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DIVERSITY OF WILD MUSHROOMS IN RUPANDEHI DISTRICT, WESTERN NEPAL

HARI PRASAD ARYAL

Bhairahawa Multiple Campus,Tribhuvan University, Nepal
haharipraasadaryal06@gmail.com

ABSTRACT

This paper highlights the one of the underappreciated natural resource of NTFPs, has high food and medicinal values. The area embraces different mycophagus ethnic communities. The work emphasized the knowledge on the use of various ways of the wild mushrooms in the different ethnic groups and communities in habiting in the district and to explore in the study area. This mycological investigation carried out in different area ranging between 90 and 1229 m asl in tropical deciduous riverine forest, to subtropical deciduous hill forest. The specimens are housed in the Central Department of Botany, Pathology Unit, Tribhuvan University. The collected samples represented 46 species of Basidiomycetes belongs to 32 genera, 20 families and 9 order. The mycoelements prevailing in this area need sustainable utilization and conservation.

Keywords: altitudinal gradients, edible, ethnomycology, socio-economy

INTRODUCTION

Mushrooms are cosmopolitan heterotrophic organisms. They are gill bearing, fleshy, agarics (Phillips, 1981). It bears cap and gills on the underside producing spores (Boa, 2004). Edible fruiting bodies of fungi are the mushroom and inedible or poisonous are the toadstools (Miller, 1984). They exhibit remarkable diversity in form, as in Ascomycetes and Basidiomycetes (Alexopoulos & Mims, 1993).

Generally the growth of fruit body is controlled by different environmental and ecological factors where they retain. They appear in such place where the habitats are undisturbed and ample volume of moisture and nutrition are necessary for growth, fructification and reproduction. Anthropogenic activities, human disturbance leads to threat the growth and developments declining their production. Therefore, this study was needed to explore. So the ecological approaches were also required along with distribution. This study had to assess the abundance density and frequency of the wild mushrooms on the study area.

The investigation and study of mushrooms in Nepal started since the contribution of Lloyd (1808). Since then several botanical investigations have been done (Bhandary, 1980,1991; Hattori *et al.,* 2002; Devkota, 2005; Panday, 2008; Manandhar & Adhikari, 2009; Bhattarai, 2013). Nepal is fairly rich in macrofungi, edible as well as poisonous ones. There are 1822 species of fungi among them macro fungi are 776 species belongs to 213 genera and 77 families (Adhikari, 2000). New description after it has increased; the total numbers of mushrooms are 817 species (Adhikari, 2009; Aryal & Budhathoki, 2013 a,b,c; Aryal *et al*., 2014a,b). It is expected to reach more than 3000 species due to the large variation in climatic condition and

vegetation types (Christenson *et al*., 2008a). Mushrooms are famous as excellent health food enriched by good quality protein and a multitude of beneficial vitamins and minerals. It is now common to find medicinal preparations from mushrooms in various forms in the world market (Balkrishna & Nair, 1994).

Several researchers have also reported ethnomycological uses of these NTFPs from different place of the country (Hattori *et al*., 2002; Devkota, 2005; Christensen *et al*., 2008 a, b; Manandhar & Adhikari, 2009; Pandey, 2008; Adhikari, 2014) but the present study area has not been given significant attention.

Study area

The study area (fig. 1) is the southern belt of west Nepal and lies in, Lumbini zone. The forest vegetation is dominated by members of the Dipterocarpaceae, Combretaceae, Fagaceae and Leguminosae. The studies were focus on natural as well as community managed forest on the basis of information found from the local informant and availability of the species. The field works were conduct during the 15th to 31st May and from 1st June to 31st October in 2011. The information was noted from the interaction with members of the individuals of ethnic groups or communities.

The study sites were divided into three categories east, center and west (on the basis of vegetation zones) and two sub categories tarai and siwalik. From each sub categories they were again narrowing down by the selection of random sampling of three sites. On the basis of the forest area, the numbers of spots to be sample were determining so as to represent 10-20 %. The total of 3 spots will be sampled from each topography, ranging between latitude of 27°20' 00" N and 27°47' 25" N and between the longitude of 83°12' 16" E and 83°38' 07" E of east, center and west vegetation zone of Rupandehi district of Nepal. Altogether 6 spots were supervised. They were randomly chosen by Randomize Block Deign method (Elliott, 1971). Altitude varies between 90 and 1229 masl. The average annual rainfall is 1391 m (GoN, 2010).

FIG. 1. Map of the sampling sites.

