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ETHNOMYCOLOGICAL KNOWLEDGE AND NUTRITIONAL ANALYSIS OF SOME WILD EDIBLE MUSHROOMS OF SAGARMATHA NATIONAL PARK (SNP), NEPAL

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Abstract

This paper describes the traditional mycological knowledge of Sherpa community of Sagarmatha National Park (SNP) and its adjoining areas (2600-4000 masl). Twenty nine species were identified having ethnomycological use. Among which 26 were identified as edible, 2 as medicine and 1 for decorative purposes. The local communities are well familiar about the morphological feature, habitat and qualities of these mushrooms. The local names of mushrooms have been derived on the basis of their morphological features, nature of growth and colour. The indexes of similarity of edible mushrooms along different forest range from 40-80%. Proximate composition (moisture, ash carbohydrate, crude fat, crude protein and crude fibre) and mineral composition (calcium, phosphorous and iron) of 11 most prized edible mushrooms was investigated. The overall nutritional values of wild edible mushrooms analyzed were good and comparable to other cultivated varieties of mushrooms.

Key words: Ethnomycology, edible, mushrooms, nutrition, protein

Introduction

Wild edible mushrooms are one of the important natural resources on which the local people of all nationalities rely heavily, and these mushrooms certainly play a role in improving the food nutrition (Yang, 2002). Edible mushrooms contain high level of dietary fiber, substantial amount of protein, vitamins and minerals but are low in fat. They also have various properties for health benefits such as antioxidative, antitumour and hypercholesterolic effects (Wong and Cheung, 2001).

In context to Nepal, ethno mycological studies have been conducted by various researchers (Sacherer 1979; Bhandary 1985, 1991, 1992; Cotter and Miller 1987; Kharel and Rajbhandary 2005; Adhikari et al. 2005; Giri and Rana 2005, 2006 and 2007; Pandey 2006. Similarly, the nutritive value of wild edible mushrooms of Nepal was analyzed by Singh and Nisha (1973), Adhikari et al. (1996) and Pandey and Budathoki (2007a and 2007b). However, information on documentation of indigenous knowledge of mushrooms is limited and poor. The present study was undertaken to document the use of wild edible mushrooms and to analyze the nutritive value of prized edible mushrooms identified with the help of Sherpa community residing within the study area.

Study area

The study area lies in Solu-Khumbu district of the northeastern region of Nepal. It encompasses the Sagarmatha National Park (1,148 sq. km) and its buffer zone area (Figure 1). The park

includes the upper catchments areas of the Dudh Kosi and Bhote Kosi rivers. The park is largely composed of the rugged terrain and gorges of the high Himalayas ranging from 2845 meter above sea level (masl.) at Monju to the top of the world Sagarmatha (Mount Everest) at 8848 masl.

The summer climate is cool and wet while the winter is cold and dry. Almost all the annual precipitation, averaging less than 1,000 mm falls during the summer monsoon, from the end of May to September. During winter (December to February) the day time temperature often falls below 0^{o} C and there is heavy snow fall.

The park contains 3% forest, 28% grazing land and 69% barren land above the tree line. The dominant vegetation at the lower elevation of the park below 3000 masl is composed mostly of blue pine and hemlock forest. The lower sub alpine region (above 3000 masl.) comprises of forests of *Pinus walliaichana, Abies spectabilis* and *Juniperus recurva*. The upper subalpine region, (above 3600 masl.) consists of birch - rhododendron forest *(Betula utilis, Rhododendron campanulatum* and *R. campylocarpum)* and the lower alpine region above the timber-line at 3800 - 4000 masl. houses scrubs *(Juniperus spp., R. anthopogan* and *R. lepidotum).*

The park is populated by approximately 3,000 of the famed Sherpa people. The main settlements are Namche Bazar, Khumjung, Khunde, Thame, Tengboche, Pangboche and Phortse. The economy of the Sherpa community has traditionally been agriculture, animal husbandry and trade with Tibet.

