at maturity, stipe stout stem-white or yellowish 2.5 cm to 10 cm; partially covered with raised network, gills- narrow, hymenium- adnate, spore print brown, mycorhizal.

**Cookeina sulcipes.** (Berk.) Kuntze. Fruiting body was cup-shaped to funnel-shaped, brightly-colored and yellow to red. The outer surface was less brightly colored the walls of the apothecium, is thin and flexible and has tiny hairs on the upper rim of the cup. Ascii were constricted abruptly below and form a blunt, rounded base with a slim, tail-like connection. Ascospores measure 20-40.5µm long, ellipsoidal and smooth.
**Entoloma bloxami** (Berk. & Broome) Sacc.
Cap up to 5-13 cm broad, convex, becoming plane, umbonate; dark bluish-grey, subviscid, wrinkled to fibrillose-streaked; flesh thick, white, unchanging, odor farinaceous. Gills were adnexed to notched, close, white to pale blue, becoming pinkish as spores mature. Stipe was 5-11 cm long, 1.5-3 cm thick, equal to tapered at base, streaked bluish-grey above, pallid to whitish below; veil absent. Spores measure 7-8.5x6-7.5 µm, oval to nearly round, angular. Spore print was salmon-pink.

**Ganoderma lucidum** (Leys ex Fr.)
Pileus was 6-22 cm wide, mostly kidney shaped or circular, flate, concentrically grooved, with shining blood red varnished crust, sometimes almost black; but sometimes colourless; stipitate or sessile; 15.2 cm Long stipe with irregular pseudosclerotia buried deep in the substratum (in soil or dead wood logs or living deciduous trees; with poroid hymenium; pore minute, 165 µm wide, spores brown, ovate, warty, rough, 11-13.5x6-7.5 µm.

**Hypsizygus tessellatus** (Bull. ex Fr.)
Cap was 2-5 cm; convex, flat at maturity, smooth; white to buff yellow, minutely hairy. Stem was 4-24 cm long, smooth, tapering towards the base and has white hairs at the base. Gills were adnexed to sinuate, attached to the stem; nearly distant, cross-veined. Spores measure 4-5 µm, globose and smooth.

**Lepista irina** (Fr.) H.E.
The cap was light brown, 5–11 cm across, flattened-convex, wavy at the margin. Stem is 55-97x8-20mm long, dirty white, covered in long fibres, ochraceous near the base. Gills were emarginated and crowded. Spore print was dirty pink. Spores measure 7-9x 3.5-4µm, oval and smooth.

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**Figure 1:** Some Edible/Medicinal macrofungi of Mokokchung, Nagaland

Figure 2: Some poisonous macrofungi of Mokokchung, Nagaland

A. Clitocybe fragans  B. Clitocybe odora  C. Armillaria tabescens  D. Hygrocybe miniata  E. Coprinus disseminates  F. Amanita rubrovolvata  G. Amanita pantherina  H. Russula nobilis. I. Russula fragrantissima

**Lentinus edodes** (Berk.) Pegler
Pileus was 3.3-14 cm in diameter, convex, subumbonate to depress, with smooth surface, in young stage the margin incurved; at maturity – decurved. Gills were whitish at first, later reddish brown tint. Spore print white. Stipe 3.3 -7.3 mm wide; central to eccentric; subcylindric, poorly developed veil. Volva absent. Basidia clavate 16.2-24.5 x 4.8-5.9 µm. Basidiospores 7.25-8.5x5.2-6.7 more or less ellipsoid, hyaline.

**Lycoperdon pyriforme** (Schaeff.): Fruiting body was pear shaped, 1.5-5 cm wide; 2.5-5 cm high; dry; often covered with tiny white spines when young and fresh, but the spines usually disappearing by maturity; typically with a pinched-off stem base; by maturity developing a central perforation through which spores are liberated by rain drops and wind currents; whitish to yellowish brown; with a white, fleshy interior at first; later with yellowish to olive granular flesh and eventually filled with brownish spore dust. Spores measure 3.5-4.5 µm; round; smooth; without a pedicel.