MATERIALS AND METHODS

Sampling process

The Participatory rural appraisal (PRA) technique (Frendenberger, 2011) was adopted with the local people aimed at getting information largely on nutritional as well as medicinal aspects. Data were obtained using combined semi-structured questionnaire, participatory discussions and field observation. For the calculation of abundance, frequency, density, and species diversity, the quadrat sizes were taken 25 m X 25 m. In each of the spot (forest) 10 quadrats were located by stratified random sampling method (Elliott, 1971). The frequency class was calculated by the formula:

$$\frac{\text{No. of Plots in which species 'x' occurs}}{\text{Total no. of plot}} \times 100$$

Mushroom samples were photographed in their natural habitat and their morphological characters were noted. The samples were well dried in mushroom dryer (Atri *et al*., 2005) and packed in wax-paper bags wrapped with aluminium foil to prevent external infection and intermixing of the spores and labeled. The habitats including ecological parameters viz. altitude, vegetation

composition, soil type, humidity, temperatures and time with macroscopic and microscopic characters of the specimens were noted. The wax-paper bags were brought to Paklihawa Campus, Institute of Agriculture and Animal Science, for further microscopic examination and followed the classification of Kuo (2006).

Identification

Specimens were identified with the help of relevant literatures (Bakshi, 1971; Mckenenny,1971; Svreck, 1975; Heim, 1977; Dickinson & Lucas, 1979; Kibby,1979; Phillips,1981; Pacioni,1985; Purkayastha & Chandra, 1985; Singer,1986; Imazeki *et al.,* 1988; Kummar *et al.,* 1990; Tulloss & Bhandary, 1992; Adhikari, 1996; Watkinson *et al*., 2000) and on line data base such as: Biodiversity Library.org, Index fungorum, Jstor.org, Mycobank.org, tropicos.org).

RESULTS AND DISCUSSION

As many as 116 specimens of wild mushrooms belonging to the class Basidiomycetes were made and worked out for their macro- and micro-morphological and ethnomycological features. A total of 46 taxa of wild mushrooms belonging to 32 genera spread over 20 families, 9 orders were identified (table 1). The identified species and varieties spread over in following genera viz., *Agaricus* (2)*, Amanita* (4), *Armelleria* (1), *Asterophora* (1), *Auricularia* (1), *Bjerkandera* (1), *Buchwaldoboletus* (1), *Cantharellus* (1), *Coltrica* (1), *Coprinus* (2), *Daldenia* (1), *Flammulina* (1), *Ganoderma* (1), *Grifola* (1), *Guepina* (1), *Laetiporus* (1), *Lentinus* (1), *Leucopaxillus* (1), *Macrolepiota* (2), *Marasmius* (1), *Nigroporus* (1), *Psthyrella* (1), *Pycnoporus* (1), *Ramaria* (2), *Rameriopsis* (1), *Russula* (3), *Schizophyllum* (1), *Scleroderma* (2), *Sparassis* (1), *Termitomyces* (4) *Tramets* (1) and *Volvorella* (2) were observed. Out of total collection, 50% of mushrooms were found to be under Agaricales order followed by Polyporales, Boletales, Russulales, Tricholomatales, Claveriales, Hymanochaetales, Tramellales and Phallels. The following graphs show the pattern of diversity, frequency and dominance of the species (fig. 2).

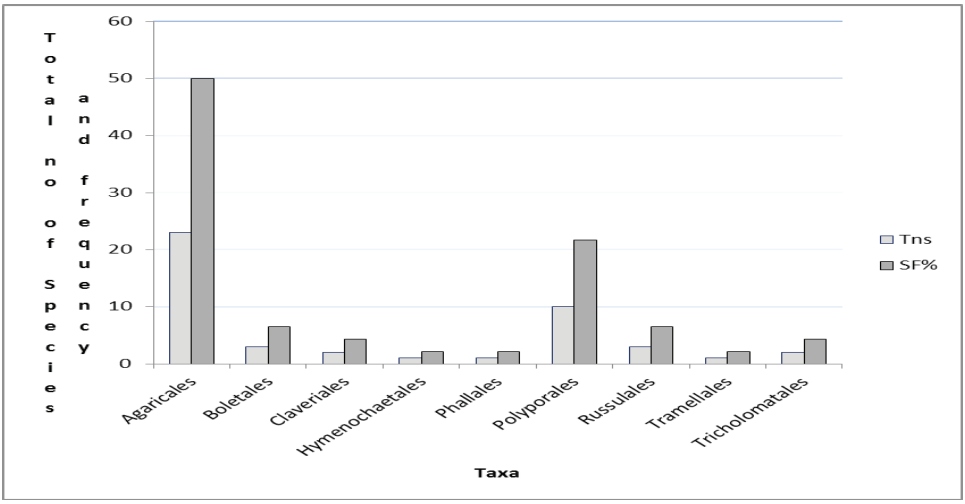

FIG. 2. The total number of species (Tns) and % frequency of groups (SF %) of basidiomycetes.