Methodology

Collection

During the field survey, a total of 200 respondents within the age of 10-70 years were interviewed by applying artifact and inventory interviewing methods (Nepal *et al*., 1999) and semi structured questionnaire. The ethnomycologically important mushrooms identified by the locals were collected from Lukla (2,800 masl.) to Pangboche (4,000 masl.) during the month of August to September 2006 (Fig 1). The fully matured mushroom species were collected from different parts of the study area by uprooting its substratum with the aid of a scalpel or sharp knife. The collected mushroom specimens were photographed in their natural habitat before they were picked up. Data on habit and habitat such as ecological parameters such as altitude, forest type, etc. were recorded in the field. Each collection was placed in butter paper bags and tag numbers were assigned to them. Morphological characters and chemicals test were performed in the field. The specimens were either sun dried or dried by placing them on tin foil over a local oven. Each dried mushrooms specimens were placed in separate butter paper bags. The specimens were identified in the laboratory with the help of standard literatures (Adhikari, 2000; Imazaki , 1979; Purukayastha and Chandra, 1985; Svreck, 1975; McKenny, 1971; Mcknight & Mcknight, 1987) and studying the macroscopic and microscopic characters. The specimens were housed in Nepal Academy of Science and Technology.

Nutritional analysis

Taxonomically and locally identified as prized wild edible mushrooms were collected, shed dried and further subjected to nutritional analysis. Proximate analysis (moisture, carbohydrate, crude protein, crude fat, crude fiber, moisture and ash) was performed at the Department of Food Technology and Quality Control (DFTQC) in accordance with the official methods of Analysis of the Association of Official Analytical Chemist (AOAC, 1995). All the calculations were carried out on dry weight basis of mushrooms. The minerals such as phosphorous (P), calcium (Ca) and iron (Fe) was read on Atomic Absorption Spectrophotometer (AAS).

Results and Discussion

Twenty nine ethnomycologically important mushrooms were identified with the help of Sherpa community residing within the study area, Among them 26 species of mushrooms were used for edible, 2 species for medicinal and one for decorative purpose.

According to respondents the most prized edible mushrooms in that region were *Amanita hemibapha* (Berk. & Br.) Sacc., *Boletus edulis* Bull.: Fr., *Boletus auripes* Peck, *Cantharella cibarius* (Fr..: Fr.) Fr., *Chroogomphus tomentosus* (Murr.) O.K. Miller, *Gomphus clavatus* (Pers.: Fr.) S. F. Gray, *Gomphus floccosus* (Schw.) Sing. var. *floccosus, Hydnum repandum* L.: Fr., *Ramaria flava* (Sch.: Fr.) Quel., *Leccinum* sp. (local name: Petok), *Hygrophorous* sp, *Paxillus involutus* (Batsch: Fr.) Fr. Among them the bigger/tastier/ abundant/ species were more popular and consumed by the locals. Species like *Amanita vaginata* (Bull.: Fr.) Vitt., *Auricularia polytricha* (Mont.) Sacc., *Boletus pulverulentus* Opat., *Clavulina cinerea* (Bull.: Fr.) Schroet., *Russula metachroa Hongo*, *Hypholoma capnoides* (Fr.) Kumm., *Rhodocollybia butyraceae* (Bull.: Fr) Lennox, *Armillaria mellea* (Vahl.: Fr.) Kummer, *Laccaria laccata* (Scop.: Fr.) Cooke may have been less popular due to their smaller size/less abundance.

Below Namche the local people hardly preserve mushrooms for culinary uses.

This may be due to availability of the variety of vegetables in this region as compared

to the upper high altitude region. Field survey reveals that a superstition "storing mushrooms results in the death of their livestock" still prevails among some Sherpas of lower region (Lukla, Benkar, etc.).

In the higher region (Khumjung, Khunde) dried mushrooms were found to be sold at 50 rupees per "mana" (locally used measurement approx. 30 gm in one mana) irrespective of the variety. According to locals the rainy season (July to September) is the favorable time for the collection of wild edible mushroom. Some local people above Namche believe that they should not initiate new work (business) or engage in agricultural work during the month of Shrawan (July - August). During this period locals are found to be engaged in collecting and drying wild edible mushrooms from nearby forests. The local who goes early gets a good collection of mushrooms. In Namche economically sound people hired local people to collect mushrooms; labor collectors earn around Rs. 100-500 per day according to the amount and variety of mushroom species.