**Pleurotus ostreatus** (Jacq. ex Fr.) P.Kumm.: Cap was 4-15 cm broad, convex, becoming flat, kidney-shaped to fan-shaped, somewhat greasy when young and fresh, smooth, pale brown to dark brown, the margin inrolled when young, later wavy, never lined. Stem usually rudimentary; it may develop a substantial and thick stem that is dry and slightly hairy near the base. Gills were running down the stem, close, whitish or with a gray tinge, sometimes yellowish in age. Spores measure 8-10.5 x 3-3.5 µm, smooth, cylindrical to narrowly kidney-shaped. Spore print was whitish to grayish.
**Pleurotus Pulmonarius** (Fr.) Quélet: Cap was white to cream, 2–10cm, convex to flat, fan shaped in overlapping groups, very finely lined the margin inrolled when young, later wavy and very finely lined. Gills were whitish, cylindric, running down the stem; close or nearly distant. Stem was rudimentary. Spore print was white. The spores measure 7–10 x 2–4 µm, smooth; cylindric, long and elliptical.

**Schizophyllum commune** (Fr. Gemeiner Spaltblättling)
Fruiting body was a leathery, fan-shaped bracket, 1-3.5 cm broad, frequently lobed or fused at the base with other brackets; upper surface densely hairy, light greyish-brown when moist, ashy grey to white when dry; under surface of the fruiting body composed of gill-like folds in the undersurface that are distinctively split, flesh thin, light grey to brown, tough. Stem was rudimentary or absent. Spore print was white. Spores measure 3-4 x 1-1.5 µm, cylindrical, smooth and cystidia absent.

**Termitomyces albuminosus** (Berk.) R.Heim
Cap was 5-11 cm, flat, acutely umbonate, pale brown to brown, glabrous, cracked, and striate. The gills were free, crowded of several lengths, white to pale brown. The stem was central, 7-16 x 1.2-1.5 cm long, solid, white, glabrous, base enlarged with black brown rhizomorphs. Spores measure 6-10 x 4-5 µm, elliptical, hyaline, smooth, Cystidia broadly clavate, hyphae with clamps.

**Termitomyces heimii** (K. Natarajan)
*Termitomyces heimii* is a termitophilous agaric fungus. Cap was smooth and white, sometimes creamy, with an incurved margin. Gills were crowded, free and white, turning pink with age. Stipe was cylindrical with a thick and persistent annulus, and the pseudorhiza can extend beneath the ground up to 16 centimeters.

**Termitomyces mammiformies** (Heim.)
Cap-6.5 cm in diameter, umbo prominent and inflexed margin; gills free, free white, stipe long-5.5 cm width-1cm; solid and white; the lower tapering end of the stipe is deep Seated in the termites hive, presence of persistent annulus is a diagnostic character of this species. Basidia clavate; basidiospores smooth, ellipsoidal, hyaline; 6.2 -3.2 µm; spore print yellowish grey.

**Tricholoma terreum** (Scaeff.Fr.)
Pileus 2.5-5.6 cm in diameter, bell-shaped, slightly umbonate, grayish, margin incurved, fleshy. Gills were greyishwhite, broad and thick. Basidiospores were ellipsoidal, 6.4-7.3x3.2-4.4µm.