Rupandehi district has rich biodiversity with its remarkable climatic variation within tropical to subtropical range. This paper is the compilation of the results from investigations done on tropical to subtropical Nepalese mycoflora. The compilation includes the species of Basidiomycota reported by earlier explorers from the nation and abroad.

Indigenous knowledge of edible mushrooms and their utilization by local population is an important component of ethnomycology, so the data were gathered during the ethnomycological survey related to collection of wild mushrooms. The results revealed that forty-six potential wild edible fleshy fungi from different locations of study area were recorded. Out of these, as many as (25) mushrooms were preferentially consumed by the native populations (10) medicinal significance, they also used as vegetable, has therapeutic use and its soup is also used as tonic (4) poisonous and (11) non-edible species of the area. Out of 57 respondents of mycophagous ethnic groups, 84% people were found to have used it for vegetable, 7% therapeutic used 5% used as tonic-syrup and 4% food.

The gathering of mushrooms shows that there are plenty of species, which are said to be edible and of medicinal value. Many mushroom species are gathered by local people for their daily livelihood and trade. The medicinally important tropical polypore like *Pycnoporus cinnabarinus* has been gathered for the remedy of infectious disease (Mump), Ear pain etc. The cosmopolitan species like *Schizophyllum commune* the inedible fungi is sometimes used for culinary proposes in food deficit condition. This species has religious value also and is used as 'Sagun' for better happening in the marriage ceremony in Newar community. Many such significant contributions in the ethnomycological studies of the macrofungi world over have been reported (Akpaja *et al*., 2003; Guissou *et al*., 2008). Therefore, the study indicates the cultural importance and long traditional use of wild mushrooms in the studied sites. The Dipterocarp inhibiting mycoelements like *Scleroderma texense* has been used both for food and medicine. During surveys, it was found that wild edible fleshy fungi are usually available in the village shops, highway road and town markets for sale in monsoon season. Most of the edible species are sold in fresh form while others such as *Macrolepiota spp. Termitomyces spp.* are put up for sale in both fresh and dried forms. These species are marketed at different rates. *Macrolepiota fuliginosa*, *M. rhacodes, Sparassis* crispa are sold @ rupees 75-100 per kg while *Coprinus comatus*, *Ramaria aurea, R. falva,* are available at rupees 100-125 per kg. Correspondingly, *Scleroderma* spp. and *Termitomyces* spp. were sold at marginally higher price of rupees 400-500 per kilogram.

Many of these observations follow the earlier studies covered in ethnomycological studies include Chepang (Tullous & Bhandary, 1992; Pandey, 2008), Sherpas (Sacherer, 1979), Tamangs (Kharel, 1999; Pandey, 2008) and Thakali (Bill & Cotter, 1989). The geographical area covered by ethnomycological studies in Nepal includes Kathmandu (Singh,1966; Singh & Nisha, 1974), Kathmandu valley and adjoining area (Adhikari, 2000; Pandey, 2008), Dumre, Pokhara, Mustang, Manang (Bhandary, 1991), Pokhara and Kathmandu valley (Joshi & Joshi ,1999), Rolwaling (Sacherer, 1979), Western Central Region of Nepal (Adhikari *et. al*., 2005), and Sukhaura Hariyali Community forest, Rupandehi (Bhattarai, 2013). The local people collected the mushrooms in bulk and further sold these through their sale counters @ Rs. 50-150/kg.

Several researchers have also reported the edibility and therapeutic used of these species from different place of the country (Hattori *et al*., 2002; Devkota, 2005; Christensen *et al*., 2008ab; Manandhar & Adhikari, 2009; Pandey, 2008; Adhikari, 2014) and abroad (Harsh *et al*., 1993; Kamat, 1999; Atri & Kaur, 2003; Sagar *et al*., 2005).

During surveys, it was found that the population of *Amanita chepangiana, Macrolepiota fuliginosa, Scleroderma bovista*, *Sparasis crispa, species of Termitomyces* and *Volvorella* are declining since the last two decades due to deterioration of forest.

It is visualized from the field survey that some of the important species need special attention to conserve against the threat to avoid their unmanaged and unscientific exploitation by the people. It is therefore necessary to conserve natural habitat of mushroom diversity for the sustainable development. The government should take special attention on these aspects.