According to the respondents the frequency and diversity of fructification of mushrooms depends upon various factors such as temperature, percentage of rainfall, humidity, etc. in a

particular season. Most of the respondents believe that due to prolonged snow fall the snow remains longer on the ground resulting in better growth of mushrooms. The indexes of similarity of edible mushroom species along different forests range from 40 - 80%. This analytical result suggests that different forests have got more than 60% similar edible mushroom species. This is because of altitudinal levels that have got more or less similar climate, rainfall, temperature and vegetation.

Local Nomenclatural Practices for Mushrooms

The local inhabitants have accumulated a large quantity of traditional knowledge and experience in utilization of the wild edible mushroom resources. They are well familiar about the morphological features, habitats, qualities of various edible mushrooms. Mushrooms are called "Shyamo" in Sherpa which means cap. In Nepali it is known as "Chyau". The local name of the wild edible mushrooms has been mostly derived on the basis of their morphological features, nature of growth, colour, etc. *Gomphus clavatus* is known as "Ee-shyamo" (Eng: mother-in-law) in Sherpa dialect. The name of this mushroom is derived from its growth characteristic. As the mother-in-law plays a dominant role in the family this mushrooms grows dominantly (about 5-7 kg) in one place. Since *Gomphus floccosus* looks like a burning "Diyo" (Eng: oil lamp) it is called "Diyo chyau" or "Khumbhe chyau". *Clavulina cinerea, Ramaria flava* and *Ramaria botrytis* are known as "Che shyamo" due to its grass like appearance. *Hydnum repandum* is locally named as "La shyamo" (Eng: musk deer) or "Kasturi chyau" due to its resemblance to the skin of musk deer. *Amanita* spp. which have an egg like volva are known as "Anda (Eng: egg) chyau" Further depending on its size or colour of the cap a prefix may be added such as "sano" (small), "rato" (red), "seto" (white), etc. *Amanita hemibapha* is known as "Rato anda chyau", *Amanita vaginata* as "Seto anda chyau", *Amanita* sp. as "Sano anda chyau" due to its red coloured, white coloured and small cap respectively. *Boletus* sp. locally called as "Fhe (Eng: mouse) shyamo" got its name due to it's resembles with a mouse hiding in the forest. *Boletus edulis* is known as "Pani (Eng: water) chyau". Armillaria mellea is known as "Chiple" (Eng: sticky) chyau because of its sticky honey like cap surface. *Hypholoma capnoides* locally known as "Taktale" which means growing in layers one above the other in a bunch. *Auricularia polytricha* locally know as "Durkha chyau" as it is chewed as Durka (Eng.: hard cheese). *Leccinum* sp. is known as "Petok" which means beautiful in Sherpa dialect. *Hygrophorous* sp. is locally known as "Omi (Eng: milk) shyamo" or "Dudh (Eng:milk) chyau" due to its milky appearance. *Cantharellus cibarius* is known as "Kujir (pothi)" and *Chroogomphus tomentosus* is known as "Kujir (keta) in Sherpa dialect. Kujir reflects acidic yellow or dull yellow colour. Further depending on size and colour they distinguish "Kujir" as "Pothi" (female) and "Keta" (male). In their view" Kujir pothi" is bigger and brighter coloured than "Kujir keta". *Tylopilus eximus* is known as" Khyakti" (Eng: bitter) in Sherpa dialect due to its bitter taste. It was observed that locals prefer to collect the pileus than the stipe for the culinary purpose. According to them the pileus is less bitter than the stipe. *Rhodocollybia butyraceae* is known as "Pothi karshya" (karshya : white) in Sherpa dialect due to its white appearance. *Lycorperdon perlatum* is known as "Phusphuse" because when pressed its powdery spore eject out slowly making a phus-phus sound. *Ganoderma* sp. is known as "Chhale (Eng: skin) chyau" because its outer layer resembles thick skin. It

was also observed that the local people have adopted both Sherpa as well as Nepali names for the mushrooms (Table 1).