The above mentioned mushroom species are very popular in the market (Figure 3) and known by a variety of local names viz. Khukh,
Cheon, Tamtour, Tamotar, Mohtran, Joru Koir, Kandi Koir, Rena konger, Ayishaka, Jung Ko, Sang sang, Lipok, Ali konger and Awunarong Armellea etc. The consumption of different mushrooms varies from tribe to tribes. Edibility of mushroom is dependent upon the palatability as well as its availability in a particular area. The favourable season for mushrooms collection is rainy season. The picking of mushrooms in these areas was mainly dominated by the males; however, it is followed by women and children. Of course, the Aoo women are fond of collecting the mushrooms. The knowledge about the use of macrofungi is dwindling and is mainly restricted to elderly people. Macrofungi such as Cantherallus cibarius, Termitomyces mammiformies, Termitomyces albuminous, Termitomyces heimii, Hypsizygus tessellates, Lentinus edodes, Pleurotus pulmonarius and Pleurotus ostreatus were most used species by the people of the area for making vegetables since these are highly delicious. Remaining species namely, Auricularia auricular, Amanita vaginata, Agaricus augustus, Agaricus arvensis, Lepista irina, Boletus edulis, Cookeina sulcipes, Schizophyllum commune, Lycoperdon pyriforme, Tricholoma terreum and Entoloma bloxami sp are not much used by the local people of the area. It was also found that macrofungi like Auricularia auricular, Ganoderma lucidum, Hypsizygus tessellates and Entoloma bloxami were used as medicinal purposes for treatment of different diseases by the local people of the area. Many macrofungi such as Russula Nobilis., Russula fragrantissima, Amanita pantherina, Amanita rubrovolvata, Coprinus disseminates, Hygrocybe miniata, Clitocybe odora, Armillaria tabescens and Clitocybe fragans collected from the forest areas were considered as poisonous by more than eighty percent respondents (Figure 2).

Respondents possessed scanty information about the uses of these mushrooms for medicinal purposes. Only few of the medicinal uses like use of mushroom soup for persons suffering with indigestion and anemia were documented. Amongst various termitophilous mushrooms T. mammiformies has been reported to serve as a medicinal mushroom for the treatment of abdominal discomfort, cough and whooping cough. This information is also supported by recent studies (Nakalembe et al., 2009; Nabubuya et al., 2010). Hypsizygus tessellates and Entoloma bloxami were used as herbal medicine to cure skin diseases and Ganoderma lucidum has been used as herbal medicine to cure asthma. The therapeutic potential of G. lucidum has been studied by (Rai et al., 2005; Sheena et al., 2005). Ganoderma lucidum is also known to lower blood pressure, anti diabetic and an anti inflammatory agent (Kabir et al., 1988; Teow, 1997). It is also used by Indian tribals for treating joint pain (Harsh et al., 1993). Lentinus sp. and G. lucidum are proved anticholesterolmic (Stavinoha et al., 1991; Ren et al., 1989). Lentinus edodus has been used to enhance vigour, sexuality, energy and as an anti aging agent (Gareth, 1990). Puffballs have been used in urinary infections (Buswell and Chang, 1993). Hobbs (1995) reported various medicinal uses of mushrooms like reishi, cordyceps, enoki, maitake, lion’s mane and splitgill for cancer treatment. Auricularia species were used since times for treating hemorrhoids and various stomach ailments (Chang and Buswell, 1996). Pleurotus sp. has been used for curing headache, high blood pressure, smallpox, asthma, colds and stomach ailments (Oso, 1997; Fasidi and Olorumaye, 1994). It is also pertinent that utilization of mushroom were being transmitted amongst the ethnic people orally from one generation to the next. The usage of these flowering bodies both commercially and domestically may be in part a result of their better taste and easily identifiable by the locals as safe for consumption. It was observed that the larger quantities of mushrooms are being consumed in the area and are regarded by many as wholesome food and in certain cases, an equivalent of meat. Several mycologists in India have also reported the edibility of these species from various states (Atkinson, 1961; Krieger, 1967; Garcha, 1980; Bhatt et al., 1988; Sharda 1997).

Conclusion

The identification and use of wild edible mushrooms play a vital role in enrichment of the socio-economic life of the tribal people. Besides their consumption, the use of mushrooms in folk medicines also paves the way for the upbringing new industries. Research and monitoring are important factors in developing strategies that will both protect and promote the edible macrofungi of the region in particular and in general in whole of the Northeast India. Knowledge about the edibility of wild edible macrofungi is diminishing especially among young generation; therefore, they have to be made aware about it. Also, more attention need to be paid towards the conservation of these important species to cater the need of
nutritional requirements of the future generation.

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