The forest biodiversity has supported the livelihood of many indigenous tribal people who live in inaccessible remote area. It plays an important role for ecosystem replenishment and performs a wide variety of ecological roles. Its documentation in different social, cultural and ethno medicinal practices is very important to sensitize the communities. It plays a vital role in enrichment of the socio-economic life of the rural marginal people. Besides their consumption, the use of its in local medicines also paves the way for the upbringing new industries. This research provides enough background to appreciate the diversity and their relevance in ecosystem maintenance in general and human welfare in particular. It creates an enthusiasm towards intensive exploration on these mycoflora.

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TABLE 1. Wild mushrooms collected from different place of Rupandehi district, western Nepal.

SN	Sample collection number	Scientific name (Family)	Local name	Ecology	Application
1	1209561	*Agaricus augustus* Fr. (Agaricaceae)	Kaile chyau	Soil,saprophytic	Used as vegetable
2	101065	*Agaricus sylvicola* (Vittad.) Peck (Plutaceae)	Sal chyau	Soil,saprophytic	not edible
3	100755	*Amanita caesarea* (Scop.) Pers. (Amanitaceae)	Suntale chyau	Soil,mycorrhizae	Used as vegetable
4	100772	*Amanita chepangiana* Tulloss & Bhandary (Plutaceae)	Salleu, cukhura phule chyau	Soil,mycorrhizae	Used as vegetable
5	101064	*Amanita fulva* Fr. (Amanitaceae)	Tahar	Soil,mycorrhizae	Edible,not commonly used
6	100773	*Amanita pantharina* (D C.) Kromb. (Amanitaceae)	Bhut chyau	Soil,mycorrhizae	Deadly poisonous
7	1008149	*Armellaria mellea* (Vahl.: Fr.) Kummer. (Marasmiaceae)	Todke chyau	On decay log from crevices in moist shady place,parasitic	Used as vegetable/ soup
8	1007214	*Asterophora parasitica* (Bull.) Sing. (Tricholomataceae)	Chyau mathi seto chyau	In moist shady place (above the *Russula* sp.),parasitic	Not edible
9	100742	*Auricularia auricular-judae* (Bull.) Wettst (=Hirneola auricular-judae) (Auriculariaceae)	Todke chyau	On dead twigs and stumps,parasitic	Used as vegetable/ soup
10	1007120	*Bjerkandera adusta* (Fr.) Karst. (Hapilopilaceae)	Kane chyau	On log (*Terminalia alata*),saprophytic	Not edible,used as a razor strop

11	1008329	*Buchwaldoboletus lignicola* (Kallenb.) Pilat (Bolataceae)	Dhyabre chyau	On log (*Shorea robusta*), saprophytic	Not edible
12	100933	*Cantharellua cibariuus* (Fr.: Fr.) Fr. var. amethysteus (Tricholomataceae)	Chyau mathi seto chyau	In moist shady place, parasitic	Edible
13	1009397	*Coltricia cinninenea*(Pers.) Murrill (Hymenochaetaceae)	Soli chyau	On leaf mould soil, saprophytic	Not edible
14	1009500	*Coprinus comatus* (O.F. Mill.) Pers. (Coprinaceae)	Gobre chyau	Soil,saprophytic	Edible in young stage.dried powder given to the child with rice or milk induced good sleep
15	100723	*Coprinus plicatilis* (Curtis) Fr. (Coprinaceae)	Payeje chyau	On log (*Acacea catechu),* saprophytic	Poisonous
16	100722	*Daldinia concentric* (Bolt.) Ces et de not. (Polyporaceae)	Dalle, kale chyau	On log (*Dalbergia sissoo),* saprophytic	Not edible,but medicinal value (used to treat burns
17	100934	*Flammulina velutipes* (Curtis) Sing. (Marasmiaceae)	Patpate chyau	On soil/Decaying log, saprophytic	Edible, but not popularly Used by the people
18	1007107	*Ganoderma lucidium* P. Karst. (Ganodermataceae)	Dadhu chyau	Trunk (*Bombax ceiba*),parasitic	To remove evil spirit, for used in decorative purpose
19	1007129	*Grifola frondosa* (Dicks.) Gray (Meripilaceae)	Giddha chyau	Stump (*Mallotus phillippinensis*), parasitic	Used to relief muscular pain
20	100715	*Guepinia spathularia* (Schw.)Fr. (Dacrymycetaceae)	Putali chyau	On rotten wood,saprophytic	Not edible
21	100759	*Lentinus tigrinus* (Bull.) Fr. (Polyporaceae)	Vedi chyau	On stump (*Eugeina jambolana),* saprophytic	Edible,but not properly used