Method for Preparation of Mushroom Food

The general method used for the preparation of the edible mushrooms comprises the following steps. After collection the mushrooms are thoroughly washed and diced and then boiled with *Zanthoxylum armatum* (timur) and *Allium sativum* (lasun). After which the water is drained off and the mushrooms are cooked according to their desire (fried or soup) and seasoned with timur, garlic, hotchilli etc. Mushroom such as *Gomphus clavatus*, *Leccinum* sp. and *Hygrophorus* sp. are specially used to prepare the filling of Momo (Dumplings). Pickle is prepared by mixing *Zanthoxylum armatum*, salt and hotchilli along with a little amount of oil and this mixture is put in glass or plastic bottle which is placed in the sun. The favorite mushrooms used by the locals to prepare pickle are *Gomphus clavatus, Ramaria flava, Paxillus involutus, Leccinum* sp. etc. In Khunde, *Auricularia polytricha* (Mont.) which grows on *Rhododendron* trees are allowed to dry in the tree till winter after which they are chewed raw as hard cheese. The common method observed for preserving mushrooms is sun drying.

Medicinal Mushrooms

In addition to food item mushroom is also used in health treatment by the rural people. According to some local informants spores of *Lycoperdon perlatum* Pers.:Pers. and *L. pyriforme* Schaeff.:Pers. are used as powder to heal wounds and to cure baby rashes. Hobbs (1987) reported several species of *Lycoperdon* to be used to stop bleeding in a fresh wound. Similar results were reported by Adhikari (1988), Bhandary (1991) and Ghimire et al. (2001) from eastern and western regions of Nepal. Joshi and Joshi (1999) reported that the aerial parts of *L. pyriforme* are used as tonic in case of weakness by the locals residing in Pokhara. Sharma (2003) reported that spores of *L. pyriforme* are used by people from Jammu to arrest the flow of blood from the wounds and in the treatment of piles. Some locals use mushrooms like *Ganoderma* sp. for decorative purposes while some polypores are used to make lids of bottle and stop cork. This was also reported by Kharel (1998) and Adhikari (2000). In this study it was observed that mushrooms were not used for religious or ceremonial purposes.

In the Nepalese mycoflora there are at least forty species of mushrooms which have been known to be toxic and dangerous. There is always the risk of eating a poisonous species mistaking it to be an edible one. In Nepal the mortality rate due to consumption of poisonous mushrooms have been found to occur around 15-20 persons annually (Adhikari, 2004). As per interviews with local people, hospital staff and traditional healers no mushroom poisoning cases were reported till date in the study area. It was observed that local people boil mushrooms along with *Allium sativum* and *zanthoxylum armatum* and discard the broth to minimize the possible poisoning from mushrooms. Whereas, in central Nepal and western Nepal people break the fruit bodies, smell and taste to find out whether mushroom are poisonous or not. People of that region used *Paris poryphylla* (Satuwa), *Zanthoxylum armatum*, *Allium sativum* to minimize possible poisonous along with vinegar (Adhikai *et al.*,

2005). Besides this, the local people aged between 10-70 years easily distinguish the poisonous mushrooms from edible ones on the basis of knowledge handed down from generations. Apart from edible mushrooms they consider other mushrooms as poisonous. This may be a way to safeguard the younger generation from eating poisonous mushrooms. The poisonous mushrooms are referred to as "bhoot chyau" in Nepali dialect and "Sindi shyamo" in Sherpa dialect. However, some local people even believe that "Mushrooms become poisonous only after being bitten by a poisonous snake." Therefore, in their view the mushrooms are not that poisonous because there are no poisonous snakes in that region. According to local informants they use *Aconitum* sp. (Bikhma) to minimize the effects of food poisoning.

In Khumbu region the Sherpa people do not sacrifice or kill animals. Meat is very expensive and rarely eaten item. It is only available in the weekly hart bazaar and is brought all the way from Jiri by carrying it in a "doko" (bamboo woven basket). Therefore, the people of higher region rely on seasonal mushrooms as a major source of protein substitute to meat. Mushrooms have good nutritional value particularly as a source of protein that can enrich human diet especially in developing countries where animal protein may not be available and are expensive (Pandey and Budathoki, 2007a).

Nutritive Values of Mushrooms

Out of 26 wild edible mushrooms (Giri and Rana, 2007) proximate chemical analyses were concentrated in eleven wild edible mushroom species. Mushrooms were selected on the basis of region-wise availability and popularity among local residents of the study area.

The selected edible mushrooms were *Ramaria flava* (Schaeff.: Fr.) Quel., *Paxillus involutus* (Batsch : Fr.), *Gomphus clavatus* (Pers.: Fr.), *Leccinum sp*., *Ramaria botrytis* (Pers.: Fr.) Ricken, *Hygrophorous* sp., *Gomphus floccosus* (Schw.) Singer, *Tylopilus eximus* (Perk) Sing., *Chroogomphus tomentosus* (Murr.) O.K.Miller, *Amanita hemibapha* (Berk. & Br.) Sacc., *Boletus* sp. During analysis nine parameters such as crude protein (%), crude fat (%), crude fibre (%), moisture (%), carbohydrate (%), calcium (mg/100g), Phosphorous (mg/100g), iron (mg/100g) of mushroom samples were carried out.

The chemical composition of edible mushrooms determines their nutritional value. It differs according to species but also depends on the substratum, atmospheric conditions, age and part of the fructification (Manzi et al., 2001). The average crude protein content of edible mushrooms ranges between 19-40% (Kurtzman, 1978). *Chroogomphus tomentosus* (11.84%) had the lowest value while *Ramaria flava* (28.32%) had the highest value. Mushrooms like *Ramaria flava* (28.32%), *Gomphus clavatus* (22.68%), *Hygroporous* sp (22.97%). *Amanita hemibapha* (25.87%), *Gomphus flocosus* (20.97%) and *Tylopilus eximus* (25.89%) have protein content comparable to commonly cultivated mushrooms in Nepal such as *Agaricus* bisporous (26.3%) and *Volvariella volvacea* (29.5%). These mushrooms have higher protein content than *Lentinula edodes* (17.5%) and *Pleurotus ostreatus* (10.5 %) (Table 4).

The average range of carbohydrate content in edible mushrooms varies from 27.6 to 71.1% of dry wt (Rautaavara, 1947 cited by Purkayastha and Chandra 1985). In the present study the

values of carbohydrates range from a low of 31.02% in *Amanita hemibapha* on a dry weight basis to a high of 62.63% for *Chroogomphus tomentosus*. The crude fat content of mushrooms is 2-8% of the dry weight but it can vary from less than 1% to as high as 15-20 % (Crisan and Sands, 1978). The lowest crude fat constituent was found in *Amanita hemibapha* (0.39%) and the highest value was observed in *Ramaria botrytis* (28.32%). The moisture content in dry mushroom ranges from 10-12% (Crisan and Sands, 1978). The moisture in eleven samples of mushroom varied from the lowest value of 8.30% in *Gomphus floccosus* to the highest of 11.95% in *Hygrophorous* sp. Crisan and Sands (1978) stated that fibre content in mushrooms is very high and varies from 3-33%. In the present study *Hygrophorous* sp. (7.73%) had the lowest fibre content while *Tylopilus eximus* (19.84 %.) had the highest value (Table 2). The calcium content in eleven samples of mushroom varied from 1.82 mg/100gm *(Boletus sp.)* to 33.09 mg/100 gm *(Gomphus floccosus*). The quantity of phosphorous was lowest in *Ramaria flava* (62.51 mg/100gm) while *Paxillus involutus* (944 mg/100 gm.) had the highest calcium content. *Leccinum sp*. (0.576 mg/100gm) had the lowest iron content while the *Amanita hemibapha* (307.26 mg/100 gm) had the highest calcium content (Table 3). The range of calcium, phosphorous and iron content in most of the studied wild edible mushroom are comparable to some cultivated mushrooms like *Agaricus bisporous, Pleurotus ostrateus*, etc, (Table 4).