22	1007127	*Laetiporus sulphareus* Murrill (Polyporaceae)	Kath-phule chyau	Tree forest (*Tectona grandis*), parasitic	Young ones used for culinary purpose
23	100704	*Leucopaxillus giganteus* Boursier (Tricholomataceae)	Pyaje chyau	open grasslandz, saprophytic	Edible,used as vegetable
24	1008118	*Macrolepiota fuliginosa* (Barla) Bon (Agaricaceae)	Gobbre chyau	Soil,saprophytic	Used as vegetable
25	1008330	*Macrolepiota rhacodes* (Vittad.) Sing. (Agaricaceae)	Gobbre chyau	Soil,saprophytic	Used as vegetable
26	100740	*Marasmius oreades* (bolt.) Fr. (Marasmiaceae)	Noune Chyau	Soil,saprophytic	Edible but not commonly use
27	1008315	*Nigroporus vinosa* (Berk.) Murrill (Fomotopsidaceae)	Jhule chyau	On log (*Syzygium cumini*),parasitic/ saprophytic	Inedible
28	100832	*Psathyrella candoleeana* (Fr.) Maire (Coprinaceae)	Todke Chyau	on log (*Dalbergia latifolia*), saprophytic	Inedible
29	100711	*Pycnoporus cinnabarinus* (Jacq.) P. Karst. (Polyporaceae)	Sindure chyau	Stump (*Syzygium cumini),* saprophytic	Medicine,for relief ear pain,mumps
30	120735	*Ramaria aurea* (Fr.) Quel. (Ramariaceae)	Thakre chyau	Moist shady place on pine tree,mycorrhizal	Used as vegetable, and also sold in local market
31	100975	*Ramaria falva* (Fr.) Quel.(Ramariaceae)	Thokre chyau	Moist shady place on pine tree,mycorrhizae	Used as vegetable, and also sold in local market
32	1008316	*Ramariopsis kunzei* (Donk) Corner (Gomphaceae)	Panje chyau	Stump (*Mallotus phillippinensis*), saprophytic	Inedible
33	100779	*Russula emetica* (Schaeff.) Pers. (Russulaceae)	Ratteuo	Litter,mycorrhizae	Poisonous medicine that cause vomiting
34	1008350	*Russula foetens* Pers. (Russulaceae)	Gandhe chyau	Soil,mycorrhizae	Poisonous
35	100751	*Russula nigricans* Fr. (Russulaceae)	Handi chyau	Soil,mycorrhizae	Edible,pickle

36	101002	*Schizophyllum commune* (Fr.:Fr.) Gerb. (Schizophyllaceae)	Pankha chyau	decayed wood: *Shorea robusta,* saprophytic	Edible,religious, cultural, culinary purpose
37	1009152	*Scleroderma bovista* Pers. (Sclerodermataceae)	Alu chyau, Ptteu	Soil,mycorrhizae	vegetable, edible/ medicinal
38	1007317	*Scleroderma citrinum* Fr. (Sclerodermataceae)	Dalle chyau	Soil,mycorrhizae	Inedible/ medicinal,causes gastric disorders or acute indigestion
39	100748	*Sparassis crispa* (Wulfen) Fr. (Sparadiaceae)	Kauli chyau	On log (*Tectona grandis*),parasitic	Used as vegetable soup
40	1010525	*Termitomyces albuminosus* (Berk.) R. Heim (Tricholomataceae)	Bemtee	Termites nest,obligatory symbionts	Soup used for the remedy of measles, yellow fevers etc.
41	1010530	*Termitomyces clypeatus* R. Heim (Tricholomataceae)	Dhamere chyau,Vemti	Termites nest,obligatory symbionts	Edible,medicinal, fever. miseales
42	1007119	*Termitomyces eurrhizus* (Berk.) R. Heim (Tricholomataceae)	Dhamere chyau, Bagale chyau	Termites nest,obligatory symbionts	Edible,medicinal, fever miseales
43	1008133	*Termitomyces microcarpus* (Berk. & Broome) R. Heim (Tricholomataceae)	Jhari/Rai	Termites nest,obligatory symbionts	Edible,medicinal, soup used as tonic
44	100701	*Trametes hirsute* (Fr.) Pilat [= Coriolus hirsutus (Fr.) Quel.] (Polyporaceae)	Kathe chyau	Rotten log (*Shorea robusta*), saprophytic	Not edible
45	1107979	*Volvorella bombaycina* (Schaeff.ex Fr.) Sing. (Plutaceae)	Chiple chyau	On wood (*Adena cordifolia*), saprophytic	Used as vegetable
46	1109856	*Volvorella volvacea* (Bull.:Fr.) Sing. (Plutaceae)	Parale chyau	decomposed paddy straw, saprophytic	Used as vegetable