The chemical composition (crude protein, carbohydrate, crude fat, crude fibre, iron, calcium and phosphorous) of mushroom samples were comparable to the range given by Crisan and Sands (1978). Most of the mushrooms are comparable with the cultivated common edible mushrooms such as *Pleurotus ostreatus, Volvariella volvacea, Agaricus bisporus* and *Lentinula edodes* (Table 4).

Conclusion

This study further helps to contribute for the document of the use of mushroom resources found in the study area. The results of this study underscore the need to conduct a nationwide survey on the indigenous uses of mushrooms to safe guard the knowledge handed down from generations.

Mushrooms have been considered as ultimate health food (Rai, 1995). In the era of healthy eating it is bound to attract attention as they possess unique chemical composition. However, research on the nutrition and evaluation of wild edible mushrooms and chemical analysis of medically important wild mushrooms is scanty in Nepal. Therefore, major emphasis has to be given to conduct intensive research in this field which would further enable us to utilize important mushrooms to the benefit of the people and nation.

Basically in Nepal research has been concentrated in pre-commercial experimentation of commercially important edible mushrooms such as *Pleurotus ostreatus, Volvariella volvacea, Agaricus bisporus* and *Lentinula edodes*, etc. However, focus has not yet been centered on the potential wild edible mushrooms. Government and private institutions should promote and undertake research to develop cultivation practices of the wild edible mushrooms which have good nutrient value and are prized by the locals.

Forest is the suitable habitat for mushrooms, but destruction of the forest and degradation of the forest resources have had an adverse impact on the existence of mushrooms and other plant resources. The local people in the study area collect these prized edible mushrooms from different forests localities haphazardly. Very few efforts have been taken into consideration to manage and protect the fungal diversity and their habitat. Moreover, the local people have been experiencing decline of some edible mushrooms within the study area (Rana and Giri, 2006). Unmanaged harvesting and climate change could be a contributing factor for this decline. In order to ensure continued production of these wild edible mushrooms from their natural habitat effective conservation methods and proper harvesting techniques is recommended.

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TABLE 1. Scientific names, family, local names, locality and uses of wild mushrooms.

S. no	Scientific Name	Family	Local Names	Locality (forest)
1	*Amanita hemibapha* (Berk. & Br.) Sacc.	Amanitaceae	Rato anda chyau	Muse (Lukla)
2	*Amanita vaginata* (Bull.:Fr.) Vitt.	Amanitaceae	Seto anda chyau	Muse (Lukla)
3	*Amanita* sp.	Amanitaceae	Sano anda chyau	Muse (Lukla)
4	*Armillariella* mellea (Vahl.:Fr.) Kummer	Tricholomataceae	Chiple chyau	Muse (Lukla), Phurte, Jamikhiau (Khumjung)
5	*Auricularia polytricha* (Mont.) Sacc	Auriculariaceae	Durkho chyau	Chire (Kunde), Deboche, Omakha (Pangboche)
6	*Boletus* sp.	Boletaceae	Fhe shyamo/Muse chyau	Chire (Kunde), Jamikhiau (Khumjung) Deboche, and Omakha (Pangboche)
7	*Boletus edulis* Bull.: Fr. Steinpliz	Boletaceae	Pani chyau	Muse (Lukla)
8	*Boletus* sp.	Boletaceae	Rato martip	Muse (Lukla), Chire (Kunde), Jamikiau (Khumjung) Deboche, and Omakha (Pangboche
9	*Boletus auripes* Peck	Boletaceae	Seto martip	Muse (Lukla) Phurte (Namche)
10	*Boletus pulverulentus* Opat.	Boletaceae	Kalo martip	Muse(Lukla)
11	*Cantharella cibarius* (Fr.: Fr.) Fr.	Cantharellaceae	Kujir (pothi)	Chire (Kunde), Jami khiau (Khumjung) Deboche
12	*Chroogomphus tomentosus* (Murr.) O.K.Miller	Gomphidiceae	Kujir (Keta)	Chire (Kunde), Jamikhiau (Khumjung) Deboche, Omakha (Pangboche)
13	*Clavulina cinerea* (Bull.: Fr.) Schroet.	Clavulinaceae	Che shyamo	Phurte (Namche)
14	*Rhodocollybia butyraceae* (Bull.: Fr.) Lennox	Marasmiaceae	Karshya (Pothi)	Phurte (Namche)
15	*Gomphus clavatus* (Pers. : Fr.) S. F. Gray	Gomphaceae	Ee- shyamo	Phurte (Namche) Chire (Kunde), Jamikhiau (Khumjung)
16	*Gomphus floccosus* (Schw.) Singer var *floccosus*	Gomphaceae	Khumbhe chyau	Phurte (Namche) Chire (Kunde), Jamikhiau (Khumjung) Deboche,
17	*Hydnum repandum* L. : Fr.	Hydnaceae	La shyamo/kasturi chyau	Jamikhiau (Khumjung)
18	*Hygrophorous* sp.	Hygrophoraceae	Petok shyamo	Phurte (Namche)
19	*Laccaria laccata* (Scop.: Fr.) Cooke	Tricholomataceae	Chinduk shyamo	Jamikhiau
20	*Leccinum sp*.	Boletaceae	Omi shyamo	Chire (Kunde), Jamikhiau (Khumjung)
21	*Ramaria flava* (Sch.: Fr.) Quel.	Ramariaceae	Che shyamo	Phurte (Namche) Chire (Kunde), Jamikhiau (Khumjung) Deboche.
22	*Ramaria botrytis (Pers.:Fr.) Ricken*	Ramariaceae	Che shyamo	Phurte (Namche), Deboche
23	*Russula metachroa* Hongo	Russulaceae	Pakar shyamo	Phurte (Namche), Jamikiau (Khumjung)
24	*Hypholoma capnoides* (Fr.) Kumm.	Strophariaceae	Taktale	Phurte (Namche)
25	*Paxillus involutus* (batsch: Fr.)Fr.	Paxillaceae	Dyangba shyamo	Jamikhiau (Khumjung)
26	*Tylopilus eximus* (Peck) Sing	Boletaceae	Kyakti / Jip chyambo	Chire (Khunde), Jamikhiau (Khumjung), Deboche

Table 2. Proximate analysis of mushrooms collected from the study area.

S. N	Mushroom species	Crude Protein (%)	Crude Fat (%)	Moisture (%)	Ash (%)	Carbo-hydrate (%)	Crude Fibre (%)
1	*Ramaria flava*	**28.32****	1.35	10.88	16.53	42.96	8.85
2	*Paxillus involutus*	16.46	3.37	10.27	**28.88****	41.02	12.55
3	*Gomphus clavatus*	22.68	0.97	10.86	18.44	47.05	8.69
4	*Leccinum* sp.	21.33	0.89	10.73	18.06	48.99	10.17
5	*Ramaria botrytis*	16.96	**0.39***	10.15	23.5	53.32	7.97
6	*Hygrophorous* sp.	22.97	1.53	**11.95****	19.18	40.05	**7.73***
7	*Gomphus floccosus*	20.97	1.89	**8.30***	16.36	40.35	14.02
8	*Tylopilus eximus*	25.89	1.78	11.46	24.36	36.51	**19.84****
9	*Chroogomphus tomentosus*	**11.84***	2.42	9.69	**13.42***	**62.63****	8.78
10	*Amanita hemibapha*	25.87	**6.48****	10.23	26.4	**31.02***	13.37
11	*Boletus* sp.	27.75	1.99	9.40	24.42	36.44	19.05

* Lowest value

** Highest value

Table 3. Mineral analysis of mushrooms collected from the study area.

S. N	Mushroom Species	Calcium (Ca) (mg/100 gm)	Phosphorous (P) (mg/100 gm)	Iron (Fe) (mg/100 gm)
1	*Ramaria flava*	6.66	**62.51***	4.07
2	*Paxillus involutus*	5.40	**944****	6.16
3	*Gomphus clavatus*	26.22	389.49	25.37
4	*Leccinum sp.*	6.10	480	**0.576***
5	*Ramaria botrytis*	6.30	441	6.21
6	*Hygrophorous sp.*	6.17	649.37	13.23
7	*Gomphus floccosus*	**33.09****	518.9	54.56
8	*Tylopilus eximus*	2.92	359	0.93
9	*Chroogomphus tomentosus*	4.01	264	2.81
10	*Amanita hemibapha*	20.09	721.75	**307.26****
11	*Boletus sp.*	**1.82***	163.77	10.66

* Lowest value

** Highest value

Table 4. Crude protein, carbohydrate, fat, fibre, calcium (C), phosphorous (P) and Iron (Fe) content of some cultivated edible mushrooms.

Mushrooms	Protein (%)	Carbohydrate (%)	Fat (%)	Fibre (%)	Ca mg/100gm)	Fe (mg/100gm)	P (mg/100gm)
Agaricus bisporous	26.3	49.5	1.8	8-10.4	23	0.2-19.0	790-1425
Pleurotus ostrateus	10.5	74.3	1.6	7.5-8.7	33	15.2	1348
Volvariella volvacea	29.5	40.0	5.7	4.4-13.4	35	6.0	978-1337
Lentinula edodes	17.5	59.5	8.0	7.3-8.0	98	8.5	476

Source: Crisan & Sands (1978) and Li & Chang (1982)

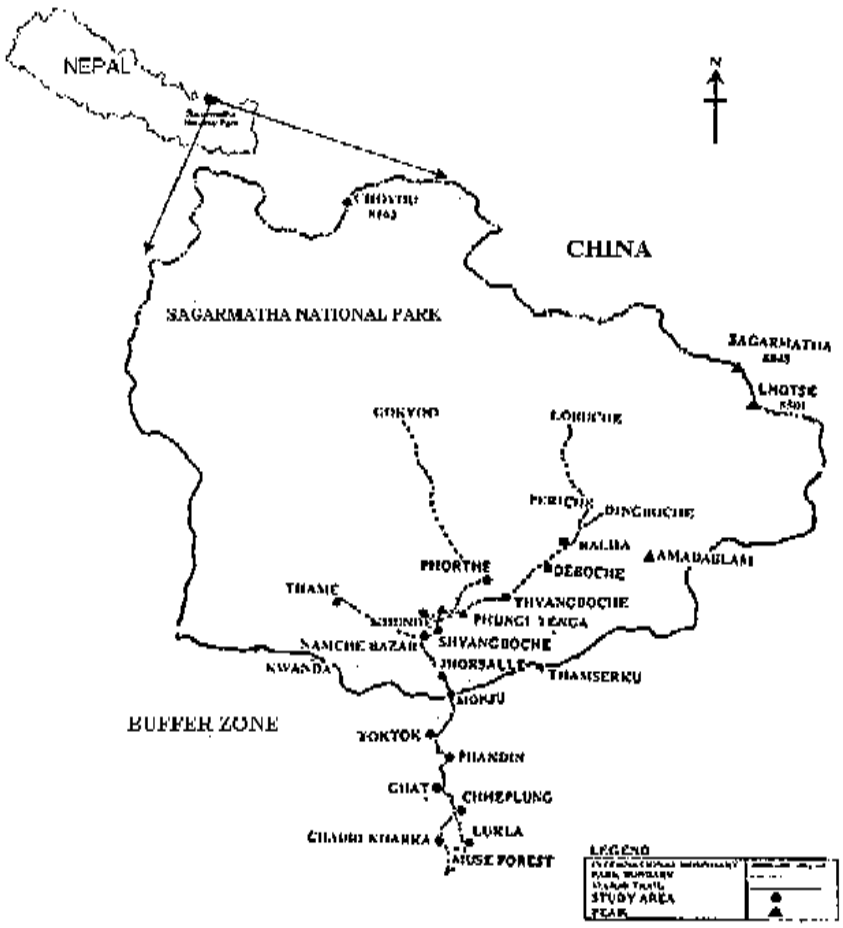

FIGURE 1. Map of the study area